RIGOL

Service Guide

DS1000B Series Digital Oscilloscope

DS1074B, DS1104B, DS1204B

Dec. 2014
RIGOL Technologies, Inc.

Guaranty and Declaration

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RIGOL guarantees this product conforms to the national and industrial standards in China as well as the ISO9001:2008 standard and the ISO14001:2004 standard. Other international standard conformance certification is in progress.

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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
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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 injury or damage 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 for use within the 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 the power cord to the Protective Earth terminal before connecting any inputs or outputs.

Connect the Probe Correctly.
If a probe is used, do not connect the ground lead to high voltage since it has isobaric electric potential as the 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 the instrument.

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 be exposed to the danger of electrical shock.

Do Not Operate Without Covers.
Do not operate the instrument with covers or panels removed.

Do Not Insert Anything Into the Holes of Fan.
Do not insert anything into the holes of the fan to avoid damaging the instrument.

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 **RIGOL** authorized 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 an increase of instrument temperature which would cause damage to the device. So please keep the instrument 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 the instrument in a humid environment.

Do Not Operate in an Explosive Atmosphere.
In order to avoid damage 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 the air, please keep the surface of the device clean and dry.

Electrostatic Prevention.
Operate the instrument in an electrostatic discharge protective environment to avoid damage induced by static discharges. Always ground both the internal and external conductors of cables to release static before making connections.

Proper Use of Battery.
If a battery is supplied, it must not be exposed to high temperature or in contact with fire. Keep it out of the reach of children. Improper change of battery (note: lithium battery) may cause explosion. Use **RIGOL** specified battery only.

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

The disturbance test of all the models meet the limit values of A in the standard of EN 61326: 1997+A1+A2+A3, but can't meet the limit values of B.

Measurement Category
DS1000B series digital oscilloscope is intended to be used for measurements in Measurement Category I.

Measurement Category Definitions
Measurement Category I is for measurements performed on circuits not directly connected to MAINS. Examples are measurements on circuits not derived from MAINS, and specially protected (internal) MAINS derived circuits. In the latter case, transient

stresses are variable; for that reason, the transient withstand capability of the equipment is made known to the user.

WARNING

IEC Measurement Category I. The input terminals may be connected to circuit terminal in IEC Category I installations for voltages up to 300 VAC. To avoid the danger of electric shock, do not connect the inputs to circuit's voltages above 300 VAC.

Transient overvoltage is also present on circuits that are isolated from mains. DS1000B series digital oscilloscopes is designed to safely withstand occasional transient overvoltage up to 1000Vpk. Do not use this equipment to measure circuits where transient overvoltage could exceed this level.

Safety Terms and Symbols

Terms Used in this Manual. These terms may appear in this manual:

WARNING
Warning statements indicate conditions or practices that could result in injury or loss of life.

CAUTION
Caution statements indicate conditions or practices that could result in damage to this product or other property.

Terms Used on the Product. These terms may appear on the product:

DANGER It calls attention to an operation, if not correctly performed, could result in injury or hazard immediately.

WARNING It calls attention to an operation, if not correctly performed, could result in potential injury or hazard.

CAUTION It calls attention to an operation, if not correctly performed, could result in damage to the product or other devices connected to the product.

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

Hazardous Voltage

Safety Warning

Protective Earth Terminal

Chassis Ground

Test Ground

Allgemeine Sicherheits Informationen

Überprüfen Sie diefolgenden Sicherheitshinweise sorgfältigumPersonenschädenoderSchäden am Gerätundan damit verbundenen weiteren Gerätenzu vermeiden. Zur Vermeidung vonGefahren, nutzen Sie bitte das Gerät nur so, wiein diesem Handbuchangegeben.

Um Feuer oder Verletzungen zu vermeiden, verwenden Sie ein ordnungsgemäßes Netzkabel.
Verwenden Sie für dieses Gerät nur das für ihr Land zugelassene und genehmigte Netzkabel.

Erden des Gerätes.
Das Gerät ist durch den Schutzleiter im Netzkabel geerdet. Um Gefahren durch elektrischen Schlag zu vermeiden, ist es unerlässlich, die Erdung durchzuführen. Erst dann dürfen weitere Ein- oder Ausgänge verbunden werden.

Anschluss einesTastkopfes.
Die Erdungsklemmen der Sonden sindauf dem gleichen Spannungspegel des Instruments geerdet. SchließenSie die Erdungsklemmen an keine hohe Spannung an.

Beachten Sie alle Anschlüsse.
Zur Vermeidung von Feuer oder Stromschlag, beachten Sie alle Bemerkungen und Markierungen auf dem Instrument. Befolgen Sie die Bedienungsanleitung für weitere Informationen, bevor Sie weitere Anschlüsse an das Instrument legen.

Verwenden Sie einen geeigneten Überspannungsschutz.
Stellen Sie sicher, daß keinerlei Überspannung (wie z.B. durch Gewitter verursacht) das Gerät erreichen kann. Andernfallsbestehtfür den Anwender die GefahreinesStromschlages.

Nicht ohne Abdeckung einschalten.
Betreiben Sie das Gerät nicht mit entfernten Gehäuse-Abdeckungen.

Betreiben Sie das Gerät nicht geöffnet.
Der Betrieb mit offenen oder entfernten Gehäuseteilen ist nicht zulässig. Nichts in entsprechende Öffnungen stecken (Lüfter z.B.)

Passende Sicherung verwenden.
Setzen Sie nur die spezifikationsgemäßen Sicherungen ein.

Vermeiden Sie ungeschützte Verbindungen.
Berühren Sie keine unisolierten Verbindungen oder Baugruppen, während das Gerät in Betrieb ist.

Betreiben Sie das Gerät nicht im Fehlerfall.
Wenn Sie am Gerät einen Defekt vermuten, sorgen Sie dafür, bevor Sie das Gerät wieder betreiben, dass eine Untersuchung durch **RIGOL** autorisiertem Personal durchgeführt wird. Jedwede Wartung, Einstellarbeiten oder Austausch von Teilen am Gerät, sowie am Zubehör dürfen nur von **RIGOL** autorisiertem Personal durchgeführt werden.

Belüftung sicherstellen.
Unzureichende Belüftung kann zu Temperaturanstiegen und somit zu thermischen Schäden am Gerät führen. Stellen Sie deswegen die Belüftung sicher und kontrollieren regelmäßig Lüfter und Belüftungsöffnungen.

Nicht in feuchter Umgebung betreiben.
Zur Vermeidung von Kurzschluß im Geräteinneren und Stromschlag betreiben Sie das Gerät bitte niemals in feuchter Umgebung.

Nicht in explosiver Atmosphäre betreiben.
Zur Vermeidung von Personen- und Sachschäden ist es unumgänglich, das Gerät ausschließlich fernab jedweder explosiven Atmosphäre zu betreiben.

Geräteoberflächen sauber und trocken halten.
Um den Einfluß von Staub und Feuchtigkeit aus der Luft auszuschließen, halten Sie bitte die Geräteoberflächen sauber und trocken.

Schutz gegen elektrostatische Entladung (ESD).
Sorgen Sie für eine elektrostatisch geschützte Umgebung, um somit Schäden und Funktionsstörungen durch ESD zu vermeiden. Erden Sie vor dem Anschluß immer Innen- und Außenleiter der Verbindungsleitung, um statische Aufladung zu entladen.

Die richtige Verwendung desAkku.
Wenneine Batterieverwendet wird, vermeiden Sie hohe Temperaturen bzw. Feuer ausgesetzt werden. Bewahren Sie es außerhalbder Reichweitevon Kindern auf. UnsachgemäßeÄnderung derBatterie (Anmerkung: Lithium-Batterie) kann zu einer Explosion führen. VerwendenSie nur von **RIGOL** angegebenenAkkus.

Sicherer Transport.
Transportieren Sie das Gerät sorgfältig (Verpackung!), um Schäden an Bedienelementen, Anschlüssen und anderen Teilen zu vermeiden.

Sicherheits Begriffe und Symbole

Begriffe in diesem Guide. Diese Begriffe können in diesem Handbuch auftauchen:

WARNING
Die Kennzeichnung WARNING beschreibt Gefahrenquellen die leibliche Schäden oder den Tod von Personen zur Folge haben können.

CAUTION
Die Kennzeichnung Caution (Vorsicht) beschreibt Gefahrenquellen die Schäden am Gerät hervorrufen können.

Begriffe auf dem Produkt. Diese Bedingungen können auf dem Produkt erscheinen:

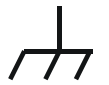
DANGER	weist auf eine Verletzung oder Gefährdung hin, die sofort geschehen kann.
WARNING	weist auf eine Verletzung oder Gefährdung hin, die möglicherweise nicht sofort geschehen.
CAUTION	weist auf eine Verletzung oder Gefährdung hin und bedeutet, dass eine mögliche Beschädigung des Instruments oder anderer Gegenstände auftreten kann.

Symbole auf dem Produkt. Diese Symbole können auf dem Produkt erscheinen:

Gefährliche Spannung

Sicherheits-Hinweis

Schutz-erde



Gehäusemasse

Erde

Document Overview

Chapter 1 Specifications
List the specifications and general specifications of DS1000B series.

Chapter 2 To Prepare for Use
Introduce the preparations should be done before using the oscilloscope.

Chapter 3 Performance Test
Introduce how to execute the performance tests of DS1000B series to understand its current performance status.

Chapter 4 Calibration
Introduce how to calibrate DS1000B series.

Chapter 5 Disassemble and Assemble
Introduce how to disassemble and assemble DS1000B series to get detailed understanding of its structure.

Chapter 6 Troubleshooting
List the failures may appear when using DS1000B series and the corresponding solutions.

Chapter 7 Replaceable Parts
List the replaceable parts.

Chapter 8 Service&Support
Provide the service and support information.

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Figures

Tables

Chapter 1 Specifications

All the specifications apply to the DS1000B series oscilloscopes unless otherwise noted. To meet these specifications, the oscilloscope should meet the following two conditions.

- The instrument must have been operating continuously for at least 30 minutes under the specified operating temperature.
- You have to perform the “Self Cal” operation, accessible through the Utility menu, if the operating temperature variation is equal to or greater than 5°C.

Note:

- The vertical scale values are measured by a probe with 1X attenuation ratio unless otherwise noted.
- All the specifications are guaranteed unless those marked with “typical”.

Specifications

Acquisition		
Sample Mode	Real-Time	Equivalent-time
Sample Rate	2GSa/s (half channel[1]) 1GSa/s (each channel)	50GSa/s[2]
Average	After all the channels finish N samples at the same time, N can be 2, 4, 8, 16, 32, 64, 128 and 256	
Input		
Input Coupling	DC, AC, GND	
Input Impedance	1MΩ±2.0% The input capacity is 18pF±3pF	
Probe Attenuation Factors	0.001X, 0.01X, 0.1X, 1X, 2X, 5X, 10X, 20X, 50X, 100X, 200X, 500X, 1000X	
Maximum Input Voltage	Maximum input voltage of the analog channel: CAT I 300Vrms, 1000Vpk; transient overvoltage 1000Vpk CAT II 100Vrms, 1000Vpk RP2200 10:1, CAT II 300Vrms RP3300A 10:1, CAT II 300Vrms	
Time delay between channel (Typical)	500ps	
Horizontal		
Sample Rate Range	3.65Sa/s to 2GSa/s (Real-Time), 3.65Sa/s to 50GSa/s (Equivalent-time)	
Waveform Interpolation	Sin(x)/x	
Memory Depth	Half channel[1]: 16k sample points when the horizontal timebase is 20ns/div or lower 8k sample points when the horizontal timebase is 50ns/div or higher Each channel: 8k sample points	
Scan Speed Range (S/div)	1ns/div~50s/div, DS1204B 2ns/div~50s/div, DS1104B 5ns/div~50s/div, DS1074B 1-2-5 Sequence	
Sample Rate and Delay Time Accuracy	±50ppm (any time interval that is ≥1ms)	
Vertical		
A/D Converter	8bit resolution, two channels sample simultaneously	
Sensitivity (V/div) Range	2mV/div to 10V/div at input BNC	
Offset Range	±40V (250mV/div to 10V/div) ±2V (2mV/div to 245mV/div)	
Equivalent Bandwidth	70MHz (DS1074B)	

	100MHz (DS1104B) 200MHz (DS1204B)	
Single-shot Bandwidth	70MHz (DS1074B) 100MHz (DS1104B) 200MHz (DS1204B)	
Selectable Analog Bandwidth Limit	20MHz (typical)	
Lower Frequency Response (AC -3dB)	≤5Hz (at BNC)	
Rise Time (Typical at BNC)	<1.75ns, <3.5ns, <5ns, On 200MHz, 100MHz, 70MHz respectively	
DC Gain Accuracy	2mV/div to 5mV/div: ±4% (Normal or Average acquisition mode) 10mV/div to 10V/div: ±3% (Normal or Average acquisition mode)	
DC Measurement Accuracy (Average Acquisition Mode)	When the vertical position is zero and N≥16: ±(DC Gain Accuracy × reading + 0.1div + 1mV) When the vertical position is not zero and N≥16: ±[DC Gain Accuracy × (reading + vertical position) + (1% × vertical position) + 0.2div] Add 2mV for settings from 2mV/div to 245 mV/div Add 50mV for settings from 250mV/div to 10V/div	
Voltage Difference (△V) Measurement Accuracy (Average Acquisition Mode)	Voltage difference between two points on the waveform after performing average operation on ≥16 waveforms captured under the same setting and environment condition: ±(DC Gain Accuracy × reading + 0.05 div)	
Trigger		
Trigger Sensitivity	0.1div to 1.0div (adjustable)	
Trigger Level Range	Internal	±6 divisions from center of screen
	EXT	±1.2V
	EXT/5	±6V
Trigger Level Accuracy (Typical) applicable for the signal of rising and falling time ≥20ns	Internal	±(0.3div × V/div) (±4div from center of screen)
	EXT	±(6% of setting + 40 mV)
	EXT/5	±(6% of setting + 200 mV)
Trigger Offset	Normal mode: pre-trigger (memory depth/(2 × sample rate)), delay trigger 1s	
	Slow Scan mode: pre-trigger 6div, delay trigger 6div	
Trigger Holdoff Range	100ns to 1.5s	
HF Rejection	100kHz ±20%	
LF Rejection	10kHz ±20%	

Set Level to 50% (Typical)	Input signal frequency ≥50Hz	
Edge Trigger		
Edge Type	Rising, Falling, Rising + Falling	
Pulse Trigger		
Trigger Condition	(>, <, =) positive pulse, (>, <, =) negative pulse	
Pulse Width Range	20ns to 10s	
Video Trigger		
Video Standard&Line Frequency	Support standard NTSC, PAL and SECAM broadcast standards. The range of the number of lines: 1 to 525 (NTSC) and 1 to 625 (PAL/SECAM)	
Pattern Trigger		
Pattern Setup	H, L, X,  , 	
Alternate Trigger		
CH1, CH2, CH3, CH4	Edge, Pulse, Video	
Measurement		
Cursor	Manual	Voltage difference between cursors (ΔV) Time difference between cursors (ΔT) Reciprocal of ΔT in Hertz (1/ΔT)
	Track	Voltage value and time value of waveform point
	Auto	Cursors can be displayed in auto measurement
Auto Measure	Vpp, Vamp, Vmax, Vmin, Vtop, Vbase, Vavg, Vrms, Overshoot, Preshoot, Freq, Period, Rise Time, Fall Time, +Width, -Width, +Duty, -Duty, Delay A→B  , Delay A→B  , Phase A→B,Phase A→B	

Note:

[1] Half channel indicates selecting one of CH1 and CH2, or one of CH3 and CH4.

[2] This is the highest specification for the highest model. The specific equivalent sample rate of each model is as follows.

DS1204B: 50GSa/s
DS1104B: 25GSa/s
DS1074B: 10GSa/s

General Specifications

Display		
Display Type	5.7 inch (145 mm diagonal line) TFT LCD	
Display Resolution	320 horizontal × RGB × 240 vertical pixels	
Display Color	64k color	
Contrast (Typical)	150:1	
Backlight Brightness (Typical)	300 nit	
Probe Compensator Output		
Output Voltage (Typical)	Approximately 3Vpp (peak-peak value)	
Frequency (Typical)	1kHz	
Power		
Power Voltage	100 to 240 VAC, 45 to 440Hz, CAT II	
Power Consumption	Less than 50W	
Fuse	2A, T rating, 250 V	
Environmental		
Ambient Temperature	Operating: +10℃ to +40℃	
	Non-operating: -20℃ to +60℃	
Cooling Method	Fan force cooling	
Humidity	+35℃ or below: ≤90% relative humidity	
	+35℃ to +40℃: ≤60% relative humidity	
Altitude	Operating 3,000 m or below	
	Non-operating 15,000 m or below	
Mechanical		
Diemnsions	Width	325mm
	Height	159mm
	Depth	133 mm
Weight	Without package	3kg
	With Package	4.3kg
IP Protection		
IP2X		
Calibration Interval		
The recommended calibration interval is one year		

Chapter 2 To Prepare for Use

Topics of this chapter:

- General Inspection
- Power-on Inspection
- To Connect the Probes
- Probe Compensation
- Auto Setting of Waveform Display

General Inspection

When you get a new DS1000B series oscilloscope, please inspect the instrument according to the following steps.

1. **Inspect the shipping container for damage**
   Keep the damaged shipping container or cushioning material until the contents of the shipment have been checked for completeness and the instrument has passed both electrical and mechanical tests.

   The consigner or carrier shall be liable for the damage to instrument resulting from shipment. **RIGOL** would not be responsible for free maintenance/rework or replacement of the unit.

2. **Inspect the instrument**
   In case of any damage, or defect, or failure, notify your **RIGOL** sales representative.

3. **Check the accessories**
   Please check the accessories according to the packing lists. If the accessories are incomplete or damaged, please contact your **RIGOL** sales representative.

   Standard Accessories:

   - Four 1:1 (10:1) passive probes
     When the switch of the probe is toggled to 1X, the bandwidth of the passive probe is about 6MHz, according with 150V CAT II.
     When the switch of the probe is set to 10X, the bandwidth of the passive probe equals the bandwidth upper limit of the oscilloscope, according with 300V CAT II.
   - A power cord that fits the standard of the destination country.
   - A USB cable
   - A CD-ROM (include the *User's Guide* and PC application software)
   - *Quick Guide*
   - *Warranty*

Power-on Inspection

The operating voltage range and frequency range for DS1000B series digital oscilloscope are 100 to 240VAC$_{RMS}$ and 45 to 440Hz, respectively. Please connect the power cord to the power socket at the rear side of the oscilloscope and then connect the power cord to AC power supply.

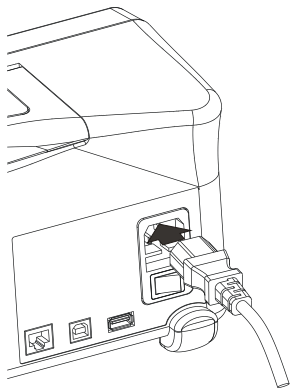


Figure 2-1 To Connect the power cord

After turning on the power switch at the rear panel of the oscilloscope and pressing the power key at the front panel, the backlights of the function keys at the upper side of the front panel will light for about 2 seconds. You can operate the instrument after the display becomes normal.

WARNING
To avoid electric shock, make sure the oscilloscope is correctly grounded before connecting the AC power supply. Power cord without ground wire should not be used.

After power-on, the oscilloscope performs all the self-test items automatically. After the instrument passes the self-test, the welcome screen is displayed. Then, press **Storage** → **Storage**, use ↻ to select **Factory** and press **Load** to restore the instrument to factory setting.

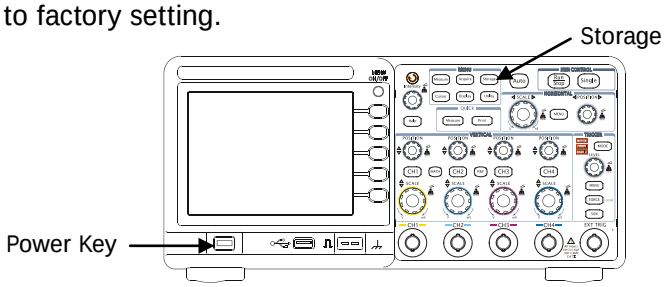


Figure 2-2 Power-on Inspection

To Connect the Probes

DS1000B series digital oscilloscope provides four channel inputs and an external trigger input.

Please take the following steps to connect the probes.

1. Connect the BNC connector of the probe to the channel input or external trigger interface. Insert the BNC connector into the interface vertically and turn it clockwise.

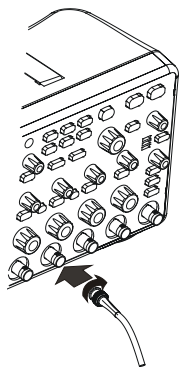


Figure 2-3 BNC Interface Connection

2. Connect the other end of the probe to the circuit under test.

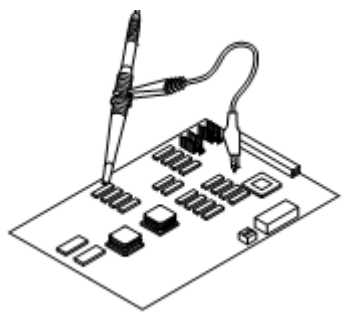


Figure 2-4 Circuit Under Test Connection

3. Disconnect the circuit when the test is finished. Turn the BNC connector of the probe anticlockwise and pull it out vertically.

WARNING
When using 10:1 probe, don't input a signal with a voltage higher than the maximum input voltage.

Probe Compensation

Probe compensation should be performed when the probe is connected to a input channel for the first time to match the probe with the input channel. Non-compensated probe or improperly compensated probe would cause measurement error. To compensate the probe, follow the steps below.

1. Set the attenuation switch of the probe and attenuation coefficient in the probe menu to 10X.

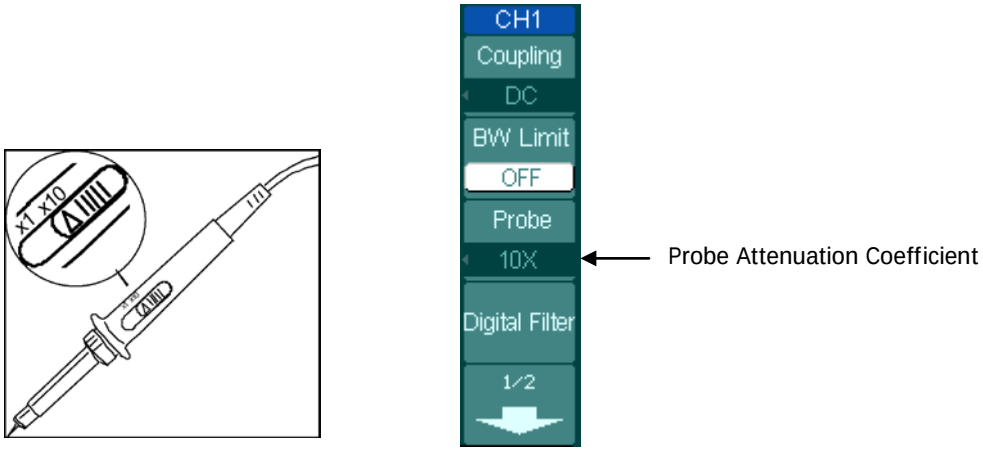


Figure 2-5 To Set the Probe Switch and Attenuation Coefficient

2. Connect the probe to CH1 of the oscilloscope. Connect the probe tip and ground clip to the connector of probe compensator.

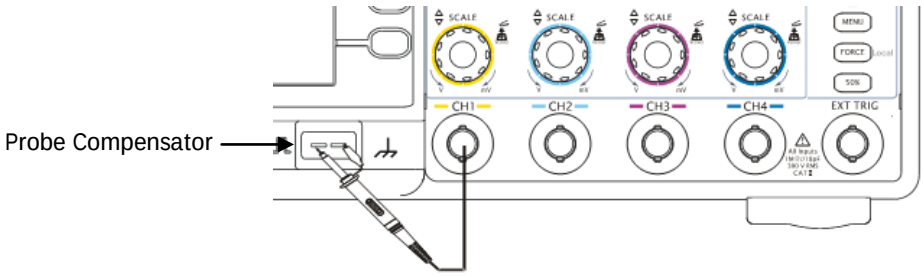
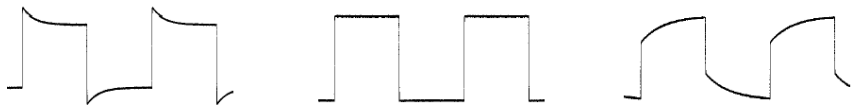


Figure 2-6 To Connect the Probe Compensator

3. Turn on CH1 and press **AUTO**; a square waveform will be displayed (1 kHz, approximately 3V peak-peak value) within several seconds. Check the shape of the waveform to determine whether the probe is correctly compensated.



Over compensated Correctly compensated Under compensated

Figure 2-7 Waveform Compensation

4. If necessary, use a non-metallic screwdriver to adjust the variable capacitor on the probe until the waveform displayed is as the “Correctly compensated” in the figure above.

5. Use the same method to check CH2, CH3 and CH4.

WARNING
To avoid electric shock while using the probe, make sure the insulated cable is in good condition, and do not touch the metallic parts of the probe while it is connected with a high-voltage power supply.

Auto Setting of Waveform Display

DS1000B series digital oscilloscope provides the auto setting function. The oscilloacope can adjust the voltage ratio, time base and trigger mode automatically according to the input signal to realize optimum waveform display. To use the auto setting function, the frequency of the input signal should be greater than or equal to 50Hz and the duty cycle should be greater than 1%.

1. Auto setting operation steps

- Connect the signal under test to the input channel.
- Press **AUTO** and adjust the parameters manually to get the optimum waveform display if necessary.

2. Auto setting items

Table 2-1 Auto Setting Items

Function	Setting
Display Format	Y-T
Acquisition Mode	Normal
Vertical Coupling	Adjust to AC or DC according to the signal
Vertical “V/div”	Adjust to the proper scale
Vertical Scale Adjustment	Coarse
Bandwidth Limit	OFF (namely full bandwidth)
Signal Invert	OFF
Horizontal Position	Center
Horizontal “S/div”	Adjust to the proper scale
Trigger Type	Edge
Trigger Source	Detect the channel with input signal automatically
Trigger Coupling	DC
Trigger Level	Midpoint setting
Trigger Mode	Auto
POSITION Knob	Trigger offset

Chapter 3 Performance Test

Topics of this chapter:

- Interfaces Test
  - USB Host Interface Test
  - USB Device Interface Test
  - LAN Interface Test
- Specification Test
  - Impedance Test
  - DC Gain Accuracy Test
  - Bandwidth Test
  - Bandwidth Limit Test
  - Time Base Accuracy Test
  - Zero Point Offset Test

Interface Test

USB Host Interface Test

Purpose: Test whether the USB Host interface works normally using a USB storage device.

Tools:

- A set of DS1000B series digital oscilloscope
- A USB storage device

Steps:

1. Insert the USB storage device into the USB Host interface at the front panel or rear panel of the oscilloscope.

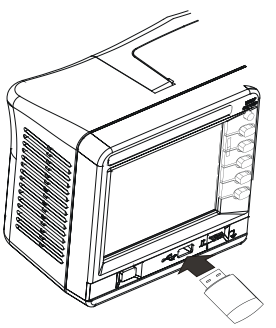


Figure 3-1 Connection of the USB Host Interface at the Front Panel

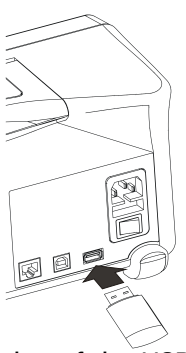


Figure 3-2 Connection of the USB Host Interface at the Rear Panel

2. When the USB storage device is correctly detected and the USB Host interface works normally, “USB device installed” is displayed on the screen. Otherwise, please check or repair this interface.

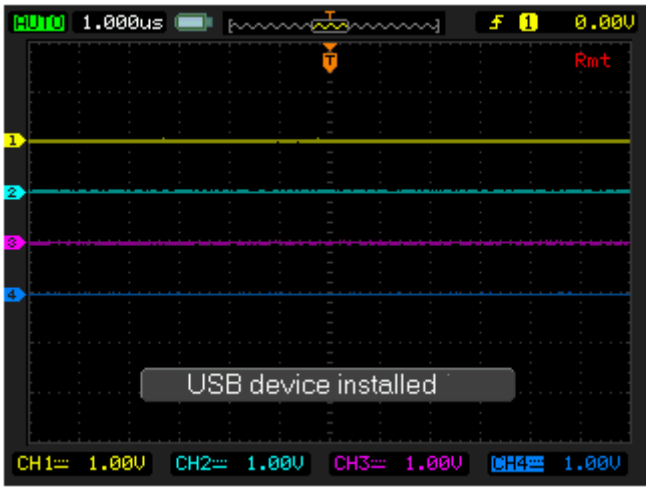


Figure 3-3 USB Storage Device Connection Succeeds

3. If an update program of the oscilloscope is stored in the USB storage device, the oscilloscope detects the program automatically and a prompt will be dispalyed to ask you whether to update the oscilloscope; if yes, the corresponding software updating process will be shown on the screen.

4. Press **Storage** → **External** to create or delete the file/folder in USB storage device.

5. Remove the USB storage device and the corresponding prompt message “USB device removed” will be displayed.

USB Device Interface Test

Purpose: Test whether the USB Device interface works normally using the PC software.

Tools:

- A set of DS1000B series digital oscilloscope
- A PC with USB interface
- A standard USB cable (Type AB)
- Ultrascope for DS1000B series

Steps:

1. Install Ultrascope for DS1000B series on the PC.
2. Connect the oscilloscope with PC using an USB cable and install the driver program according to the directions.

Figure 3-4 USB Device Interface Connection

3. Click **Tools → Connect to Oscilloscope**. If the connection succeeds, the corresponding connection status indicator at the upper right corner of the software will change from red to blue indicating that the USB Device interface works normally. If the connection fails, the prompt message as shown in the figure below will be displayed; at this point, you need to check or repair the interface.

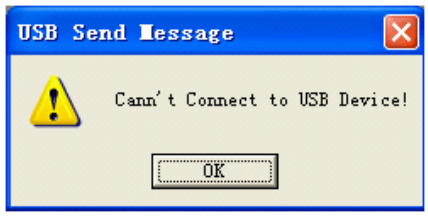


Figure 3-5 USB Device Interface Connection Fails

Tip

For the newest version of Ultrascope for DS1000B Series, please download it from **RIGOL** official website (www.rigolna.com).

LAN Interface Test

Propose: Test whether the LAN interface works normally using IE explorer.
Tools:

- A set of DS1000B series digital oscilloscope
- A PC with LAN interface
- A standard network cable

Steps:

1. Connect the network interface of the PC and the LAN interface of DS1000B using a network cable.
2. Press **Utility** → **I/O Setting** → **LAN Set**, to enter the LAN setting interface.
3. Press **LAN Init** → **Recall** and select **OK**.
4. Wait for a moment and observe whether "Configured" is displayed in the status display area (LAN Status). If "Configured" is displayed, the connection succeeds as shown in the figure below. If characters other than "Configured", please wait.

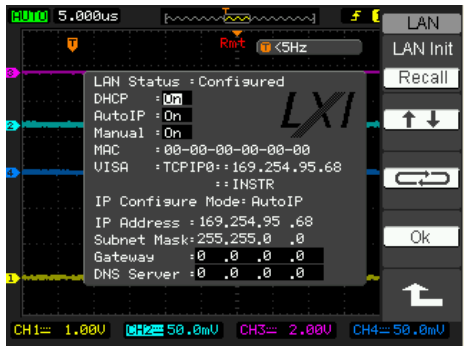


Figure 3-6 LAN Setup Interface

5. Open the IE explorer of the PC, input the IP address shown on the oscilloscope into the address bar and click "Enter". At this point, if the webpage is as shown in the figure below, the connection succeeds.

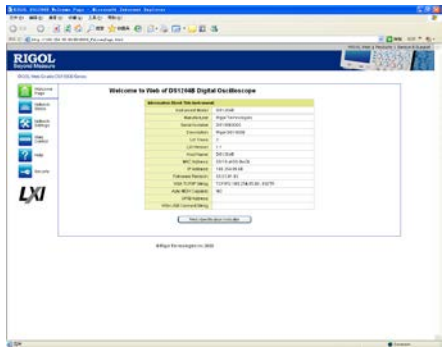


Figure 3-7 Remote Control Interface Based on LAN Interface Connection

Specification Test

DS1000B series digital oscilloscope includes 3 models (DS1074B, DS1104B and DS1204B). In this manual, DS1204B is taken as an example to illustrate the specification test methods. Unless otherwise noted, the introductions are applicable to the other models.

Purpose: Test whether all the specifications of the oscilloscope are within the specified range.

Tools:

- A set of DS1000B series oscilloscope
- A set of FLUKE 9500B oscilloscope calibrator and the corresponding accessories

Test Connection Diagram:

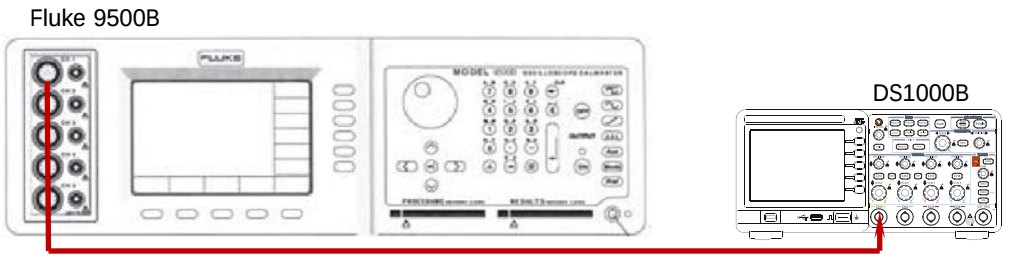


Figure 3-8 To Connect the Test Devices

Note:

1. Before performing the specification tests, make sure that the oscilloscope has passed the self-test and the self-calibration is performed.
2. Before performing any of the following tests, make sure that the oscilloscope has been warmed up for at least 30 minutes.
3. Before or after performing any of the following tests, restore the instrument to the factory setting.

Impedance Test

Specification:

Input Impedance	
Analog Channel (CH1 to CH4)	1 MΩ: 0.98 MΩ to 1.02 MΩ

Test Procedures:

1. Impedance test of CH1 to CH4

1) Connect the active signal terminal of Fluke 9500B to CH1 of the oscilloscope, as shown in Figure 3-8.
2) Configure the oscilloscope:
   a) Press **CH1** in the vertical control area (VERTICAL) at the front panel to turn on CH1.
   b) Rotate **VERTICAL SCALE** to set the vertical scale of CH1 to 100 mV/div.
3) Turn on Fluke 9500B; set its impedance to 1 MΩ and select the resistance measurement function. Read and record the resistance measured.
4) Rotate **VERTICAL SCALE** to adjust the vertical scale of CH1 of the oscilloscope to 500 mV/div; read and record the resistance measured.
5) Turn off CH1. Repeat the steps above to test the impedances of CH2, CH3 and CH4 and record the measurement results.

2. Impedance test of the [EXT TRIG] channel

1) Disconnect the connections of the four input channels.
2) Connect the external trigger channel **[EXT TRIG]** with the active signal terminal of Fluke 9500B.
3) Turn on Fluke 9500B; set its impedance to 1 MΩ and select the resistance measurement function. Read and record the resistance measured.

Test Record Form:

CH1 to CH4

Channel	Vertical Scale	Test Result	Limit	Pass/Fail
CH1	100 mV/div		0.98 MΩ to 1.02 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			

External Trigger Channel

Channel	Input Impedance	Test Result	Limit	Pass/Fail
EXT TRIG	1 MΩ		0.98 MΩ to 1.02 MΩ	

DC Gain Accuracy Test

Specification:

DC Gain Accuracy	
Specification	2 mV/div to 5 mV/div, ±4% × Full Scale [1] 10 mV/div to 10 V/div, ±3% × Full Scale

Note[1]: Full Scale = 8 × Current Vertical Scale

Test Procedures:

1. Connect the active signal terminal of Fluke 9500B to CH1 of the oscilloscope, as shown in Figure 3-8.
2. Turn on Fluke 9500B and set its impedance to 1 MΩ.
3. Output a DC signal with +6 mV_{DC} voltage (Vout1) via Fluke 9500B.
4. Configure the oscilloscope:
   1) Press **CH1** in the vertical control area (VERTICAL) at the front panel to turn on CH1.
   2) Press **CH1** → **Probe** to set the probe attenuation ratio to "1X".
   3) Rotate **VERTICAL SCALE** to set the vertical scale to 2 mV/div.
   4) Rotate **HORIZONTAL SCALE** to set the horizontal time base to 100 us.
   5) Press **VERTICAL POSITION** to set the vertical position to 0.
   6) Press **Acquire** → **Acquisition** and use to select "Average" acquisition mode; press **Averages** and use to set the number of averages to 32.
5. Press **Measure** → **Voltage** → **Vavg** to turn on the average measurement function. Read and record Vavg1.
6. Adjust Fluke 9500B to make it output a DC signal with -6 mV_{DC} voltage (Vout2).
7. Press **Measure** → **Voltage** → **Vavg** to turn on the average measurement function. Read and record Vavg2.
8. Calculate the relative error of this vertical scale: **|(Vavg1 - Vavg2) - (Vout1 - Vout2)|/Full Scale × 100%**.
9. Keep the other settings of the oscilloscope unchanged:
   1) 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.
   2) Adjust the output voltage of Fluke 9500B to 3 × the current vertical scale and -3 × the current vertical scale respectively.
   3) Repeat steps 3 to 7 and record the test results.
   4) Calculate the relative error of each vertical scale: **|(Vavg1 - Vavg2) - (Vout1 - Vout2)|/Full Scale × 100%**.
10. Turn off CH1. Repeat the steps above to test the relative error of each scale of CH2, CH3 and CH4 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					
CH3	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					

Test Record Form (continue)

Channel	Vertical Scale	Test Result			Limit	Pass/Fail
		Vavg1	Vavg2	Calculation Result[1]		
CH4	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) - (Vout1 - Vout2)|/Full Scale × 100%; wherein, Vout1 and Vout2 are 3 × the current vertical scale and -3 × the current vertical scale respectively.

Bandwidth Test

The bandwidth test verifies the bandwidth performance of the oscilloscope by testing the amplitude loss of the oscilloscope under test at full bandwidth.

Specification:

Bandwidth	
Amplitude Loss [1]	-3 dB to 3 dB

Note[1]: Amplitude Loss (dB) = 20 × lg (Vrms2/Vrms1); wherein, Vrms1 is the measurement result of amplitude effective value at 1MHz and Vrms2 is the measurement result of amplitude effective value at full bandwidth.

Test Procedures:

1. Connect the active signal terminal of Fluke 9500B to CH1 of the oscilloscope, as shown in Figure 3-8.
2. Turn on Fluke 9500B and set its impedance to 1 MΩ.
3. Configure the oscilloscope:
   1) Press **CH1** in the vertical control area (VERTICAL) at the front panel to turn on CH1.
   2) Press **CH1** → **Probe** to set the probe attenuation ratio to "1X".
   3) Rotate **HORIZONTAL** **SCALE** to set the horizontal time base to 500 ns.
   4) Rotate **VERTICAL** **SCALE** to set the vertical scale to 100 mV/div.
   5) Press **HORIZONTAL** **POSITION** and **VERTICAL** **POSITION** respectively to set the horizontal position and vertical position to 0.
   6) Press **TRIGGER** **LEVEL** to set the trigger level to 0 V.
4. Output a Sine with 1 MHz frequency and 600 mVpp amplitude via Fluke 9500B.
5. Press **Measure** → **Voltage** → **Vrms** to turn on the root mean square value measurement function. Read and record Vrms1.
6. Output a Sine with 200 MHz frequency (the setting value is different for different model of oscilloscope under test; please refer to Table 3-1) and 600 mVpp amplitude via Fluke 9500B.

   Table 3-1 Setting Value of the Oscilloscope under Test

Model	Full Bandwidth	Horizontal Time Base
DS1204B	200 MHz	5 ns
DS1104B	100 MHz	5 ns
DS1074B	70 MHz	10 ns

7. Rotate **HORIZONTAL** **SCALE** to set the horizontal time base to 5 ns (the setting value is different for different model of oscilloscope under test; please refer to Table 3-1).
8. Press **Measure** → **Voltage** → **Vrms** to turn on the root mean square value measurement function. Read and record Vrms2.
9. Calculate the amplitude loss: **Amplitude Loss (dB) = 20 × lg (Vrms2/Vrms1)**.
10. Keep the other settings of the oscilloscope in step 3 unchanged and set the vertical scale to 200 mV/div.

11. Output a Sine with 1 MHz frequency and 1.2 Vpp amplitude via Fluke 9500B.
12. Repeat step 5.
13. Output a Sine with 200 MHz frequency (the setting value is different for different model of oscilloscope under test; please refer to Table 3-1) and 1.2 Vpp amplitude via Fluke 9500B.
14. Repeat steps 7 to 9.
15. Keep the other settings of the oscilloscope in step 3 unchanged and set the vertical scale to 500 mV/div.
16. Output a Sine with 1 MHz frequency and 3 Vpp amplitude via Fluke 9500B.
17. Repeat step 5.
18. Output a Sine with 200 MHz frequency (the setting value is different for different model of oscilloscope under test; please refer to Table 3-1) and 3 Vpp amplitude via Fluke 9500B.
19. Repeat steps 7 to 9.
20. Turn off CH1. Repeat the steps above to test CH2, CH3 and CH4 and record the test results.

Test Record Form:

Channel	Vertical Scale	Test Result			Limit	Pass/Fail
		Vrms1	Vrms2	Amplitude Loss[1]		
CH1	100 mV/div				-3 dB to 3 dB	
	200 mV/div					
	500 mV/div					
CH2	100 mV/div					
	200 mV/div					
	500 mV/div					
CH3	100 mV/div					
	200 mV/div					
	500 mV/div					
CH4	100 mV/div					
	200 mV/div					
	500 mV/div					

Note [1]: Amplitude Loss (dB) = 20 × lg (Vrms2/Vrms1).

Bandwidth Limit Test

The bandwidth limit test verifies the 20 MHz bandwidth limit function of the oscilloscope by testing the amplitude losses of the oscilloscope under test at the bandwidth limits.

Specification:

Bandwidth Limit	
Amplitude Loss [1]	-3 dB to 0 dB

Note[1]: Amplitude Loss (dB) = 20 × lg (Vrmsn/Vrms1). Wherein, Vrmsn represents Vrms2 or Vrms3; Vrms1 is the measurement result of amplitude effective value at 1MHz; Vrms2 is the measurement result of amplitude effective value at the bandwidth limit; Vrms3 is the measurement result of amplitude effective value when the frequency is greater than the bandwidth limit.

Test Procedures:

1. Connect the active signal terminal of Fluke 9500B to CH1 of the oscilloscope, as shown in Figure 3-8.
2. Turn on Fluke 9500B and set its impedance to 1 MΩ.
3. Configure the oscilloscope:
   1) Press **CH1** in the vertical control area (VERTICAL) at the front panel to turn on CH1.
   2) Press **CH1** → **Probe** to set the probe attenuation ratio to "1X".
   3) Rotate **VERTICAL SCALE** to set the vertical scale to 100 mV/div.
   4) Rotate **HORIZONTAL SCALE** to set the horizontal time base to 500 ns.
   5) Press **HORIZONTAL POSITION** and **VERTICAL POSITION** respectively to set the horizontal position and vertical position to 0.
   6) Press **TRIGGER LEVEL** to set the trigger level to 0 V.
4. Press **CH1** → **BW Limit** → **ON** to set the bandwidth limit to 20 MHz.
5. Output a Sine with 1 MHz frequency and 600 mVpp amplitude via Fluke 9500B.
6. Press **Measure** → **Voltage** → **Vrms** to turn on the root mean square value measurement function. Read and record Vrms1.
7. Output a Sine with 20 MHz frequency and 600 mVpp amplitude via Fluke 9500B.
8. Rotate **HORIZONTAL SCALE** to set the horizontal time base to 50 ns.
9. Press **Measure** → **Voltage** → **Vrms** to turn on the root mean square value measurement function. Read and record Vrms2.
10. Calculate the amplitude loss: **Amplitude Loss A1 (dB) = 20 × lg (Vrms2/Vrms1)** and compare the result with the specification. At this point, the amplitude loss should be within the specification range.
11. Output a Sine with 50 MHz frequency and 600 mVpp amplitude via Fluke 9500B.
12. Rotate **HORIZONTAL SCALE** to set the horizontal time base to 10 ns.
13. Press **Measure** → **Voltage** → **Vrms** to turn on the root mean square value measurement function. Read and record Vrms3.
14. Calculate the amplitude loss: **Amplitude Loss A2 (dB) = 20 × lg (Vrms3/Vrms1)**. At this point, the amplitude loss should be lower than -3 dB.
15. Keep the other settings of the oscilloscope in step 3 unchanged and set the vertical scale to 200 mV/div.

16. Output a Sine with 1 MHz frequency and 1.2 Vpp amplitude via Fluke 9500B.
17. Repeat step 6.
18. Output a Sine with 20 MHz frequency and 1.2 Vpp amplitude via Fluke 9500B.
19. Repeat steps 8 to 10.
20. Output a Sine with 50 MHz frequency and 1.2 Vpp amplitude via Fluke 9500B.
21. Repeat steps 12 to 14.
22. Keep the other settings of the oscilloscope in step 3 unchanged and set the vertical scale to 500 mV/div.
23. Output a Sine with 1 MHz frequency and 3 Vpp amplitude via Fluke 9500B.
24. Repeat step 6.
25. Output a Sine with 20 MHz frequency and 3 Vpp amplitude via Fluke 9500B.
26. Repeat steps 8 to 10.
27. Output a Sine with 50 MHz frequency and 3 Vpp amplitude via Fluke 9500B.
28. Repeat steps 12 to 14.
29. Turn off CH1. Repeat the steps above to test CH2, CH3 and CH4 and record the test results.

Test Record Form:

Channel	Vertical Scale	Test Result			Calculation Result		Limit	Pass /Fail
		Vrms1	Vrms2	Vrms3				
CH1	100 mV/div				Amplitude Loss A1[1]		-3 dB to 0 dB	
					Amplitude Loss A2[2]		≤-3 dB	
	200 mV/div				Amplitude Loss A1[1]		-3 dB to 0 dB	
					Amplitude Loss A2[2]		≤-3 dB	
	500 mV/div				Amplitude Loss A1[1]		-3 dB to 0 dB	
					Amplitude Loss A2[2]		≤-3 dB	
CH2	100 mV/div				Amplitude Loss A1[1]		-3 dB to 0 dB	
					Amplitude Loss A2[2]		≤-3 dB	
	200 mV/div				Amplitude Loss A1[1]		-3 dB to 0 dB	
					Amplitude Loss A2[2]		≤-3 dB	
	500 mV/div				Amplitude Loss A1[1]		-3 dB to 0 dB	
					Amplitude Loss A2[2]		≤-3 dB	

Test Record Form (continue)

Channel	Vertical Scale	Test Result			Calculation Result		Limit	Pass/ Fail
		Vrms1	Vrms2	Vrms3				
CH3	100 mV/div				Amplitude Loss A1[1]		-3 dB to 0 dB	
					Amplitude Loss A2[2]		≤-3 dB	
	200 mV/div				Amplitude Loss A1[1]		-3 dB to 0 dB	
					Amplitude Loss A2[2]		≤-3 dB	
	500 mV/div				Amplitude Loss A1[1]		-3 dB to 0 dB	
					Amplitude Loss A2[2]		≤-3 dB	
CH4	100 mV/div				Amplitude Loss A1[1]		-3 dB to 0 dB	
					Amplitude Loss A2[2]		≤-3 dB	
	200 mV/div				Amplitude Loss A1[1]		-3 dB to 0 dB	
					Amplitude Loss A2[2]		≤-3 dB	
	500 mV/div				Amplitude Loss A1[1]		-3 dB to 0 dB	
					Amplitude Loss A2[2]		≤-3 dB	

Note [1]: Amplitude Loss A1 (dB) = 20 × lg (Vrms2/Vrms1).
Note [2]: Amplitude Loss A2 (dB) = 20 × lg (Vrms3/Vrms1).

Time Base Accuracy Test

Specification:

Time Base Accuracy	
Specification	±50 ppm

Test Procedures:

1. Connect the active signal terminal of Fluke 9500B to CH1 of the oscilloscope, as shown in Figure 3-8.
2. Turn on Fluke 9500B and set its impedance to 1 MΩ.
3. Output a Sine with 10 MHz frequency and 1.2 Vpp amplitude via Fluke 9500B.
4. Configure the oscilloscope:
   1) Press **CH1** in the vertical control area (VERTICAL) at the front panel to turn on CH1.
   2) Press **CH1** → **Probe** to set the probe attenuation ratio to "1X".
   3) Rotate **VERTICAL SCALE** to set the vertical scale to 200 mV/div.
   4) Press **VERTICAL POSITION** to set the vertical position to 0.
   5) Rotate **HORIZONTAL POSITION** to set the horizontal position to 1 ms.
      Tip: To quickly set the horizontal position to 1 ms, you can first rotate **HORIZONTAL SCALE** to set the horizontal time base to 50 ms.
   6) Rotate **HORIZONTAL SCALE** to set the horizontal time base to 10 ns.
5. Observe the screen of the oscilloscope. Press **Cursor** → **Mode** → "Manual" to turn on the manual cursor function. Measure the offset (ΔT) of the middle point of the signal (namely the crossing point of the rising edge of the current signal and the trigger level line) relative to the screen center using manual cursor measurement and record the measurement result.
6. Calculate the time base accuracy; namely the ratio of ΔT to the horizontal position of the oscilloscope. For example, if the offset measured is 1 ns, the time base accuracy is 1 ns/1 ms=1 ppm.

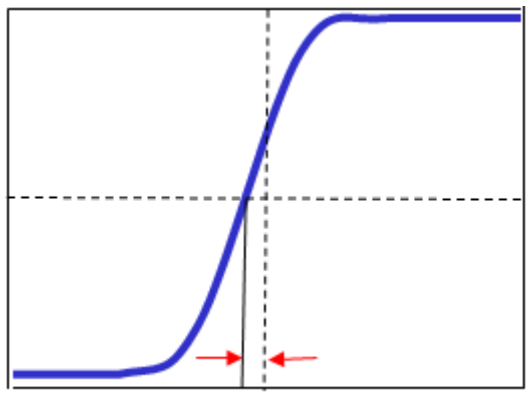
Test Record Form:

Channel	Test Result ΔT	Calculation Result[1]	Limit	Pass/Fail
CH1			≤ ±50 ppm	

Note: Calculation Result = Test Result ΔT/1 ms.

Zero Point Offset Test

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



Zero Point Offset

Specification:

Zero Point Offset	
Specification	±0.5 div × Minimum Time Base Scale[1]

Note[1]: For different models of oscilloscopes under test, the minimum time base scales are different. For DS1204B, the minimum time base scale is 1 ns/div; for DS1104B, the minimum time base scale is 2 ns/div; for DS1074B, the minimum time base scale is 5 ns/div.

Test Procedures:

1. Connect the active signal terminal of Fluke 9500B to CH1 of the oscilloscope, as shown in Figure 3-8.
2. Turn on Fluke 9500B and set its impedance to 1 MΩ.
3. Output a fast edge signal with 150 ps rise time and 1.2 V amplitude via Fluke 9500B.
4. Configure the oscilloscope:
   1) Press **CH1** in the vertical control area (VERTICAL) at the front panel to turn on CH1.
   2) Press **CH1** → **Probe** to set the probe attenuation ratio to "1X".
   3) Rotate **VERTICAL** **SCALE** to set the vertical scale to 200 mV/div.
   4) Rotate **HORIZONTAL** **SCALE** to set the horizontal time base to 1 ns (the setting value is different for different model of oscilloscope under test; please refer to Table 3-2).

Table 3-2 Horizontal Time Base Setting Value for the Oscilloscope under Test

Model	Horizontal Time Base
DS1204B	1 ns/div
DS1104B	2 ns/div
DS1074B	5 ns/div

5) Rotate **HORIZONTAL** **POSITION** and **VERTICAL** **POSITION** respectively to adjust the horizontal position and vertical position properly.
6) Rotate **TRIGGER** **LEVEL** to adjust the trigger level to the middle of the screen.

5. Observe the screen of the oscilloscope. Press **Cursor** → **Mode** → "Manual" to turn on the manual cursor function. Measure the zero point offset using manual cursor measurement and record the measurement result.
6. Output a fast edge signal with 150 ps rise time and 3 V amplitude via Fluke 9500B.
7. Keep the other settings of the oscilloscope unchanged and set the vertical scale to 500 mV/div.
8. Repeat step 5. Measure the zero point offset and record the test result.
9. Turn off CH1. Repeat the steps above to test 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		≤ 0.5 div ×Minimum Time Base Scale[1]	
	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			

Note[1]: For different models of oscilloscopes under test, the minimum time base scales are different. For DS1204B, the minimum time base scale is 1 ns/div; for DS1104B, the minimum time base scale is 2 ns/div; for DS1074B, the minimum time base scale is 5 ns/div.

Chapter 4 Calibration

By performing the calibration program, the oscilloscope can quickly reach the optimum working state and acquire the most accurate measurement values. You can execute the calibration program at any time. Calibration must be performed when the environment temperature variation is up to or more than 5℃.

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

Steps:

1. Disconnect all the probes or cables from the input connectors.
2. Press **Utility** → **Self-Cal** and the self-calibration interface as shown in the figure below is displayed.

Figure 4-1 Self-calibration interface

3. Press **RUN/STOP** to start the self-calibration. The oscilloscope will calibrate the parameters of the vertical system (CH1, CH2, CH3, CH4 and Ext), horizontal system and trigger system automatically to guarantee that the specifications can always meet the specifications in different environment.
4. After the self-calibration finishes, "Calibration Finished" is displayed, as shown in the figure below. You can press **RUN/STOP** to exit the self-calibration program.

Figure 4-2 Self-Calibration Finishes

Generally, the self-calibration will last for about 10 to 15 minutes. If the instrument does not pass the self-calibration after this period of time or the progress bar stops at one of the calibration items, failure might occur to the instrument. Please restart the instrument and perform the self-calibration again; if the problem still remains, please contact **RIGOL** technical support.

Chapter 5 Disassemble and Assemble

Topics of this chapter:

- Disassemble and Assemble Notices
- Structure Diagram
- To Disassemble and Assemble the Cover
- To Disassemble and Assemble the Upper Metal Cover
- To Disassemble and Assemble the Rear Metal Cover and Power Board
- To Disassemble and Assemble the Interface Board and Fan
- To Disassemble and Assemble the Panel and LCD
- To Disassemble and Assemble the Keyboard
- To Disassemble and Assemble the Main Board

Disassemble and Assemble Notices

Notices:

- Do not disassemble the instrument unless for working requirement.
- Only authorized personnel can disassemble the instrument.
- Cut off the power supply before disassembling the instrument.
- Please wear anti-static wrist strap or make other anti-static precaution when disassembling the instrument.
- Please use proper tools and follow the correct steps.
- Take care not to deform the metal structure and be scuffed when disassembling the metal structures.

Tools:

- Screwdriver (T10)
- BNC socket

WARNING

Make sure that the power supply is cut off before disassembling the instrument. Only personnel with relative training or relative qualification certification can disassemble the instrument.

Structure Diagram

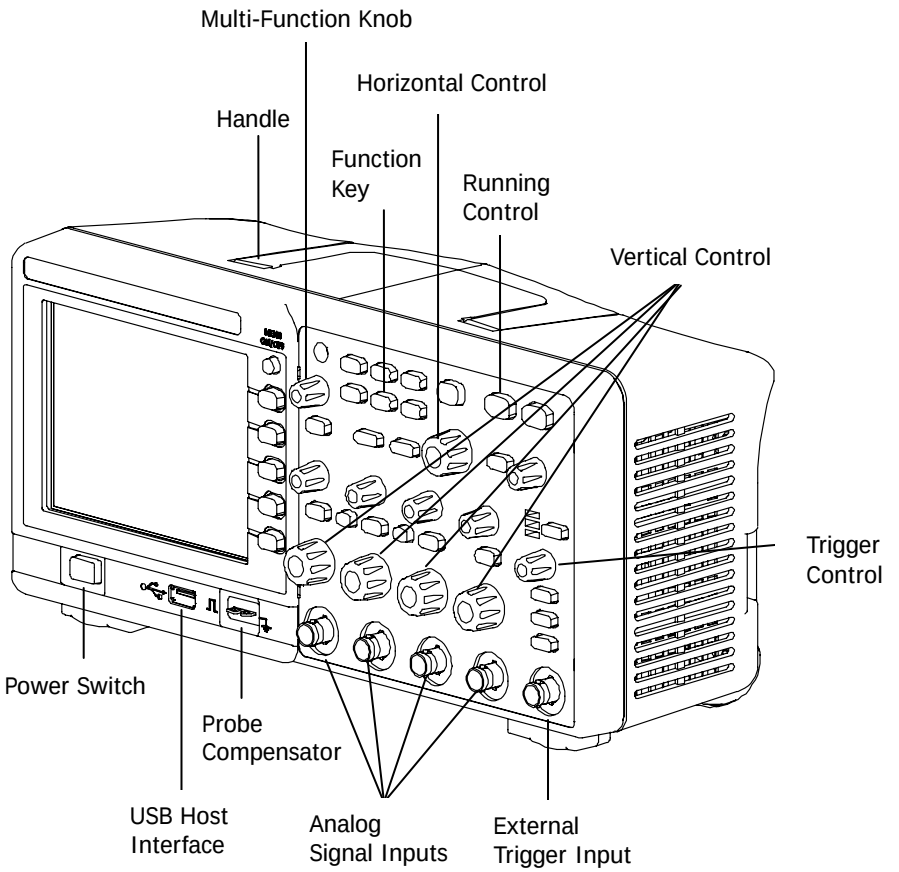


Figure 5-1 DS1000B Stereogram

To Disassemble and Assemble the Cover

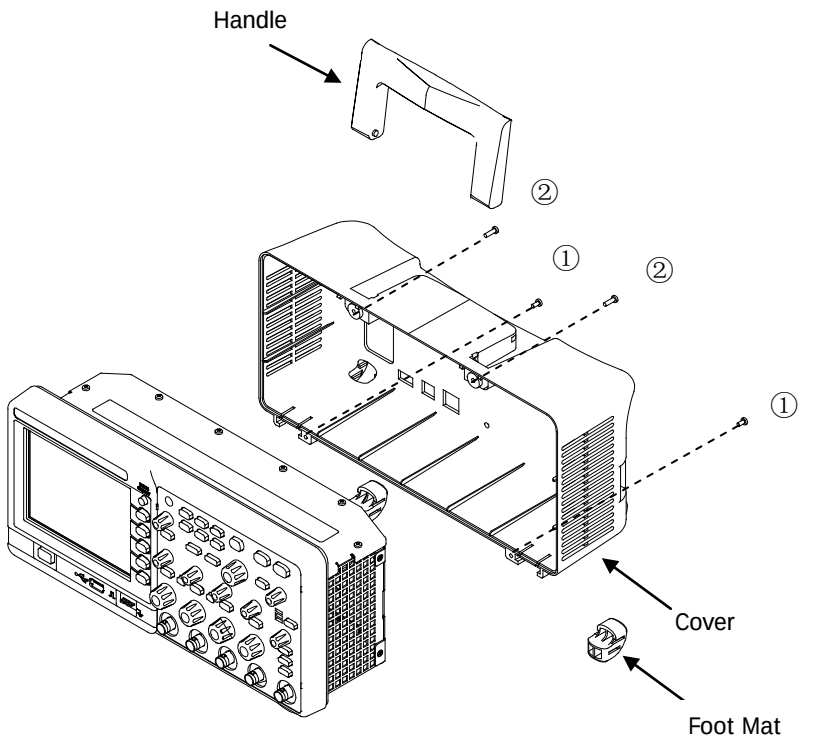


Figure 5-2 To Disassemble and Assemble the Cover

Part Explanations:

① 2 screws (M3*12 pan head torx pointed self-tapping screw) at the bottom of the cover.
② 2 screws ((small nailhead) M3*10 pan head torx machine screw) at the handle groove.

Disassemble steps:

1. Remove the 4 screws (① and ②) using the screwdriver (T10).
2. Remove the cover gently.

Assemble steps:

The assemble steps are the reverse of the disassemble steps. The same goes for the introductions below.

To Disassemble and Assemble the Upper Metal Cover

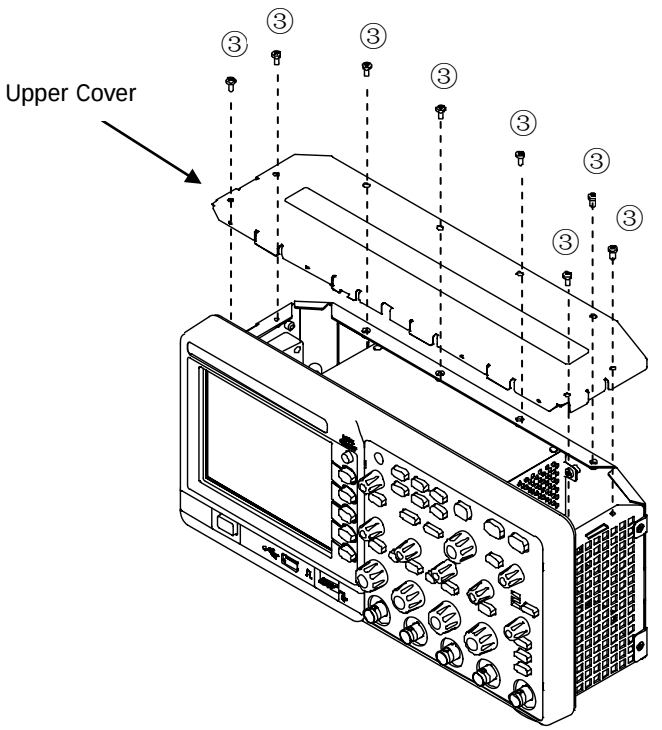


Figure 5-3 To Disassemble and Assemble the Upper Metal Cover

Part Explanation:

③ 8 screws (M3*6 countersunk head torx machine screw) at the upper cover.

Disassemble step:

1. Remove the 8 screws (③) using the screwdriver (T10). Remove the upper cover.

To Disassemble and Assemble the Rear Metal Cover and Power Board

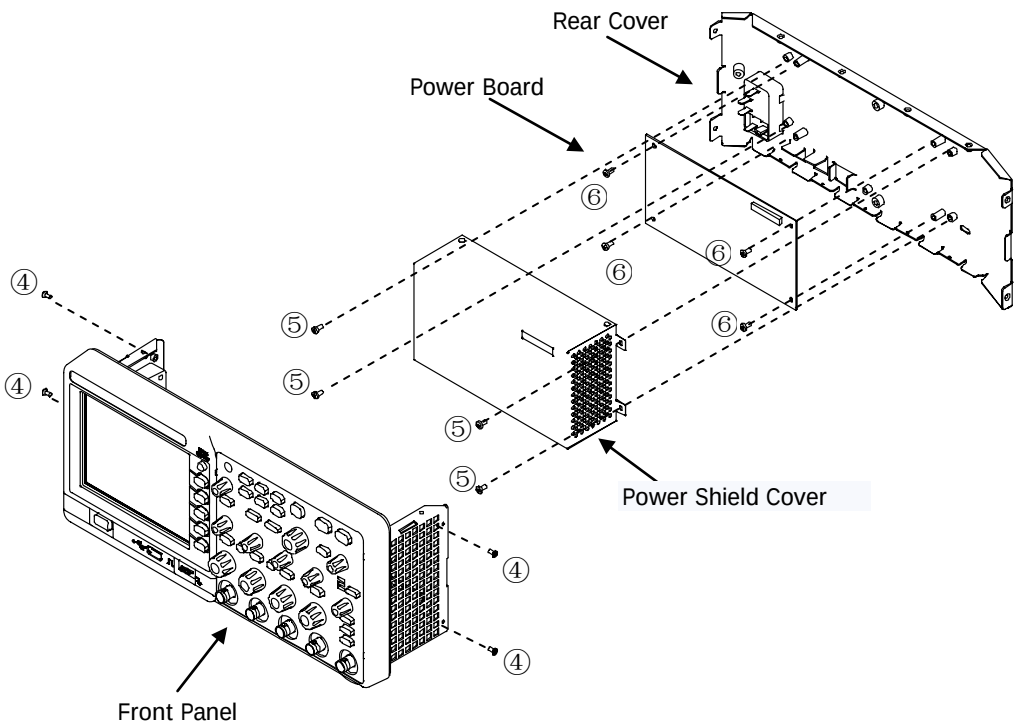


Figure 5-4 To Disassemble and Assemble the Rear Metal Cover and Power Board

Part Explanations:

④ 4 screws (M3*6 countersunk head torx machine screw) fixing the rear cover and chassis.

⑤ 5 screws (M3*6 pan head torx composite machine screw with plain washer) fixing the power shield cover and rear cover (the positions of the screws are not marked out in the figure above and please remove them according to their actual positions).

⑥ 4 screws (M3*6 pan head torx composite machine screw with plain washer) fixing the power board and rear cover.

Disassemble steps:

1. Remove the 12-pin power cable from the main board.
2. Remove the 4 screws (④) using the screwdriver (T10). Then, remove the rear cover.
3. Remove the 5 screws (⑤) using the screwdriver (T10). Then, remove the power shield cover.

4. Remove the power cable connecting the power socket and power board.
5. Remove the 4 screws (⑥) using the screwdriver (T10). Then, remove the power board.

To Disassemble and Assemble the Interface Board and Fan

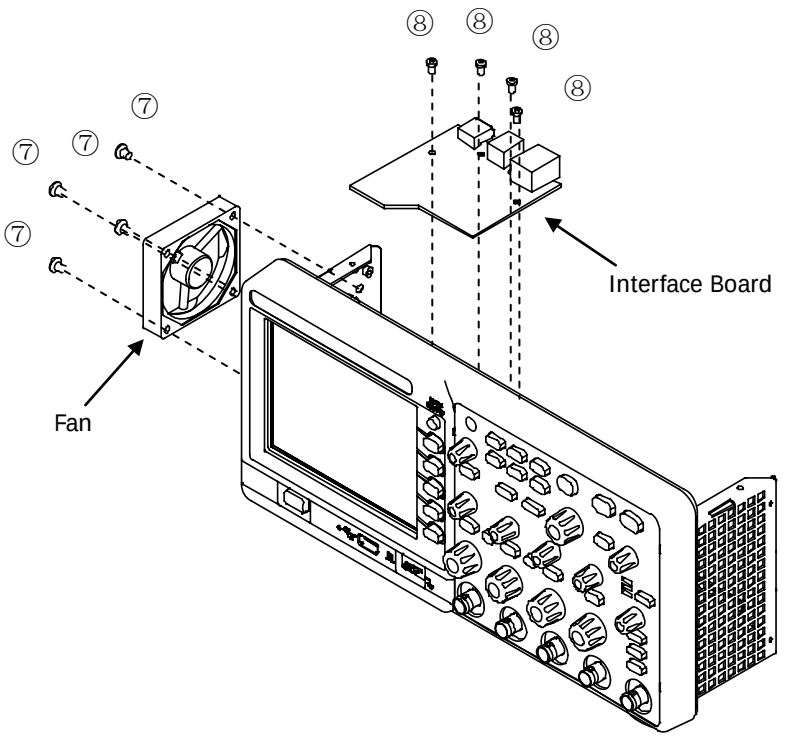


Figure 5-5 To Disassemble and Assemble the Interface Board and Fan

Part Explanations:

⑦ 4 screws (M5*10 countersunk head torx cutting self-tapping screw) fixing the fan.
⑧ 4 screws (M3*6 pan head torx composite machine screw with plain washer) fixing the interface board.

Disassemble steps:

1. Remove the fan cable from the corresponding port.
2. Remove the 4 screws (⑦) fixing the fan using the screwdriver (T10). Then, remove the fan.
3. Remove the interface board cable connected to the main board.
4. Remove the 4 screws (⑧) fixing the interface board using the screwdriver (T10). Then, remove the interface board.

To Disassemble and Assemble the Panel and LCD

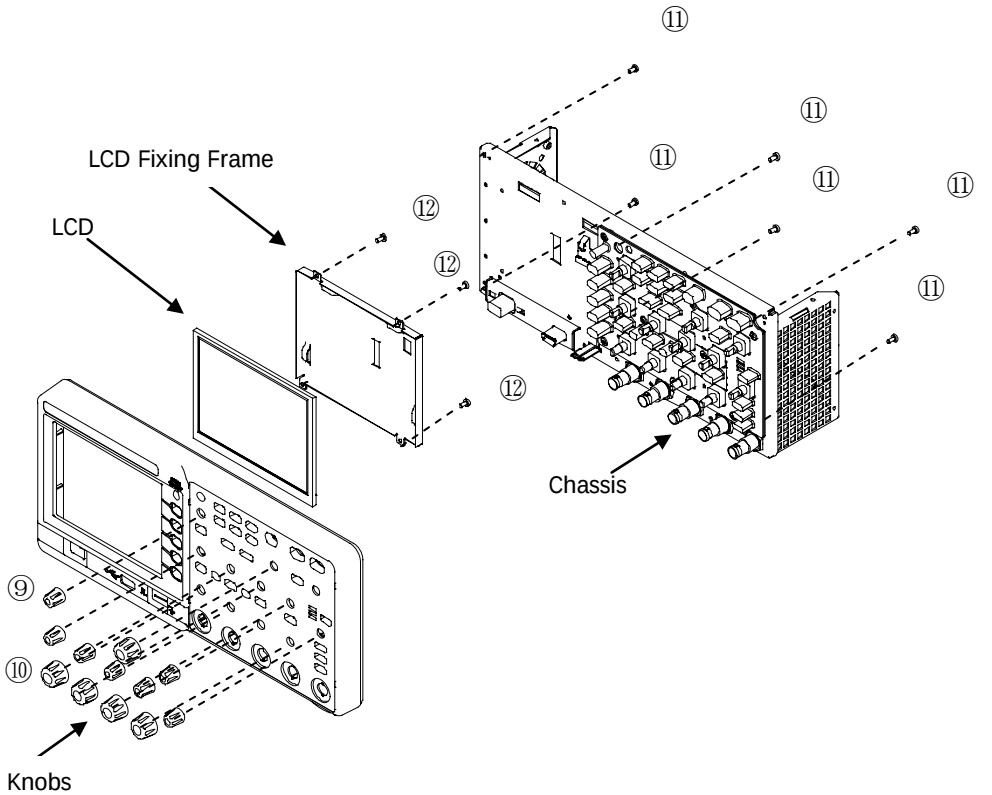


Figure 5-6 To Disassemble and Assemble the Panel and LCD

Part Explanations:

⑨ 7 small knobs
⑩ 5 large knobs
⑪ 6 screws (M3*8 pan head torx cutting self-tapping screw) fixing the chassis and front panel.
⑫ 4 screws (M3*8 pan head torx cutting self-tapping screw) fixing the LCD fixing frame and LCD (the positions of the screws are not marked out in the figure above and please remove them according to their actual positions).

Disassemble steps:

1. Remove the LCD screen wire from the main board.
2. Remove the 7 small knobs (⑨) and 5 large knobs (⑩) (note: do not use hard article to avoid damaging the panel).
3. Remove the 6 screws (⑪) using the screwdriver (T10). Then, remove the chassis.
4. Remove the 4 screws (⑫) using the screwdriver (T10). Then, remove the LCD gently (pay attention to LCD screen wire and ground wire).

To Disassemble and Assemble the Keyboard

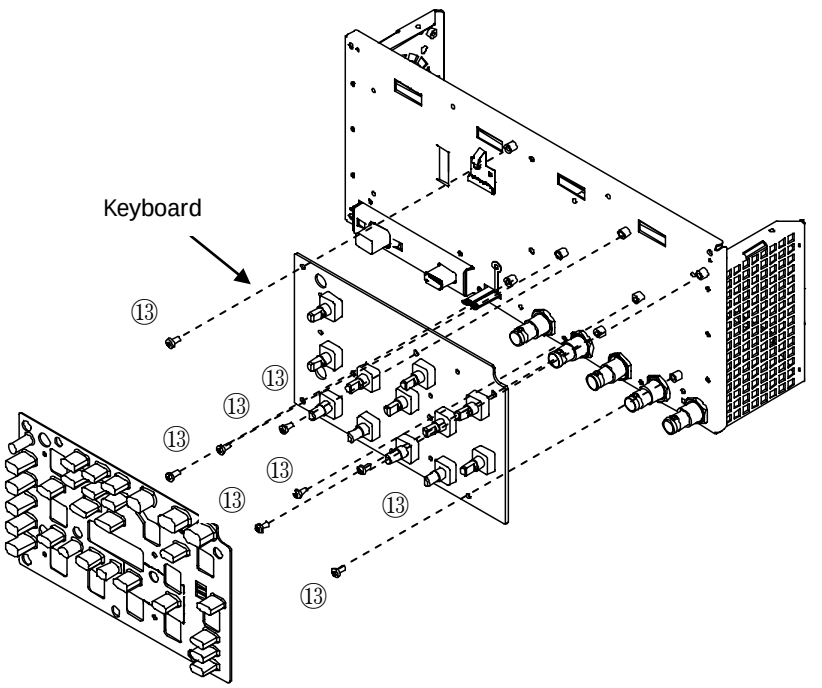


Figure 5-7 To Disassemble and Assemble the Keyboard

Part Explanation:

⑬ 8 screws (M3*6 countersunk head torx machine screw) fixing the keyboard.

Disassemble steps:

1. Remove the keyboard ribbon cable from the main board.
2. Remove the 8 screws (⑬) using the screwdriver (T10).
3. Remove the keyboard gently (pay attention to the keyboard wire).

To Disassemble and Assemble the Main Board

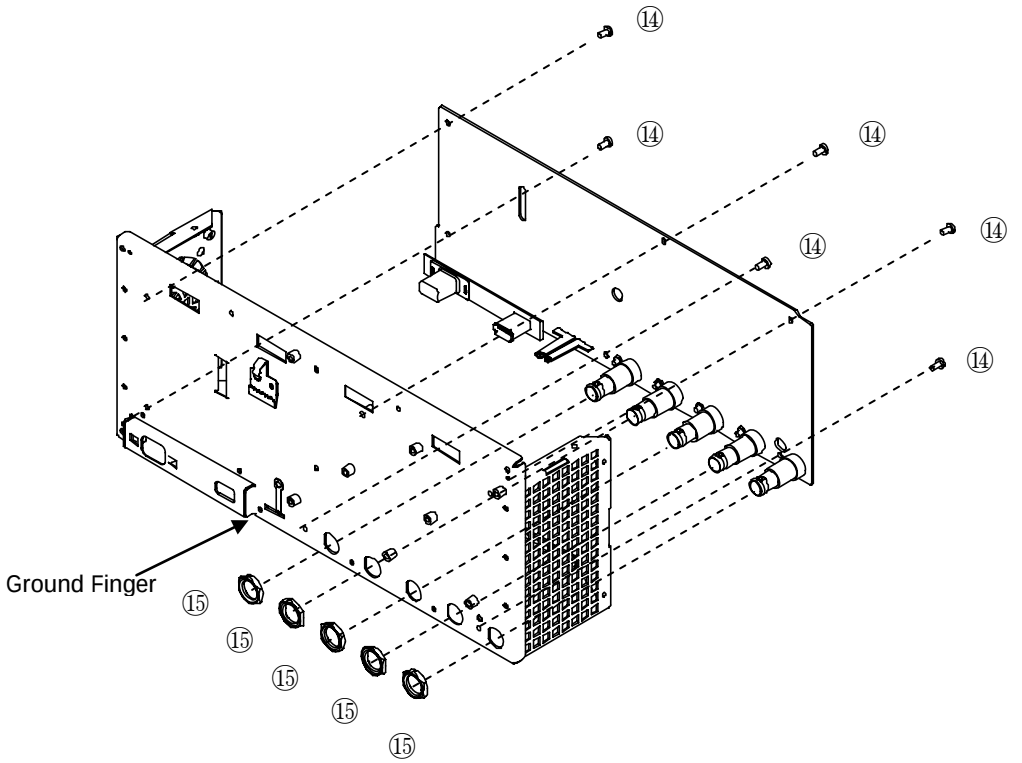


Figure 5-8 To Disassemble and Assemble the Main Board

Part Explanations:

⑭ 6 screws (M3*6 pan head torx composite machine screw with plain washer) fixing the main board.
⑮ 5 nuts (BNC nut) at the BNC terminals.

Disassemble steps:

1. Remove the 6 screws (⑭) fixing the main board using the screwdriver (T10).
2. Remove the 5 nits (⑮) at the BNC terminals using BNC socket.
3. Disconnect the ground finger on the metal chassis and the ground terminal of the main board using an electric soldering iron.
4. Remove the main board gently.

Chapter 6 Troubleshooting

1. The screen is still dark (no display) after pressing the power key:

(1) Check whether the power is correctly connected.
(2) Check whether the power switch is really on.
(3) Check whether the fuse is burned out.
(4) Restart the instrument after finishing the above inspections.
(5) If it still does not work correctly, please contact **RIGOL**.

2. The signal is sampled but no waveform of the signal is displayed:

(1) Check whether the probe is correctly connected with the signal connecting wire.
(2) Check whether the signal connecting wire is correctly connected to the BNC (namely the channel connector).
(3) Check whether the probe is correctly connected with the item to be tested.
(4) Check whether there are signals generated from the item to be tested (you can connect the probe compensation signal to the problematic channel to determine which has problem, the channel or the item to be tested).
(5) Repeat the acquisition.

3. The tested voltage amplitude is 10 times greater or lower than the actual value:

Check whether the probe attenuation ratio matches with the channel attenuation coefficient.

4. There is waveform display but not stable:

(1) Check the trigger source: check whether the trigger source selected in **Source** in the trigger menu complies with the signal channel actually used.
(2) Check the trigger type: general signals should use “Edge” trigger and video signal should use “Video” trigger. Only when the proper trigger type is used, can the waveform be displayed stably.
(3) Switch the **Coupling** mode to “LF Reject” or turn on “HF Reject” in order to filter out the low-frequency or high-frequency noise which disturbs the trigger.
(4) Modify the trigger sensitivity and trigger holdoff settings.

5. No display after pressing RUN/STOP:

Check whether the trigger mode in the trigger control area (TRIGGER) at the front panel is “Normal” or “Single” and whether the trigger level exceeds the waveform range. If yes, set the trigger level to the middle or press **MODE** to set the trigger mode to “Auto”.
Note: Using **AUTO** could automatically finish the above setting.

6. The display speed becomes slow when average acquisition mode is turned on:

Normal phenomenon.

7. The display of waveform is ladder-like:

(1) Normal phenomenon. The horizontal time base might be too low. Increase the horizontal time base to increase the horizontal resolution and improve the display.
(2) If the display **Type** is **Vectors**, the lines between the sample points may cause ladder-like display. Set the display **Type** to **Dots** to solve the problem.

8. Unable to connect to PC or the PictBridge printer by USB:

(1) If "Unknown device" is displayed or the PC prompts that scanner or camera is found when connecting to the PC, **USB Device** in **I/O Setting** under **Utility** might be set to **PictBridge**. Please switch it to **Auto Detect** or **Computer**. If necessary, restart the oscilloscope.
(2) If PictBridge printer connection fails or the printer cannot work normally, **USB Device** in **I/O Setting** under **Utility** might be set to **Computer**. Please switch it to **Auto Detect** or **PictBridge**. If necessary, restart the oscilloscope.

Chapter 7 Replaceable Parts

RIGOL provides some replaceable parts for users in order to maintain or update the instrument. For the details, please refer to Figure 7-1 and Table 7-1. Note that the numbers in the figure correspond to those in the table.

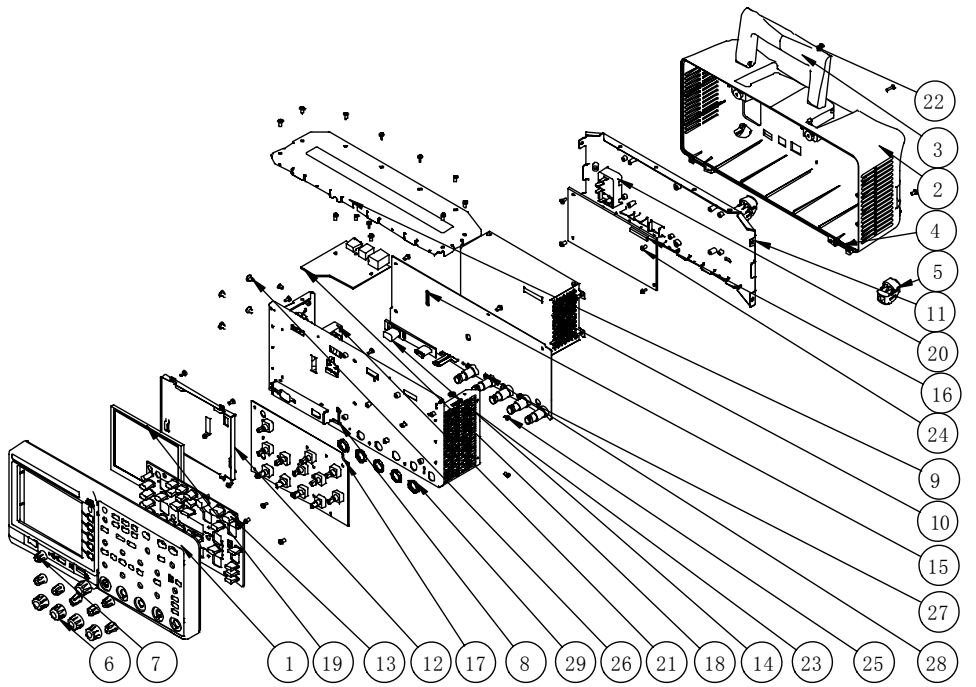


Figure 7-1 DS1000B Exploded View

Table 7-1 Replaceable Part List

No.	Part Name	Specification
1	DS1000B Panel	
2	DS1000B Cover	
3	DS1000B Handle	
4	DS1000B Front Supporting Leg	
5	DS1000B Rear Supporting Leg	
6	DS1000B Large Knob	
7	DS1000B Small Knob	
8	DS1000B Chassis	
9	DS1000B Upper Cover	
10	DS1000B Power Shield Cover	
11	DS1000B Rear Cover	
12	LCD Fixing Frame	
13	DS1000B Rubber Key	
14	DS1000B Power Key	

15	DS1000B Main Board	
16	Power Board	
17	Keyboard	
18	LAN Board	
19	LCD	
20	DS1000B Power Socket (With Cable)	
21	Fan	60mm×60mm×15mm DC12V/0.16A/5000RPM
22	Screw	M3*10 pan head torx machine screw
23	Screw	M3*8 pan head torx cutting self-tapping screw
24	Screw	M3*6 pan head torx composite machine screw with plain washer
25	Screw	M3*6 countersunk head torx machine screw
26	Screw	M5*10 countersunk head torx cutting self-tapping screws
27	Copper Stud M3H8	
28	Nut	M3 hexagon nut with locking plate
29	BNC Nut	

Chapter 8 Service&Support

Topics of this chapter:

- Warranty
- Worry-free Support Plan
- General Care and Cleaning

Warranty

RIGOL warrants that its products mainframe and accessories will be free from defects in materials and workmanship within the warranty period.

If a product is proven to be defective within the respective period, **RIGOL** guarantees the free replacement or repair of products which are approved defective. To get repair service, please contact with your nearest **RIGOL** sales and service office.

RIGOL does not provide other warranty items except the one being provided by this warranty statement. The warranty items include but not being subjected to the hint guarantee items related to tradable characteristic and any particular purpose. **RIGOL** will not take any responsibility in cases regarding to indirect, particular and ensuing damage.

Worry-free Support Plan

1. Worry-free Maintemance Plan (MP)

In addition to the standard warranty service, **RIGOL** also provide free maintemance service for products damaged due to the following reasons.

(1) Non-personal accidental damage (such as: accidental fall-down and deformations due to extrusion).
(2) Surface part damage or loss (such as: knob loss).
(3) Unauthorized disassemble of the instrument and removal of the product warranty seal.
(4) Product damage due to non-personal violent factors (such as: accidental high-voltage input).

Service Code	Service Period	Explanation
MP3	Within standard warranty period	Enjoy the worry-free maintenance service since the date of perchase until the end of the standard warranty period
MP4	Within 1 year after the standard warranty period expires	Enjoy the worry-free maintenance service within 1 year after the standard warranty period expires
MP5	Within 2 years after the standard warranty period expires	Enjoy the worry-free maintenance service within 2 years after the standard warranty period expires

2. Worry-free Extended Warranty Plan (EP)

After the standard warranty period expires, users can extend the warranty period of the product through the worry-free extended warranty plan. Limited free maintenances will be provided within the warranty period according to **RIGOL** warranty explanations.

Service Code	Service Period	Explanation
EP1	Within 1 year after the standard warranty period expires	Extend the standard warranty period for 1 year
EP2	Within 2 years after the standard warranty period expires	Extend the standard warranty period for 2 years

3. Worry-free Calibration Plan (CP)

(1) Company level calibration plan: check and calibrate the instrument according to the product pre-delivery standard of **RIGOL** and provide traceable

calibration report that meets the national standards.

(2) Measurement level calibration plan: check and calibrate the instrument according to the product pre-delivery standard of **RIGOL**; while at the same time, perform measurements on the product by national level 1 measurement organization and provide calibration report that meets the national standards and is traceable to the national measurement standard (NMS).

Service Code	Service Period	Explanation
CPC3	3 years	Enjoy company level calibration service according to the recommended calibration period of **RIGOL** since the date of perchase
CPV3	3 years	Enjoy measurement level calibration service according to the recommended calibration period of **RIGOL** since the date of perchase

General Care and Cleaning

General Care

Do not store or leave the instrument where it may be exposed to direct sunlight for long periods of time.

Cleaning

Clean the instrument regularly according to its operating conditions. To clean the exterior surface, perform the following steps:

1. Disconnect the instrument from all power sources.
2. Clean the loose dust on the outside of the instrument with a lint-free cloth (with a mild detergent or water). When cleaning the LCD, take care to avoid scarifying it.

CAUTION
To avoid damage to the instrument, do not expose it to caustic liquids.

WARNING
To avoid injury resulting from short circuit, make sure the instrument is completely dry before reconnecting to a power source.

Appendix Test Record Form

RIGOL DS1000B Series Digital Oscilloscope
Performance Verification Test Record Form

Model:_____ Tested by:_____ Test Date:_____

Impedance Test

CH1 to CH4:

Channel	Vertical Scale	Test Result	Limit	Pass/Fail
CH1	100 mV/div		0.98 MΩ to 1.02 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			

External Trigger Channel:

Channel	Input Impedance	Test Result	Limit	Pass/Fail
EXT TRIG	1 MΩ		0.98 MΩ to 1.02 MΩ	

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					

DC Gain Accuracy Test (continue)

Channel	Vertical Scale	Test Result			Limit	Pass/Fail
		Vavg1	Vavg2	Calculation Result[1]		
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					
CH3	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					
CH4	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) - (Vout1 - Vout2)|/Full Scale × 100%; wherein, Vout1 and Vout2 are 3 × the current vertical scale and -3 × the current vertical scale respectively.

Bandwidth Test

Channel	Vertical Scale	Test Result			Limit	Pass /Fail
		Vrms1	Vrms2	Amplitude Loss[1]		
CH1	100 mV/div				-3 dB to 3 dB	
	200 mV/div					
	500 mV/div					
CH2	100 mV/div					
	200 mV/div					
	500 mV/div					
CH3	100 mV/div					
	200 mV/div					
	500 mV/div					
CH4	100 mV/div					
	200 mV/div					
	500 mV/div					

Note [1]: Amplitude Loss (dB) = 20 × lg (Vrms2/Vrms1).

Bandwidth Limit Test

Channel	Vertical Scale	Test Result			Calculation Result		Limit	Pass/ Fail
		Vrms1	Vrms2	Vrms3				
CH1	100 mV/div				Amplitude Loss A1[1]		-3 dB to 0 dB	
					Amplitude Loss A2[2]		≤-3 dB	
	200 mV/div				Amplitude Loss A1[1]		-3 dB to 0 dB	
					Amplitude Loss A2[2]		≤-3 dB	
	500 mV/div				Amplitude Loss A1[1]		-3 dB to 0 dB	
					Amplitude Loss A2[2]		≤-3 dB	
CH2	100 mV/div				Amplitude Loss A1[1]		-3 dB to 0 dB	
					Amplitude Loss A2[2]		≤-3 dB	
	200 mV/div				Amplitude Loss A1[1]		-3 dB to 0 dB	
					Amplitude Loss A2[2]		≤-3 dB	
	500 mV/div				Amplitude Loss A1[1]		-3 dB to 0 dB	
					Amplitude Loss A2[2]		≤-3 dB	

Bandwidth Limit Test (continue)

Channel	Vertical Scale	Test Result			Calculation Result		Limit	Pass/ Fail
		Vrms1	Vrms2	Vrms3				
CH3	100 mV/div				Amplitude Loss A1[1]		-3 dB to 0 dB	
					Amplitude Loss A2[2]		≤-3 dB	
	200 mV/div				Amplitude Loss A1[1]		-3 dB to 0 dB	
					Amplitude Loss A2[2]		≤-3 dB	
	500 mV/div				Amplitude Loss A1[1]		-3 dB to 0 dB	
					Amplitude Loss A2[2]		≤-3 dB	
CH4	100 mV/div				Amplitude Loss A1[1]		-3 dB to 0 dB	
					Amplitude Loss A2[2]		≤-3 dB	
	200 mV/div				Amplitude Loss A1[1]		-3 dB to 0 dB	
					Amplitude Loss A2[2]		≤-3 dB	
	500 mV/div				Amplitude Loss A1[1]		-3 dB to 0 dB	
					Amplitude Loss A2[2]		≤-3 dB	

Note [1]: Amplitude Loss A1 (dB) = 20 × lg (Vrms2/Vrms1).
Note [2]: Amplitude Loss A2 (dB) = 20 × lg (Vrms3/Vrms1).

Time Base Accuracy Test

Channel	Test Result ΔT	Calculation Result[1]	Limit	Pass/Fail
CH1			≤ ±50 ppm	

Note: Calculation Result = Test Result ΔT/1 ms.

Zero Point Offset Test

Channel	Fast Edge Signal Amplitude	Vertical Scale	Test Result	Limit	Pass/Fail
CH1	1.2 Vpp	200 mV/div		≤ 0.5 div ×Minimum Time Base Scale[1]	
	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			

Note[1]: For different models of oscilloscopes under test, the minimum time base scales are different. For DS1204B, the minimum time base scale is 1 ns/div; for DS1104B, the minimum time base scale is 2 ns/div; for DS1074B, the minimum time base scale is 5 ns/div

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