User's Guide

RIGOL

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PA1000 Series Power Amplifier

Copyright Information

Safety Notices

Please review the following safety precautions carefully before using your new amplifier to avoid any personal injuries or damages to the instrument and products connected with.

The instrument should be serviced by qualified personnel only.

Please avoid Fire or Personal Injury.

Use Proper Power Cord. Use the power cord only designed for the instrument and authorized in your country.

Ground The Instrument. The power grounding conductor(s) of the instrument must be grounded properly before any connection to the input or output terminals of the amplifier in order to avoid electric shock.

Observe All Terminal Ratings. To avoid fire or shock hazard, please check all ratings and marks on the instrument, and refer this guide for further ratings information before any connection.

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

Avoid Circuit or Wire Exposure. Do not touch exposed connections and components when the power is on.

Do Not Operate With Suspected Failures. If suspected damage occurs with the instrument, have it inspected by qualified service personnel before further operations.

Keep Proper Ventilation.

Do Not Operate in Wet/Damp Conditions.

Do Not Operate in an Explosive atmosphere.

Keep Product Surfaces Clean and Dry.

Safety Terms and Symbols

Safety Notices in this Manual:

WARNING

Indicates a potentially hazardous situation or practice which, if not avoided, will result in serious injury or death.

CAUTION

Indicates a potentially hazardous situation or practice which, if not avoided, could result in damage to the product or loss of important data.

Safety Terms 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.

Safety Symbols on the Product:

Hazardous Voltage

Safety Warning

Protective Earth Terminal

Chassis Ground

Test Ground

PA1000 Power Amplifier Introduction

The amplifier is one of the options provided for RIGOL DG Series Function/Arbitrary Waveform Generators, with up to 1MHz full power bandwidth and higher than 80 V/μs slew rate, which can be used in fast constructions of a test platform in connection with all DG series products, and as a single power amplifier in coordination with other generators.

The power amplifier at present available in this series is PA1011.

Features:

- Easily and neatly communicate with DG and PC software through the USB interface;
- Enables to set the Gain (x1 or x10), Polarity (Invert or Normal), Output offset and the output status in connection with its software;
- Up to 50kΩ output impedance;
- The integrated output protection circuit (overcurrent protection and internal temperature abnormal protection) provided with ensures the instrument is working stably and safely;
- Compact size, easy to carry and use.

Document Overview

1 Quick Start

Guide you how to operate the front/rear panel and the user interface of PA1011 as well as the preparation works for the first time.

2 Operations

Give detailed information about how to operate the user interface of PA1011 and to set the output state of the instrument.

3 Application Examples

Introduce you the PA1011 functions and features by some examples.

4 Troubleshooting

Show some possible failures or faults in using the product as well as the corresponding trouble shootings.

5 Characteristics and Specifications

List the working curves and characteristics of the amplifier.

6 Appendix

Information about the accessories, warranties, services, supports and so on.

Contents

Chapter 1 Quick Start

This chapter guides you how to operate the front/rear panel and the user interface of PA1011 as well as some preparation works when you first use the instrument.

General Inspection

Please inspect the Power Amplifier carefully following the guidelines below as soon as you get it.

1. **Inspect the packaging**
   If the packaging has been damaged, do not dispose the damaged packaging or cushioning materials until the shipment has been checked for completeness and has passed both electrical and mechanical tests.
   The consigner or carrier shall be liable for the damage to the instrument resulting from shipment. **RIGOL** would not be responsible for free maintenance/rework or replacement of the instrument.
2. **Inspect the instrument**
   In case of any mechanical damage, missing parts, or failure in passing the electrical and mechanical tests, contact your **RIGOL** sales representative.
3. **Check the accessories**
   Please check the accessories according to the packing lists. If the accessories are damaged or incomplete, please contact your **RIGOL** sales representative.

Front Panel

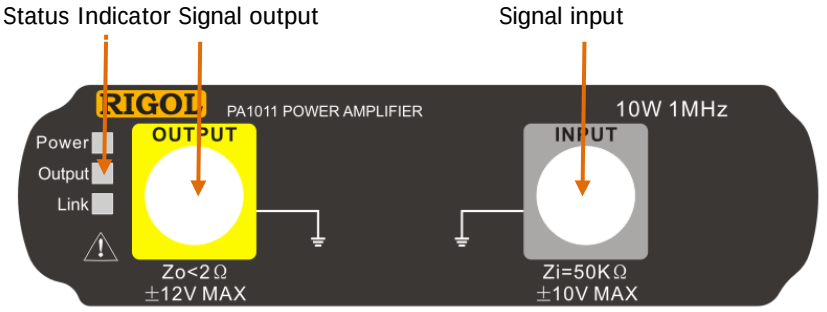


Figure 1-1 PA1011 View of Front Panel

CAUTION

The input impedance of the instrument Zi is 50kΩ, and the range of voltage is -10V~+10V or -1.25V~+1.25V separately while the voltage gain is set to X1 or X10.

The inputs exceed these ranges may cause damages to the instrument or other hazards.

CAUTION

The output impedance of the instrument Zo is less than 2Ω, and the range of output voltage is -12V~+12V. Although the amplifier actually enables to output voltages up to ± 12.5V, it may increase the total wave harmonic distortion.

Status Indicator

Power: On Red, indicating the successful power supply to the instrument.
Output: On Green, indicating the output is on.
Link: On Yellow, indicating the successful connection between USB device and the instrument.

Rear Panel

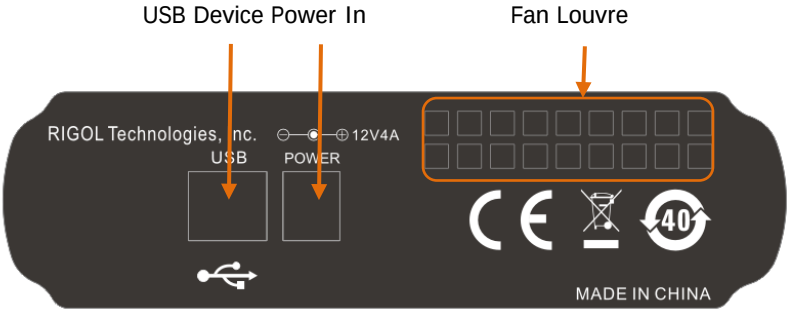


Figure 1-2 View of Rear Panel

1. Power In

Please plug with AC (12V, 4A) using the power cord provided in the accessories.

CAUTION

Do not use any other adapters to supply power for the PA1011, or else it may cause degradation or perpetual damage.

2. USB Device

Connect the PA1011 to PC with the USB data cable.

CAUTION

Please make sure the vents at both sides and the fan aperture at the rear panel are visible in operation for normal working.

User Interface

Figure 1-3 User Interface of PA1011

See figure above, the user interface is a soft panel shown in the computer, users can select or set desired parameters and output status for the instrument by using the keyboard and mouse.

Installation

The PA1011 Power Amplifier consists of two components: the control software and the instrument module. Please correctly connect them together as following steps before use:

1. Software Installation

Log in to **RIGOL** official website (www.rigol.com), and then click **Product** to select any one of the DG series from the Function/Arbitrary Waveform Generator menu to enter the webpage of the specified product. At the right section of the webpage, select PA1000 Software under "Software Download" to download the software for PA1011 Power Amplifier.

(1) If the Labview has already been installed in your computer, please go to next step directly; if not, double click the file **lv82runtime.msi** to install it.

(2) If the NI Visa library has already been installed, please go to next step directly; if not, double click the file **NIVISAruntime.msi** to install it.

(3) Right click the file **PA1000.inf** and select “Install” from the pop-up menu.

(4) Run **PA1000Control.exe** directly after the device is well connected. (see follows)

2. Power on

Plug with AC power using the power cord provided in the accessories and turn on the instrument.

3. USB Connection and Driver Installation

Connect the instrument with computer using the USB data cable provided in the accessories. A Hardware Wizard dialog box will pop up to guide you to install the USB driver when connection succeeds for the first time.

Figure 1-4 Pop-up Dialog Box

Select “No, not this time” and click “Next” to enter the interface below:

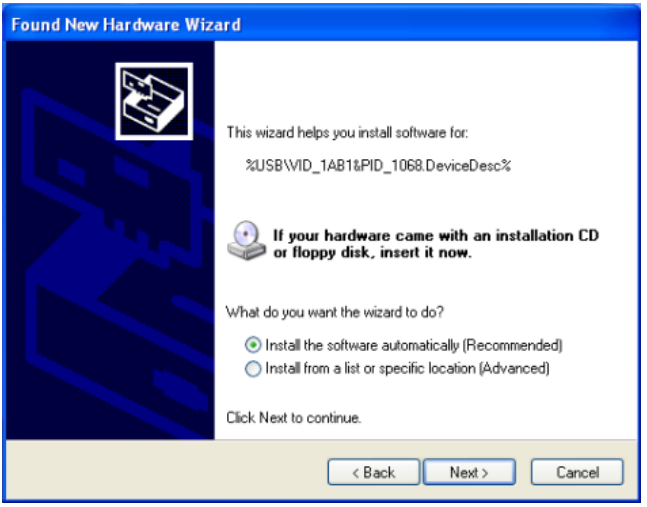


Figure 1-5 Select to Install the Driver Automatically

Click “Next” to enter the interface below:

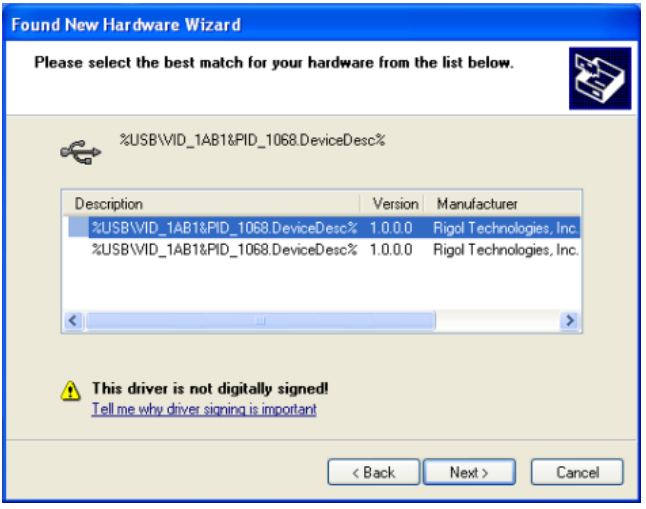


Figure 1-6 Select the Desired Driver

Click “Next” to enter the interface below:

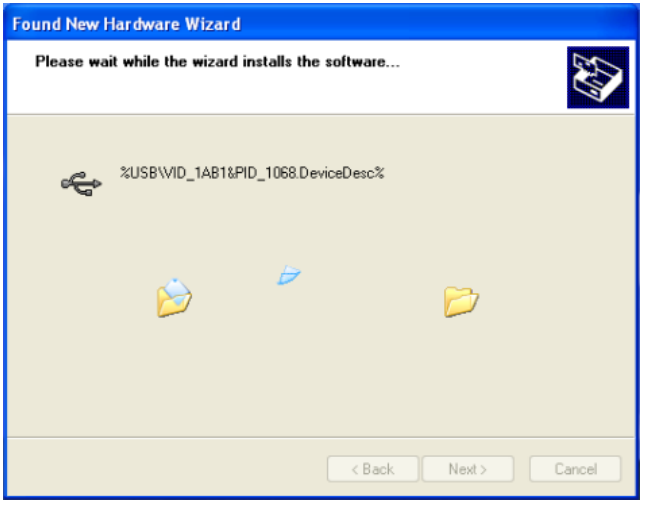


Figure 1-7 Install the Driver

The figure below will be shown after successful installation:

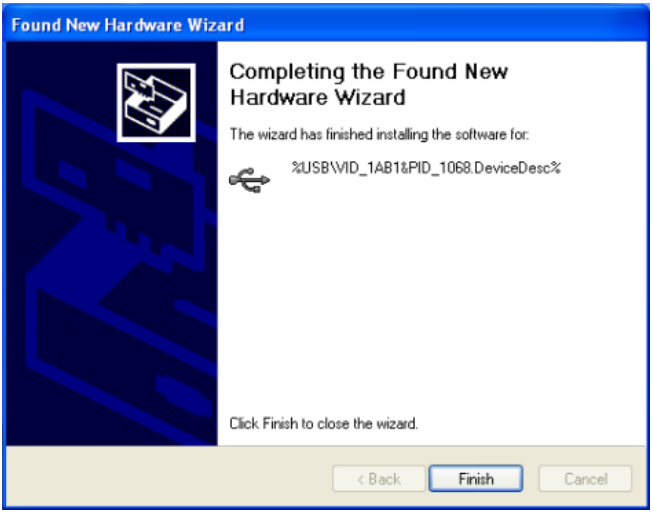


Figure 1-8 Finish the Installation

After all above steps have been completed, you can use PA1011 to begin your work. For more operations, refer to Chapter 2.

Note

The instrument should be powered on before USB cable connection if you want to control the instrument by software. Wrong procedures may cause malfunction.

Chapter 2 Operations

How to Set the Output Status

See Figure 2-1, there are four groups of button on the panel, which separately represents a set of status parameter. Choose the one you want from each group and click “Send” to transmit these new settings into PA1011.

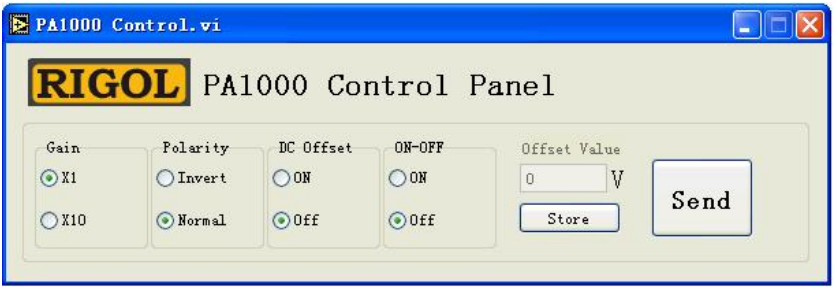


Figure 2-1 Control Panel

For the details of each selection on the control panel of PA1011, see table below:

Button	Setup	Explanation
Gain	X1, X10	Sets the output gain. The input range of signals is different in different gain setting.
Polarity	Invert Normal	Sets the desired output polarity.
DC Offset	ON, OFF	Turns on/off the offset setting.
ON-OFF	ON, OFF	Enables or disables the output.

Store		Saves the working state that has been transmitted currently.
Send		Transmits the state settings from the control panel into the instrument.

The input box at the right side of control panel is available only when DC Offset is On.
The offset unit is V, the setting range is -12V to +12V and the default is 0V.

How to Save the Instrument State

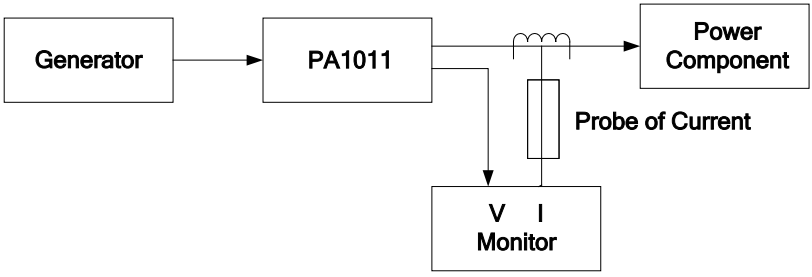
Click “Store” to save the current working state, and the instrument will start with the last stored working status automatically.

Note: The state saved here is actually the current working state of PA (status sent last time), but not for the options selected on the current control panel.

Chapter 3 Application Examples

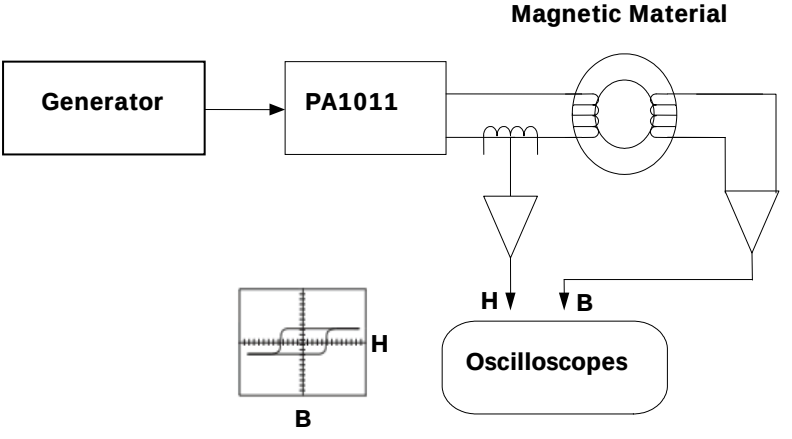
Power Component Measurements

PA1011 could be used as the power amplifier of a generator to evaluate the performance of a power component. In virtue of its wide
Bandwidth and High speed output, users can evaluate or test the components through various waves, pulses and arbitrary waves. See the measurement system of a power component below:



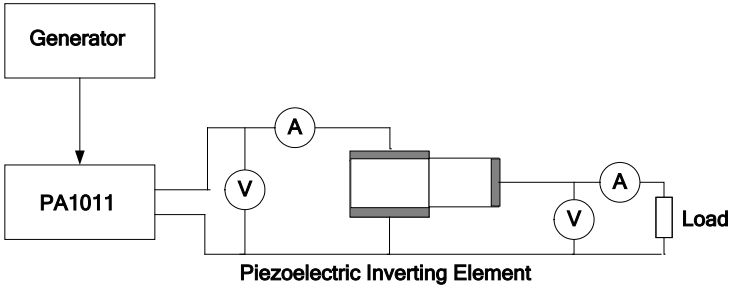
Magnetization Characteristic Measurements

PA1011 can measure the magnetization characteristic (B-H curve) of magnetic material (10W driver, with additional impedance transformer), such as the ferrite or amorphous material etc.



Act as Driver of Piezoelectric Element

Besides, PA1011 could also be used as the driver of piezoelectric element (10W driver, with additional impedance transformer). Particularly the piezoelectric element with higher electrostatic capacity (up to 1000pF), better step responses are gainable from the PA1011 because of its tiny output impedance.



Furthermore, PA1011 could also be used as the driver amplifier in research and development or experiment of other technologies.

Chapter 4 Troubleshooting

This chapter lists some troubles that may occur when you use the power amplifier and the corresponding solutions. Please follow the appropriate steps to deal with; if the trouble still exists, please contact **RIGOL** for help.

1. **No response to the instrument when click "Send" on the control panel of software after power-on:**
   (1) Check if the power is correctly connected;
   (2) Check if the contact of USB data line is good;
   (3) After above checks, restart the instrument;
   (4) If it still cannot work properly, please contact your local **RIGOL** Support center.

2. **Circuit Protection**
   The instrument will start Overcurrent protection or Overtemperature protection once the output current is too high or the internal temperature of PA1011 is abnormal (Overtemperature) to avoid damages.

   The phenomenon of Circuit Protection is:
   - Overcurrent: The output relay is cutoff, and the yellow light is flashing.
   - Overtemperature: The output relay is cutoff, and the green light is flashing.

   PA1011 must be restarted after the Circuit Protection is launched.

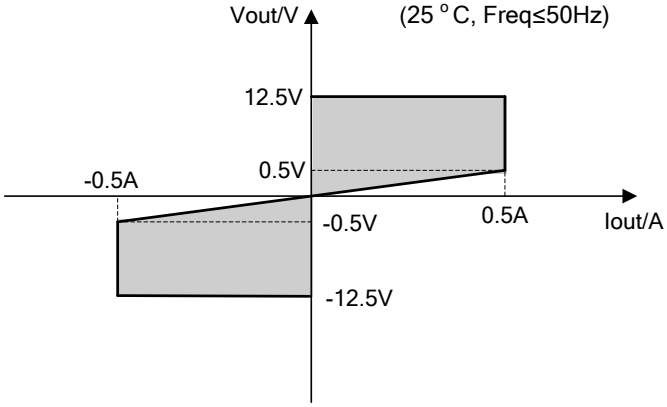
We kindly suggest you to inspect the load of PA1011 or the ambient temperature and make sure both of these specifications are within the prescribed limits when the Circuit Protection is on.

Chapter 5 Characteristics and Specifications

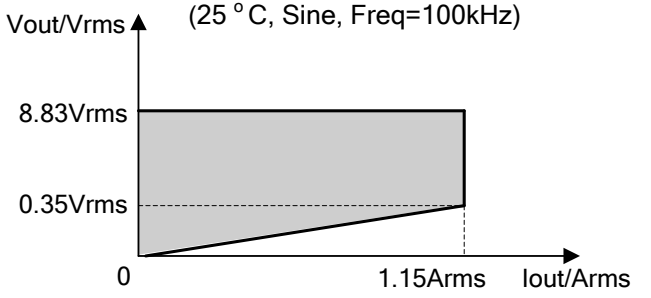
Safety Curves

Please observe the curves below carefully and ensure your PA1011 works within the range of shaded areas to avoid degradation or damages to the instrument.

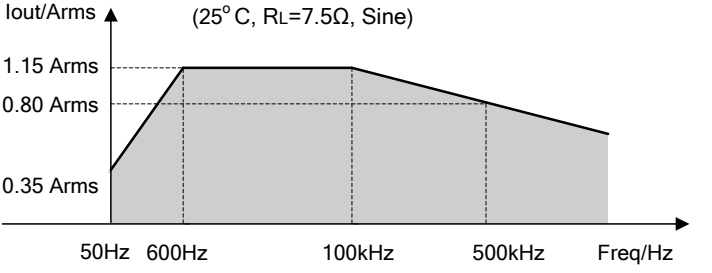
1. DC Working Range



2. AC Working Range

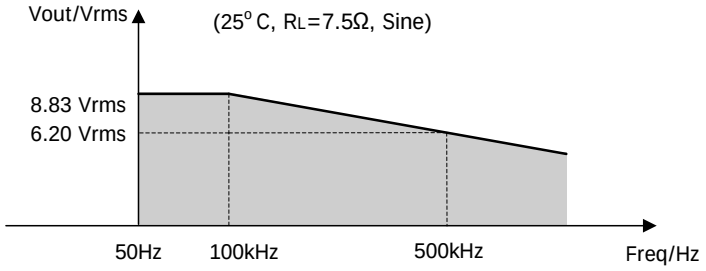


3. Relationships between the Output current and the Working frequency



4. Relationships between the Output voltage and the Working frequency 【Remark】

If signals input is increasing in frequency (>100 kHz), you are suggested to reduce its amplitude. Please follow the relationship between output voltage and working frequency below when signals are input, in order to maintain the output voltage of PA1011 within curves.



【Remark】: The key parameters which determine the performance of the amplifier are Slew Rate and the Heat Extraction when a signal with high amplitude is input. Along with the frequency increase of the input signal, the working current and the power consumption of the instrument without loads as well as the signal distortion will be increased that may heat the amplifier and reduce the performance. Thus, we set limits on the relationships between the frequency and the amplitude of output signals which have high amplitude.

Specifications

All specifications listed in the table below can be met under following two conditions unless where noted:

- The instrument has been continuously operated for 30 minutes at the stated temperature.
- All the specifications are guaranteed except for the one marked "typical".

Signal Input	
Input Impedance	50kΩ
Internal Bias (equivalent at the output terminals)	+/-12V
External Input	+/-10Vmax (Gain: X1) +/-1.25Vmax (Gain: X10)
Amplifier	
Working Mode	Constant Voltage
Gain	Switching in 10V/1V and 10V/10V (DC Gain error: <5%)
Polarity Switching	Normal/Invert
Virtual Value of Sine Output Power (RL=7.5Ω)	10W (typical, input: Sine, 100kHz, X10)
Output Voltage	12.5Vpeak (output: Sine, 100kHz)
Output Current	1.65Apeak (input: Sine, 100kHz)
Output Impedance	<2Ω
Full Power Bandwidth	DC~1MHz[Remark1]

Slew Rate	≥80V/μs (typical) 【Remark2】
Overshoot	<7%
Bias Voltage	
Gained Error	5%±100mV
Others	
Power Supply	DC 12V±5%, 4Apeak
Output Protection	Output Overcurrent protection, internal temperature abnormal protection
Working Temperature	0 ℃～+35 ℃ 【Remark3】
Dimension(W×H×D)	142.2mm×48.1mm×215.4mm
Net Weight	850g±20g

【Remark 1】 The Full-power bandwidth refers to the maximum frequency of signal generated with undistorted and utmost amplitude in AC output state from the Amplifier.

$$FPB = \frac{SR}{2\pi V_{\max}}$$

SR: Slew Rate

Vmax: Maximum undistorted output amplitude

【Remark 2】 Slew Rate: When you send a large step signal to the amplifier, the output slope of signal will be stable as a constant at some certain point; this constant is named Slew Rate.

【Remark 3】 All above specifications are formed at 25 ℃, the working temperature is between 0 ℃～+35 ℃. Reduce the output power and the working frequency of PA1011 when the ambient temperature exceeds 35 ℃.

Chapter 6 Appendix

Appendix A: Accessories

Standards:

- A Power Cord that fits the standard of destination country
- An AC Adapter that fits the local standards
- A USB Data Cable
- A User's Guide (Hard Copy)
- BNC cable

All the accessories below can be ordered from your local **RIGOL** office.

Appendix B: Warranty

RIGOL TECHNOLOGIES, INC. (hereinafter referred to as **RIGOL**) warrants that the product will be free from defects in materials and workmanship within the warranty period. If a product proves defective within the warranty period, **RIGOL** guarantees free replacement or repair for the defective product.

To get repair service, please contact with your nearest **RIGOL** sales or service office.

There is no other warranty, expressed or implied, except such as is expressly set forth herein or other applicable warranty card. There is no implied warranty of merchantability or fitness for a particular purpose. Under no circumstances shall **RIGOL** be liable for any consequential, indirect, ensuing, or special damages for any breach of warranty in any case.

Appendix C: Care and Cleaning

General Care

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

CAUTION
To avoid damage to the instrument, do not expose it to sprays, liquids, or solvents.

Cleaning

To clean the exterior surface, perform the following steps:

1. Remove loose dust on the outside of the instrument with a lint-free cloth. Take care to avoid scratching the clear plastic display filter.
2. Use a soft damp cloth to clean the instrument.

WARNING: Make sure the instrument is completely dry before power again.

Appendix D: Contact Us

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

用户手册

RIGOL

文件编号 UGF01004-1110
2017 年 05 月

PA1000 系列功率放大器

版权信息

一般安全概要

了解下列安全性预防措施，以避免受伤，并防止损坏本产品或与本产品连接的任何产品。为避免可能的危险，请务必按照规定使用本产品。

只有授权人员才能执行维修程序。

避免起火和人身伤害。

使用正确的电源线。
只允许使用所在国家认可的本产品专用电源线。

将产品接地。
本产品通过电源的接地导线接地。为避免电击，接地导体必须与地相连。在连接本产品的输入或输出端之前，请务必将本产品正确接地。

查看所有终端额定值。
为避免起火和过大电流的冲击，请查看产品上所有的额定值和标记说明，请在连接产品前查阅产品手册以了解额定值的详细信息。

请勿开盖操作。
外盖或面板打开时，请勿运行本产品。

避免电路外露。
电源接通后，请勿接触外露的接头和元件。

怀疑产品出故障时，请勿进行操作。
如果您怀疑本产品已经出故障，可请 **RIGOL** 授权的专业维修人员进行检查。

保持适当的通风。

请勿在潮湿环境下操作。

请勿在易燃易爆的环境下操作。

请保持产品表面的清洁和干燥。

安全术语和符号

本手册中的安全术语：

警告

警告性声明指出可能会造成人身伤害或危及生命安全的情况或操作。

注意

注意性声明指出可能导致本产品损坏或数据丢失的情况或操作。

产品上的安全术语：

DANGER 表示您如果不进行此操作，可能会立即对您造成危害。

WARNING 表示您如果不进行此操作，可能会对您造成潜在的危害。

CAUTION 表示您如果不进行此操作，可能会对本产品或连接到本产品的其他设备造成损坏。

产品上的安全符号：

高电压　安全警告　保护性接地端　壳体接地端　测量接地端

PA1000 功率放大器简介

PA1000 系列功率放大模块是 **RIGOL** 公司 DG 系列函数/任意波形发生器的一款选配附件。它的全功率带宽高达 1MHz，输出摆率 Slew Rate 大于 80V/μs；它既可以和 DG 全系列产品连接从而快速地搭建测试平台，又可以作为单独的功率放大器配合其他的信号源使用。

目前提供的 PA1000 系列功率放大器型号为：PA1011。

PA1011 具有以下性能特色：

- 通过 USB 接口和 **RIGOL** DG 系列信号发生器或 PC 上位机通讯，操作灵活，简单；
- 配合上位机软件用户可以灵活的设置放大器的增益（X1 或 X10）、极性（同相或反相）、输出偏移和输出开关。
- 具有 50kΩ 的高输入阻抗；
- 完整的输出保护电路（输出过流保护、内部温度异常保护），确保仪器稳定、可靠、安全的工作；
- 体积小巧，便于携带，使用方便；

文档概述

1 快速入门

本章介绍 PA1011 功率放大器的前后面板和用户界面，以及首次使用仪器时的准备工作。

2 操作指南

本章详细介绍如何操作 PA1011 的用户界面，以及如何设置仪器的输出状态。

3 应用举例

本章通过实例更直观地介绍 PA1011 的功能和特点。

4 故障处理

本章列举了功率放大器使用过程中可能出现的故障及处理方法。

5 性能指标

本章介绍了功率放大器的工作曲线和性能指标。

6 附录

本章列举了 PA1011 的附件并提供服务与支持的相关信息。

目 录

第1章 快速入门

本章介绍 PA1011 功率放大器的前后面板和用户界面，以及首次使用仪器时的准备工作。

一般性检查

当您得到一套新的 PA1011 功率放大器，请按以下步骤进行检查。

1. 检查是否存在因运输造成的损坏

请保留被损坏的货运包装或防震材料，直到货物经过完全检查且仪器通过电性和机械测试。

如果因运输造成仪器损坏，请通知运输部门和负责此业务的**RIGOL**经销商，**RIGOL**会安排维修或更换。

2. 检查仪器

若有机械损坏或缺失，或者仪器未通过电性和机械测试，请告知您的**RIGOL**经销商。

3. 检查附件

关于随机提供的附件明细，请参考本手册中的**“附录A：附件”**一节。若包装中内容有缺失或损坏请告知您的**RIGOL**经销商。

前面板

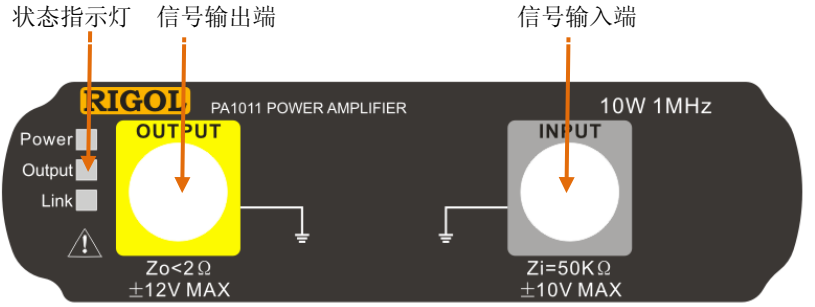


图 1-1 PA1011 前面板视图

注意

仪器输入阻抗 Zi=50kΩ，电压增益为 X1 时输入电压范围为：-10V~+10V；电压增益为 X10 时输入电压范围为：-1.25V~+1.25V，超出此范围的输入可能损坏仪器或发生危险。

注意

仪器输出阻抗 Zo<2Ω，输出电压范围为-12V~+12V。实际输出电压可以达到±12.5V，但波形的总谐波失真会增加。

状态指示灯

Power：红灯亮，表示电源连接成功。
Output：绿灯亮，表示输出开关已打开。
Link：黄灯亮，表示USB连接成功。

后面板

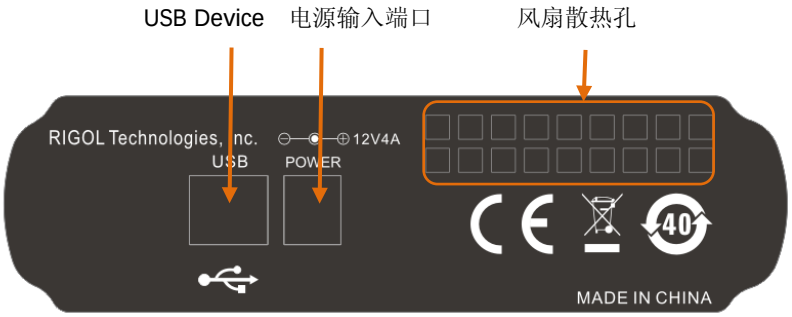


图 1-2 PA1011 后面板视图

1. 电源输入端口

请使用附件提供的电源线连接该端口，电源输入为 12V，4A 的信号。

注意

请勿使用其它输出类型的适配器给 PA1011 供电，否则会造成仪器性能下降或永久性损坏。

2. USB Device

通过 USB 数据线将 PA1011 与计算机相连。

注意

在操作 PA1011 时，请确认没有遮挡物遮住 PA1011 侧面的通风孔和后面板的风扇散热孔，以免影响其正常工作。

用户界面

图 1-3 PA1011 系列用户界面

如上图所示，PA1011 的用户界面是显示在计算机上的软面板，用户可通过计算机的键盘和鼠标来选择或设置仪器参数和输出状态。

设备安装

PA1011 功率放大器由上位机控制软件和仪器模块两部分组成，使用之前需进行软件安装和设备连接。具体操作步骤如下：

1. 软件安装

登陆 **RIGOL** 官网（www.rigol.com），从“产品”菜单中找到 DG 系列产品。点击任意一款 DG 系列产品进入相关产品页面，在页面右侧“软件下载”栏找到“PA1000 软件”，单击可下载 PA1000 上位机软件。

(1) 如果您的计算机上已安装 labview 软件，则直接进入第(2)步；如果未安装，则双击安装 lv82runtime.msi 文件。

(2) 如果您的机器上已安装 NI Visa 库，则直接进入第(3)步；如果未安装，则双击安装 NIVISAruntime.msi 文件。

(3) 鼠标右击 PA1000.inf 文件，在弹出菜单中选择“安装”。

(4) 参考下面的步骤 2 和步骤 3，连接设备后直接运行 PA1000Control.exe 即可。

2. 连接仪器电源

请使用附件提供的电源线连接仪器并给仪器上电。

3. USB 连接及驱动安装

请使用附件提供的 USB 数据线，将仪器与计算机进行通信连接。首次将仪器成功连接到计算机后，计算机画面会弹出硬件安装向导对话框，如下图所示：

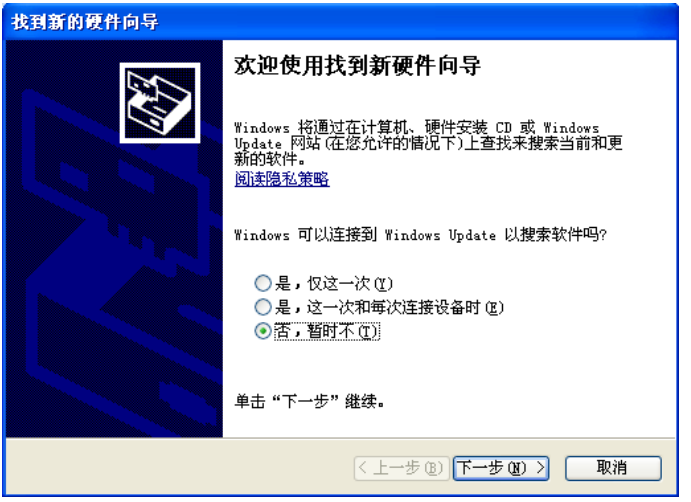


图 1-4 硬件安装向导对话框

请选择“否，暂时不”选项，然后点击“下一步”，进入下图所示对话框：

图 1-5 自动搜索硬件驱动

选择“下一步”，进入下图所示对话框：

图 1-6 找到硬件驱动

选择“下一步”，进入下图所示界面：

图 1-7 安装硬件驱动

成功安装硬件驱动后，将出现下图的提示：

图 1-8 成功安装硬件驱动

上述步骤完成后，您就可以使用 PA1011 工作了。具体的操作方法请参考第 2 章的介绍。

注意：

若要通过上位机控制仪器，需要先给 PA1011 上电，然后连接 USB 数据线。如果先连接 USB 数据线后给仪器上电，系统将无法正常工作。

第2章 操作指南

如何设置输出状态

如图 2-1 所示，PA1011 控制面板上有 4 个单选按钮，分别对应仪器的 4 个状态参数。设定这 4 个参数后，点击“发送”按钮，即可将当前设置的状态发送到 PA1011 仪器上。

图 2-1 PA1011 控制面板

PA1011 控制面板上各功能按钮的详细说明如下表所示。

功能按钮	功能设置	功能描述
增益选择	X1、X10	选择输出增益。不同增益下输入信号范围不同。
输出极性	同相输出 反相输出	选择输出极性。
偏移开关	打开、关闭	打开或关闭偏移量设置。
输出开关	打开、关闭	打开或关闭输出。
状态存储		保存当前已“发送”的工作状态。
发送		将控制面板上设置的状态参数发送到仪器中。

面板右侧的偏移输入框只有当选择“偏移开关”为“打开”时才有效。偏移量单位为“V”，默认值为 0V，可设置范围为-12V~+12V。

如何存储仪器状态

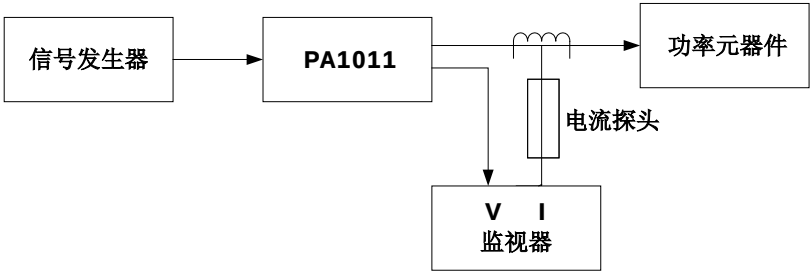
若需保存 PA1011 当前的工作状态，请点击“状态存储”按钮。下次开机时，PA1011 将自动设置成上次保存的工作状态。

注意：点击“状态存储”时，实际存储的是 PA1011 当前的工作状态（最后一次点“发送”按钮时的状态），而非控制面板当前所选择的状态。

第3章 应用举例

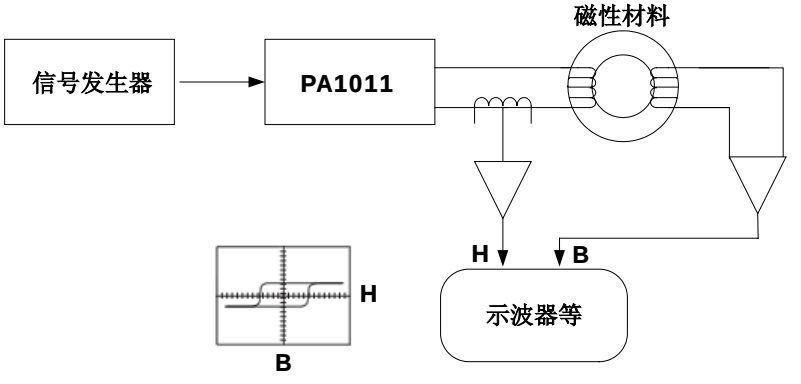
功率元器件的测量

PA1011 可作为信号发生器的功率放大器，评价功率元器件性能。利用 PA1011 的宽频带、高速输出性能，可用各种波形、各种脉冲模式、以及任意波形进行元器件的评价和测试。功率元器件的测量系统示意图如下所示：



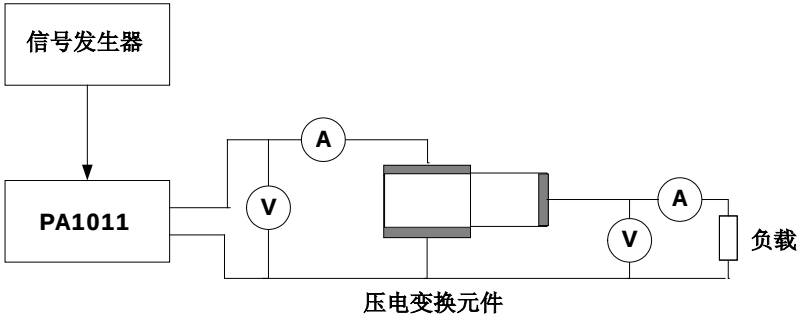
磁化特性的测量

PA1011 可用于磁性材料的磁化特性（B-H 曲线）测量（10W 驱动，附加阻抗变换变压器）。利用它可测量铁氧体和非晶型材料等磁性材料的 B-H 曲线。



压电元件的驱动

PA1011 可做为压电元件的驱动（10W 驱动，附加阻抗变换变压器）。PA1011 输出的阻抗极小，所以静电容量很大（高至 1000pF）的压电元件也能得到良好的阶跃响应。



此外，PA1011 还可用于其他技术领域的研究开发以及实验的驱动放大器。

第4章 故障处理

本章列举了功率放大器在使用过程中可能出现的故障及其处理方法。当您遇到这些故障时，请按照相应的步骤进行处理，如果不能处理，请与 **RIGOL** 公司联系。

1. 连接电源和USB后，点击软件控制面板上的“发送”按钮后，仪器没有响应：

(1) 检查电源接头是否接触接好。
(2) 检查USB数据线是否接触良好。
(3) 做完上述检查后，重新启动仪器。
(4) 如果仍然无法正常使用本产品，请与**RIGOL**联络，让我们为您服务。

2. 保护电路

当输出电流过大或者PA1011内部温度异常（过高）时，仪器将自动启动过流保护和过温保护电路，以免损坏仪器。

保护电路动作的具体现象描述如下：

- 过流保护：输出继电器被切断，黄灯闪烁。
- 过温保护：输出继电器被切断，绿灯闪烁。

保护电路启动后，用户必须重启PA1011。

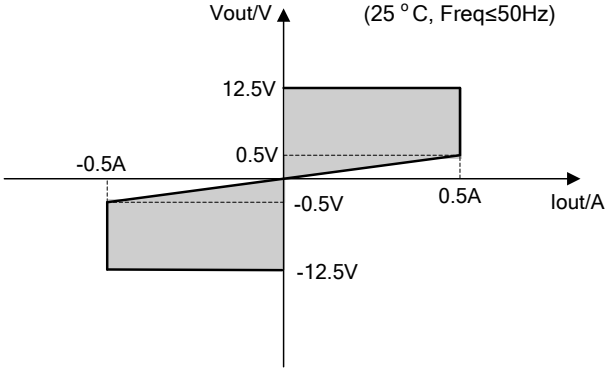
保护电路动作时，建议用户检查自己所接的负载是否超过PA1011的极限输出值，或者环境温度是否高于PA1011所规定的极限温度值。

第5章 性能指标

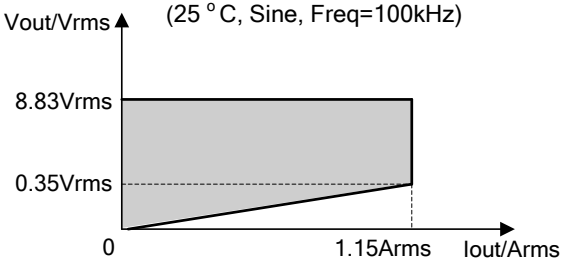
安全工作曲线

请用户仔细参考以下曲线，并确保在使用时使 PA1011 工作于以下曲线内（阴影部分），以防止 PA1011 性能下降或者出现设备损坏。

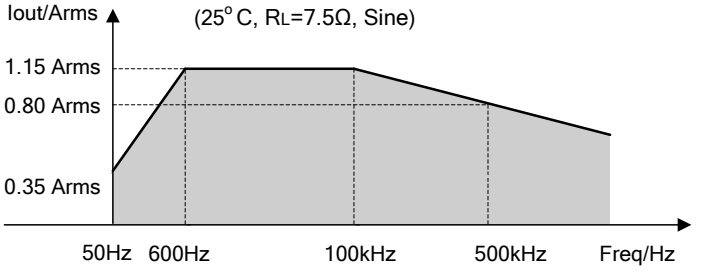
1. 直流工作区域



2. 交流工作区域

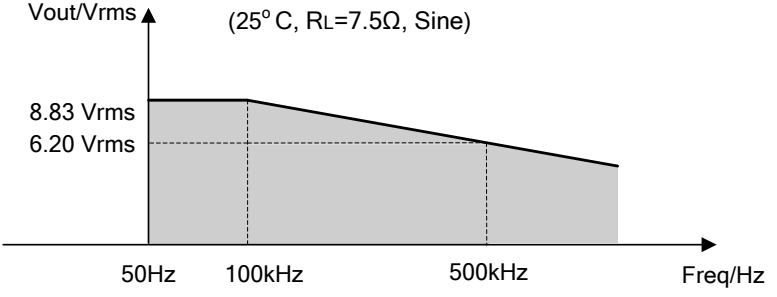


3. 输出电流与工作频率的关系



4. 输出电压与工作频率的关系【注】

当输入信号的频率增加（>100kHz），我们建议减小输入信号的幅值，使 PA1011 的输出信号也减小。请用户在输入信号时遵循如下图所示的输出电压与工作频率的关系曲线，以便使 PA1011 的输出电压在曲线区域内。



【注】当给放大器输入一个幅值很大的信号时，决定放大器性能的主要参数是 Slew Rate 及其散热条件。当输入大幅值信号的频率增加时，放大器即使在不带负载的时候其本身的工作电流、功耗也会随着输入信号频率的增加而增加，且信号的失真也会随着频率的增加而增加，从而造成放大器发热，性能下降，所以我们对 PA1011 的大幅值输入信号的频率和幅值的关系作了限制。

技术指标

除非另有说明，所有指标在下述两个条件下均能满足：

- 仪器必须在规定的操作温度下连续运行 30 分钟以上。
- 除标有“典型”字样的规格以外，所用规格都有保证。

信号输入	
输入阻抗	50kΩ
内置偏压（输出端等效）	+/-12V
外部输入	+/-10Vmax（增益：X1） +/-1.25Vmax（增益：X10）
放大器指标	
运行模式	恒定电压
增益	10V/1V、10V/10V 二档切换（直流增益误差：<5%）
极性切换	同相/反向
正弦输出功率有效值（RL=7.5Ω）	10W（典型值，输入 Sine，100kHz，X10）
输出电压	12.5Vpeak（输入 Sine，100kHz）
输出电流	1.65Apeak（输入 Sine，100kHz）
输出阻抗	<2 Ohm
全功率带宽	DC~1MHz【注 1】
输出摆率	≥80V/μs（典型值）【注 2】
过冲	<7%
偏压指标	
偏置电压增益误差	5%±100mV
其他	

电源	DC 12V±5%, 4Apeak
输出保护	输出过流保护、内部温度异常保护
操作温度	0 ℃～+35 ℃【注 3】
尺寸（宽×高×深）	142.2mm×48.1mm×215.4mm
净量	850g±20g

【注 1】：

全功率带宽指的是放大器能够产生具有最大可能幅度的无失真交流输出时的最大频率。

$$\text{全功率带宽 } FPB = \frac{SR}{2\pi V_{\max}}$$

SR：Slew Rate（输出摆率）

Vmax：放大器能够输出的最大无失真幅度

【注 2】：

输出摆率(Slew Rate)定义：给放大器输入一个大的阶跃信号，发现其信号输出斜率会在某处饱和成为一个固定常数，这个常数称为放大器的 Slew Rate。

【注 3】：

以上指标均为 25 ℃时的指标，PA1011 工作时的环境温度范围为 0 ℃～+35 ℃，当环境温度大于 35 ℃时建议用户降低输出功率和 PA1011 的工作频率。

第6章 附录

附录 A：附件

标准附件:

- 一根符合所在国标准的电源线
- 一个符合所在国安全认证标准的电源适配器
- 一根 USB 数据线
- 一份《产品保修卡》
- 一份《用户手册》
- BNC 电缆

注：所有附件均可向当地的 RIGOL 办事处订购。

附录 B：保修概要

北京普源精电科技有限公司及其授权生产的苏州普源精电科技有限公司（**RIGOL** TECHNOLOGIES, INC.，以下简称 **RIGOL**）承诺其产品在保修期内无任何材料和工艺缺陷。在保修期内，若产品被证明有缺陷，**RIGOL** 将为用户免费维修或更换。

详细保修条例请参见 **RIGOL** 官方网站或产品保修卡的说明。欲获得维修服务或保修说明全文，请与 **RIGOL** 维修中心或当地办事处联系。

除本概要或其他适用的保修卡所提供的保证以外，**RIGOL** 公司不提供其他任何明示或暗示的保证，包括但不局限于对产品可交易性和特殊用途适用性之任何暗示保证。在任何情况下，**RIGOL** 公司对间接的、特殊的或继起的损失不承担任何责任。

附录 C：保养与清洁

保养一般保养

请勿把仪器储存或放置在长时间受到直接日照的地方。

小心

请勿让喷雾剂、液体和溶剂沾到仪器上，以免损坏仪器。

清洁

根据操作情况经常对仪器进行检查。按照下列步骤清洁仪器外表面：

1. 请用质地柔软的布擦拭仪器外部的浮尘。
2. 用潮湿但不滴水的软布擦试仪器，请注意断开电源。可使用柔和的清洁剂或清水擦洗。请勿使用任何腐蚀性的化学清洗剂，以免损坏仪器。

警告

在重新通电使用前，请确认仪器已经干透，避免因水分造成电气短路甚至人身伤害。

附录 D：联系我们

如您在使用此产品或本手册的过程中有任何问题或需求，可与 **RIGOL** 联系：

电子邮箱：service@rigol.com

网址：www.rigol.com