

## Waveform Amplifier for Function Generator

**Waveform amplifier** is a very handy piece of equipment to have in the lab. Most function generator, pulse generator, and arbitrary waveform generator output voltage are limited to about 10V. Function generator output resistance is typically 50 ohm, making it not suitable driving low resistance (high current) load. For applications require higher voltage or higher current or both, a waveform power amplifier is required. For applications require to drive heavy load, the waveform output resistance must be very low (e.g. less than 1 ohm). Similarly some applications require to drive high capacitance, a laboratory power amplifier is needed. The TS200 and the TS250 are high voltage and **high current amplifier** for general laboratory and bench testing. It can output up to 65V (TS250-7) or can drive more than 6.5A (TS250-0). See our products page for additional information. This app note will use the TS200 as an example.

### Waveform Amplifier Applications:

- Function generator amplifier
- Pulse generator amplifier
- LDO PSRR measurement
- Step Response or line transient response
- Drive and testing piezoelectric device
- General lab power amplifier

Figure 1 shows the functional equivalent diagram of the TS200 lab amplifier. It features a selectable AC or DC coupled input. It also feature an adjustable DC offset voltage output which is useful for LDO PSRR and line transient response testing. Two versions of the TS200 are available, the A-version has unity gain and the B-version has 20dB gain.

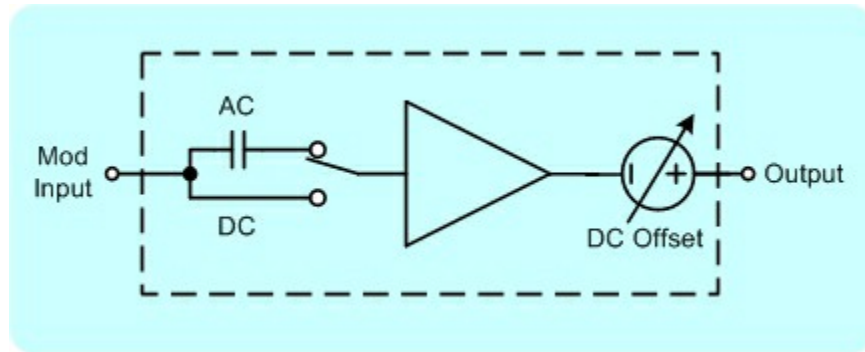


Figure 1. TS200 waveform amplifier functional equivalent circuit.

Figure 2 shows how to amplify a function generator to drive heavy load or large capacitance. It uses the TS200 wideband power amplifier. The function generator or pulse generator output is connected the TS200 modulation input. The TS200 output is connected to the load. Typically, the TS200 DC Offset or DC output voltage is set to zero and input modulation is set to DC-couple. For the A-version of TS200 the gain is unity (gain of one). Whatever voltage output from the signal generator is buffered (current amplified) by the TS200. For the B-version of TS200 the gain is 20dB (gain of ten). Voltage at the Mod Input is amplified by a factor 10.

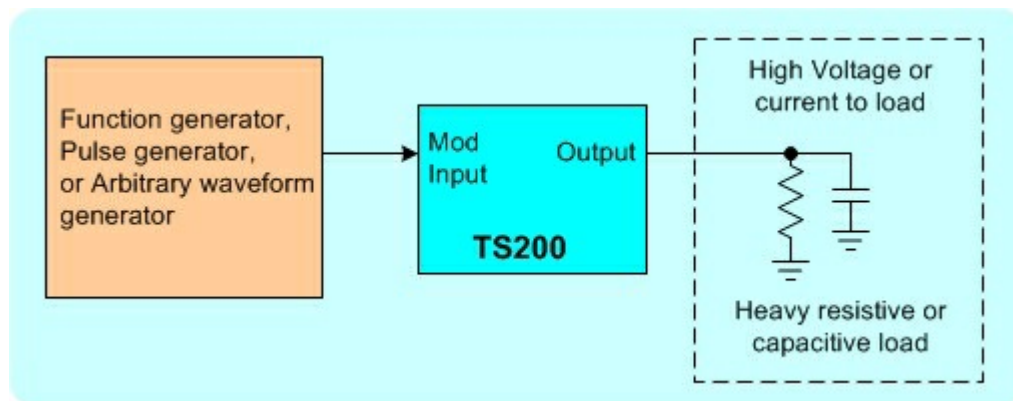


Figure 2. Application diagram showing a signal generator is amplified by TS200 for driving heavy

The TS200 modulation output can be AC-couple or DC-coupled. For the B-version, if the TS200 is set to DC-couple, both the DC voltage and AC signal are amplified by a factor of 10. If the TS200 is set to AC-couple, only AC signal is amplified while the DC output is set by the DC Offset knob.

In summary, a function generator produces the desired signal waveform and the TS200 amplifies the signal to drive high current load or high capacitive load. The TS200 amplifier is flexible enough to work with a variety of function generators, pulse generators, and arbitrary waveform generators.

## High Voltage Function Generator

Most function generator and signal generator output voltage are limited to about +/-5V. Their output impedance is also designed for 50 ohm system. These generators expect the load to be 50 ohm too. For test applications required higher voltage, a function generator amplifier is required. As shown in Figure 2, using the TS200/TS250 waveform amplifier and a function generator together formed a [high voltage function generator](#) for many of the bench laboratory testing applications. 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.

## Lab Amplifier

Many research and development laboratory such as those in universities and other R&D facilities often required laboratory power amplifiers that can output high power, or high current, or high voltage, or any of the combination. Examples of laboratory amplifier usages are driving Helmholtz coil (high current), MEMS or microelectromechanical systems (high voltage), pulse and transient thermal generation (high power), driving piezo transducer (high voltage and high current), and much more. The TS200 and TS250 are ideal bench equipment for R&D [lab amplifier](#).

## More Output Current

As shown in the Selection Guide below, the TS200 and TS250 are capable of output very high current from 1.4A to 6A. For some laboratory experiments, even higher current or power is needed. Fortunately two or three lab amplifiers can be parallel connected as illustrated in Fig 3. The total current is the sum of the two waveform amplifiers current combined. The two high-voltage function generator amplifiers must be isolated each with a  $0.3\Omega$  to  $1.0\Omega$  series resistor. Okay to use higher resistance for higher voltage output. Use high power dissipation resistors to handle the high current.

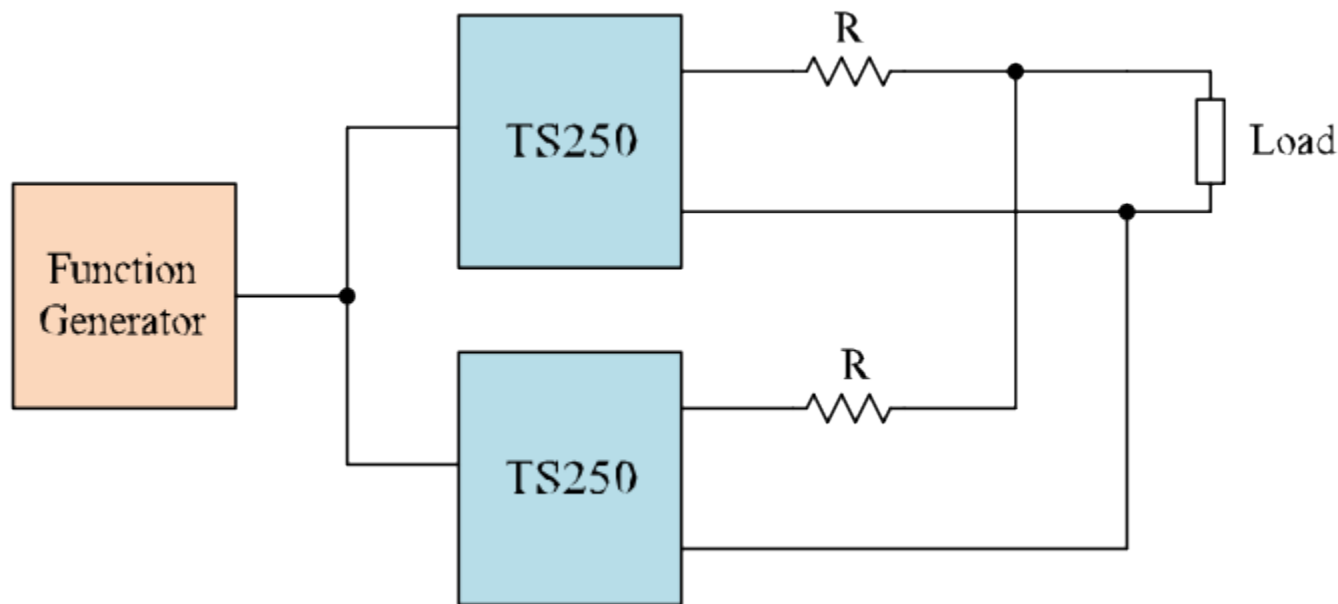
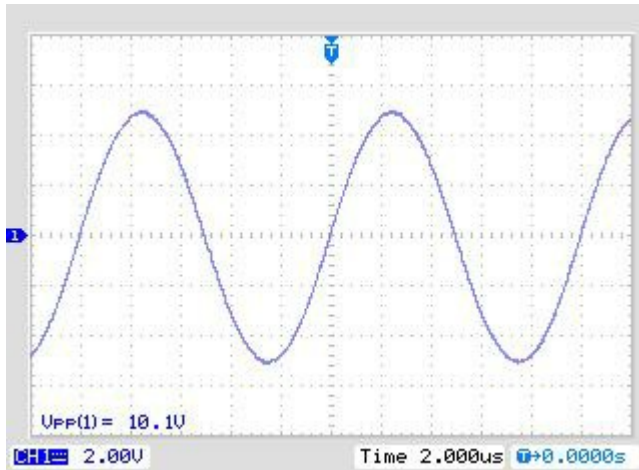


Figure 3. Using two laboratory amplifiers connected together will increase the current by two fold.

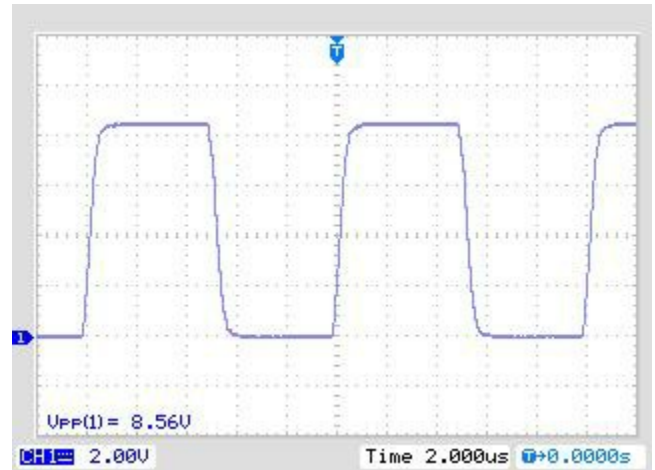
## Table 1. Select a Bench Laboratory Amplifier for Testing

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

## Waveform Amplifier Typical Performance



TS200-0A, 1-ohm load (+/-5A), 100kHz



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