
User's Guide

RIGOL

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PA1000 Series Power Amplifier

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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/ μ s 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 50k Ω 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.

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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

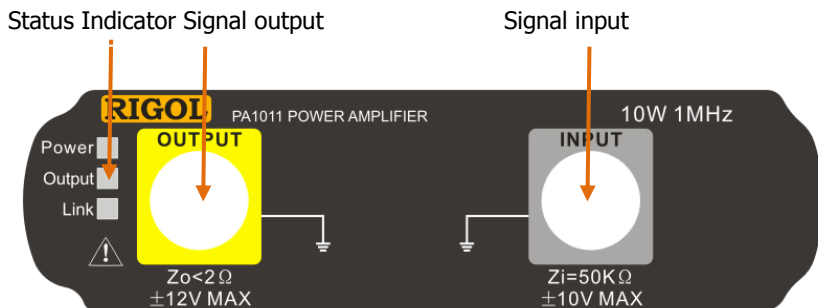


Figure 1-1 PA1011 View of Front Panel



CAUTION

The input impedance of the instrument Z_i is $50k\Omega$, and the range of voltage is $-10V \sim +10V$ or $-1.25V \sim +1.25V$ 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 Z_o is less than 2Ω , and the range of output voltage is $-12V \sim +12V$. Although the amplifier actually enables to output voltages up to $\pm 12.5V$, 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

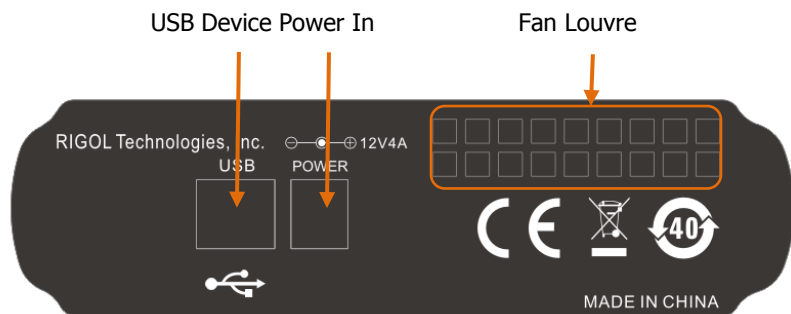


Figure 1-2 View of Rear Panel

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:

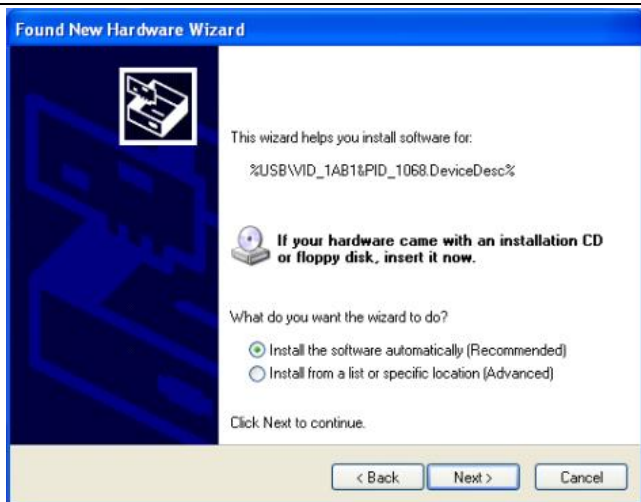


Figure 1-5 Select to Install the Driver Automatically

Click "Next" to enter the interface below:

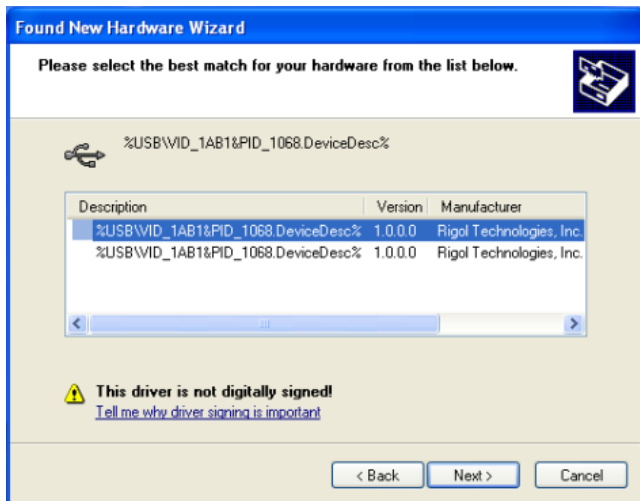


Figure 1-6 Select the Desired Driver

Click "Next" to enter the interface below:

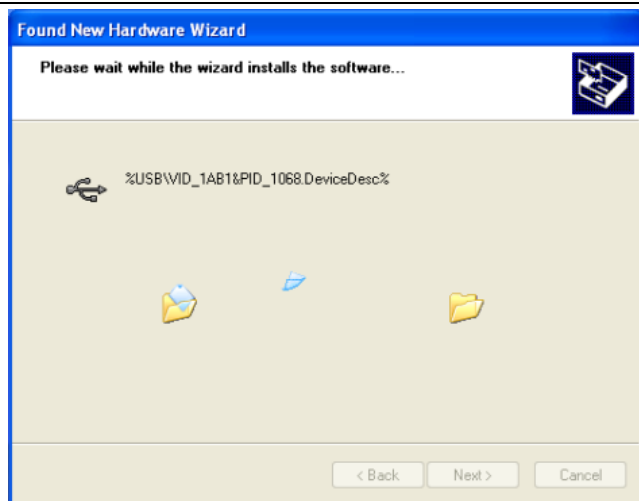


Figure 1-7 Install the Driver

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.

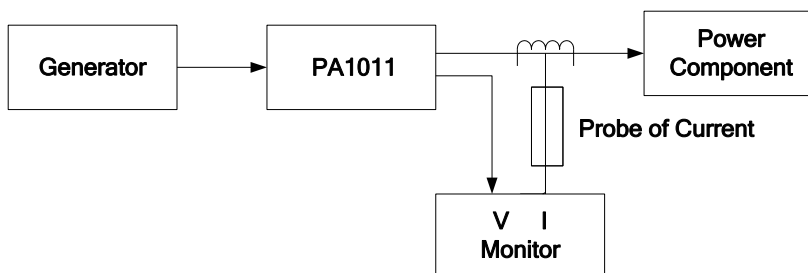
Chapter 3 Application Examples

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.

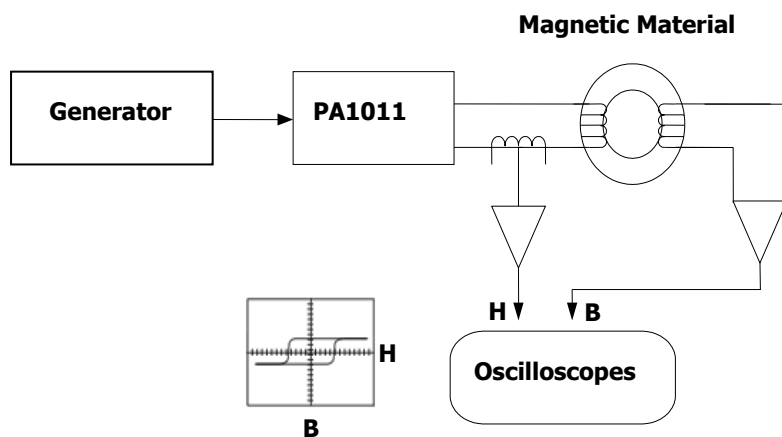
See the measurement system of a power component below:



Magnetization Characteristic

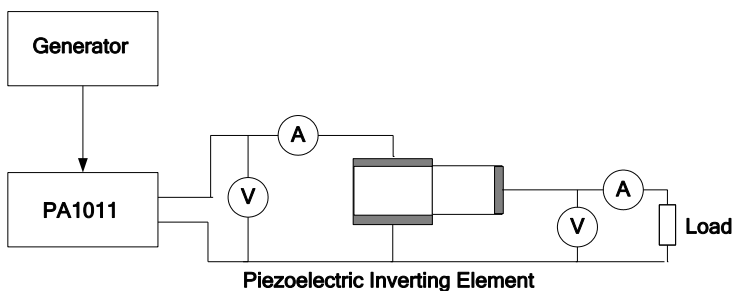
Measurements

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.

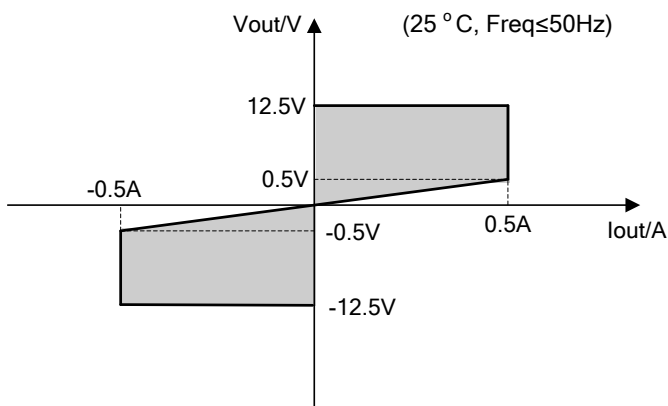
We kindly suggest you to inspect the load of PA1011 or the ambient temperature and make sure both of these specifications are within the prescribed limits when the Circuit Protection is on.

Chapter 5 Characteristics and Specifications

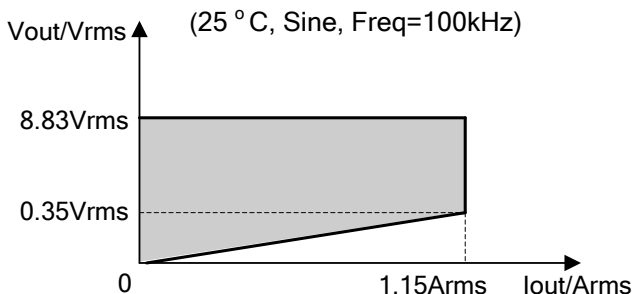
Safety Curves

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.

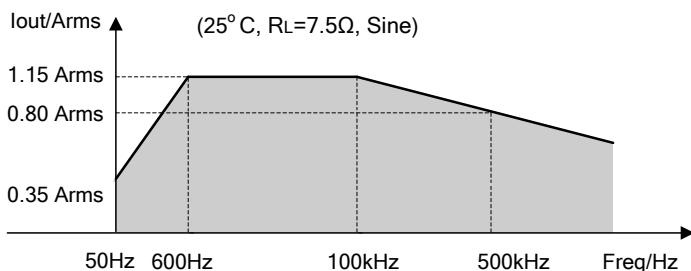
1. DC Working Range



2. AC Working Range

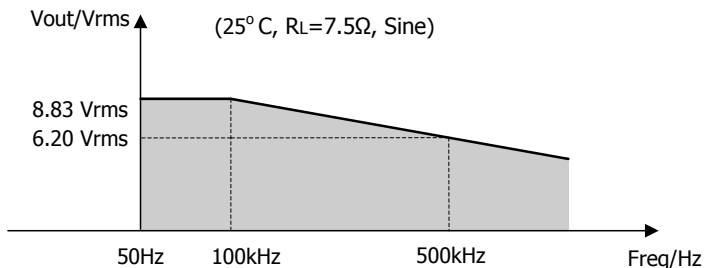


3. Relationships between the Output current and the Working frequency



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	50k Ω
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=7.5 Ω)	10W (typical, input: Sine, 100kHz, X10)
Output Voltage	12.5Vpeak (output: Sine, 100kHz)
Output Current	1.65Apeak (input: Sine, 100kHz)
Output Impedance	<2 Ω
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 °C ~ +35 °C ^{【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 °C, the working temperature is between 0 °C ~ +35 °C. Reduce the output power and the working frequency of PA1011 when the ambient temperature exceeds 35 °C.

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

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.

1. Disconnect the instrument from all power sources.
2. Clean the external surfaces of the instrument with a soft cloth dampened with 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 short-circuit resulting from moisture or personal injuries, ensure that the instrument is completely dry before connecting it to the power supply.

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