# High-Voltage Function Generator Amplifier

Function generators are commonly used for lab bench testing. For some lab testing and scientific experiments, these commonly available function/arbitrary generator output voltage is about +/-5V into a 50 ohm load. For bench test applications that required higher voltage, a high-voltage function generator amplifier is needed. As shown the Figure 1 below, the function generator output is connected to the high-voltage amplifier input. By combining the signal generator and the amplifier forms a high-voltage signal generator.

A high voltage amplifier such as the TS250/TS200 offers the flexibility to choose voltage from +/-10V to +65V. In addition to high voltage, these high-current amplifiers feature high output current up to 6A. Conventional function/waveform generator output resistance is 50 ohm which limits the output current. The test setup in Figure 1 can output high current as well as high voltage. Because the TS250/TS200 waveform amplifier can output up to 70 watts of power, they can also do the job of a high-power function generator for heavy loads. In short, the above mentioned method of combining a high-voltage amplifier and an arbitrary waveform generator offers many advantages over a single-unit high-voltage function generator.

## High-Voltage Function Generator Connection

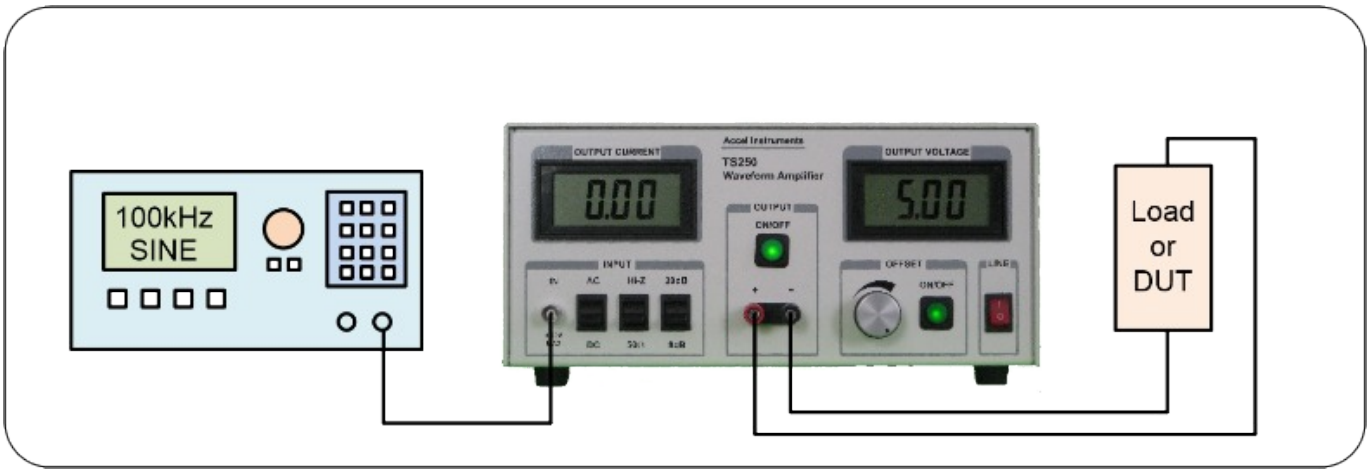


Figure 1. TS250 Waveform Amplifier is used makes a high-power function generator.

# High Voltage Function Generator Applications

- High Voltage Function Generator
- High Voltage Pulse Source
- Power Supply Transient and Noise Simulator
- Piezoelectric Transducers and Sensors
- Electrochemical Cells and Plating
- MEMS Devices
- High Speed Relays
- High Speed Solenoid Valves
- High-Frequency AC Magnetic Field
- Plasma Generation
- Research and Development
- Scientific Experiments

# High Output Current and Low Output Resistance

Conventional function/arbitrary generator output resistance is 50 ohm. This 50 ohm output resistance severely limits its output current to about 100mA. The TS250/TS250 amplifiers has very low output resistance (~50 mOhm). Their output current is up to 6A, depends on the model. See the Selection Guide below for output current and voltage range. Using an arbitrary generator and an amplifier combination (Figure 1) offers flexible output voltage and current for lab testing applications.

# Advanced Techniques

# Further Increase Output Current

Another flexibility for using external driver amplifier is it can increase the output current by connecting multiple amplifiers in parallel. Very high current is sometimes needed for some tests and experiments such as driving magnetic coils. As shown in Figure 2 below, 2 or more TS200/TS250 high-voltage amplifiers can be connected together to boost the output current. To connect amplifiers outputs together, small resistors are needed to isolate high-current amps from each other. 0.3Ω to 1.0Ω series resistance is typically used. For higher output voltage, use larger resistance. Since the output is high current, the resistors must be rated for high power dissipation.

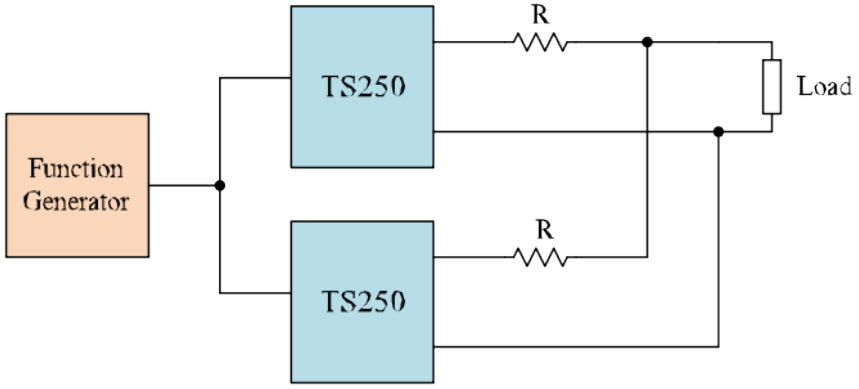


Figure 2. High-power function generator uses two TS250 drivers for higher output current.

## Table 1. High-Voltage Signal Generator Amp Selection Guide

| Model | Voltage Range | DC Current | Max Peak Current |
|---|---|---|---|
| TS200-0A/B | -10V to + 10V | 0 – 4.0A | 0 – 5.0A |
| TS200-1B | -20V to + 20V | 0 – 2.8A | 0 – 3.8A |
| TS200-2B | -20V to + 45V | 0 – 1.4A | 0 – 2.0A |
| TS200-3B | -10V to + 70V | 0 – 1.4A | 0 – 2.0A |
| TS200-4A/B | 0V to + 15V | 0 – 3.5A | 0 – 4.5A |
| TS200-5B | -40V to + 40V | 0 – 1.4A | 0 – 2.0A |
| TS250-0 | -10V to + 10V | 0 – 5.0A | 0 – 6.0A |
| TS250-1 | -20V to + 20V | 0 – 3.1A | 0 – 4.4A |
| TS250-2 | -30V to + 30V | 0 – 2.1A | 0 – 3.0A |
| TS250-3 | -40V to + 40V | 0 – 1.7A | 0 – 2.5A |
| TS250-4 | -6V to + 15V | 0 – 4.0A | 0 – 5.0A |
| TS250-5 | -6V to + 30V | 0 – 2.1A | 0 – 3.0A |
| TS250-6 | -6V to + 45V | 0 – 1.7A | 0 – 2.5A |
| TS250-7 | -6V to + 65V | 0 – 2.1A | 0 – 2.5A |

# Obtain Higher DC Offset Voltage

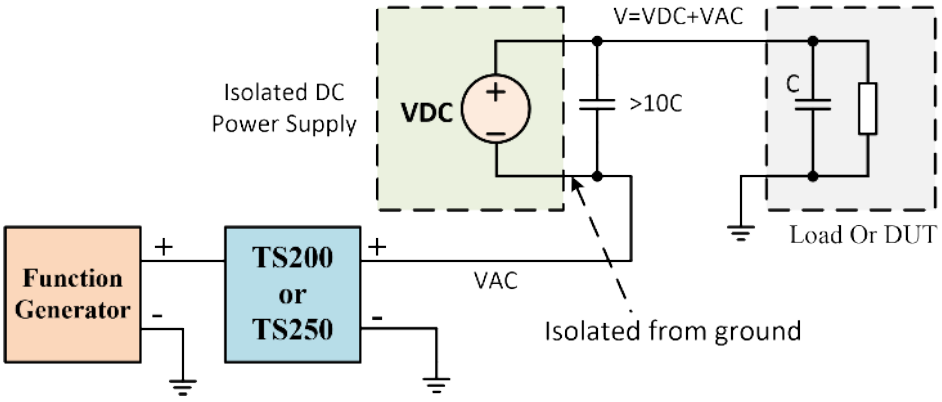


Figure 3. Using an external isolated DC power supply connected in series with an high-voltage amplifier to produce high DC offset voltage.

Some test applications require high DC bias voltage. In such applications, this requires high DC bias voltage, but low DC current. For example, in power supply ripple testing applications, the DC input voltage may be up to 100V, but the input ripple voltage required for this test is only 1Vpp. The unit under test (UUT) has large input capacitance and at high frequency (100kHz), it will required +/-6A current. To fulfill this requirement the function generator must be able to output 100V and 6A. You would need a signal generator that can output 600 watt power.

By the use of the TS250/TS200 Waveform Amplifier and an isolated DC voltage supply, a high-current and high voltage function generator is achieved. As depicted in Figure 3, the high-current driver amplifier is series connected with an isolated power supply. The TS250/TS200 driver's negative terminal is connected to the system ground. The system GND node is in common with the function generator GND as well as the UUT ground. The AC waveform driver's positive terminal is connected the DC power supply's negative terminal. Lastly the DC power supply's positive terminal is connected to the unit-under-test (UUT). The voltage seen by the UUT is the VDC plus VAC voltage.

DC voltage supplies have internal capacitors. Adding additional external bypass capacitors is recommended. This is especially true for high frequency waveform. Multiple capacitors with various capacitance that are connected in parallels offer better frequency response. Using low ESL and ESR ceramic capacitors is the best, but a combination of tantalum, electrolytic, and ceramic capacitors are okay. The external bypass capacitance must be high enough so that its impedance is at least ten-times lower than the UUT input impedance.

To produced the required waveform, the external isolated DC voltage supply is used to set the DC or nominal voltage. The amplifier driver produces the AC voltage. The AC amplitude is set by the function generator and the TS250/TS200 gain. For instant, a piezo transducer requires a 100V bias DC voltage as well as a 80Vpp sinusoidal. This is same as 60V to 140V sinusoidal swing voltage. This is accomplish by setting the external DC voltage to 100V, set the TS250 gain to 20dB, and set the function generator voltage to 8Vpp (+/-4V). In conclusion, by using the test setup in Figure 3, it achieves very high power function generator.

# Select a Function Generator

The TS250/TS200 are designed to interface with most function generators as well as signal generators. These high voltage amplifiers inputs are using BNC female connector. They use standard 50-ohm coaxial cable to connect to function/signal generators. Table 2 shows a few recommended function/waveform generators.

## Table 2. Function Generator Selection Guide

| Manufacture | Model | Features |
|---|---|---|
| Rigol | DG1022 | Low-cost |
| BK Precision | 4014B | Low-cost |
| Tektronix | AFG1000 | |
| Keysight | 33220A | 20MHz |
| Keysight | 33250A | Variable slew-rate control |