Maximizing TS200 Output Current

(Optional)

This App Note details how to maximize the TS200 output current. Maximizing output current is optional and it is intended for applications where the load impedance is too low.

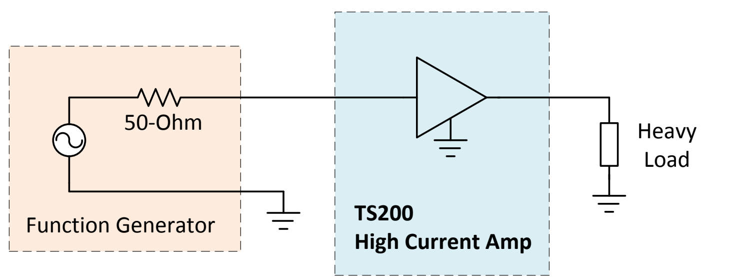

Figure 1. Simplified diagram is showing how to amplify signal from a function generator to delivery high current to a heavy load without current maximization.

High Current Amplifier Applications

- Relay
- Solenoid
- Magnetic coil
- Helmholtz coil
- High-power heat generation
- Electrochemical reactor
- Piezo element
- Circuit characterization
- Motor/actuator driver
- Scientific and Industrial testing
- Automotive transient test
- Laser diode

Model	**Voltage Range (V)**	**Peak Current**
TS200-0x	-10 to +10	5.0A
TS200-1x	-20 to +20	3.8A
TS200-2x	-20 to +45	2.0A
TS200-3x	-10 to +70	2.0A
TS200-4x	0 to +15	3.5A
TS200-5x	-40 to +40	2.0A

Amplifier Current Optimization - Optional

The TS200 can drive heavy load and outputs high current for most application without any optimization as shown in Figure 1. In some applications such as driving magnetic coil or electrochemical reactor, where the highest possible current is desired, but don't care about the voltage amplitude. The highest current is achieved when the TS200 is operating near its maximum voltage. If the load resistance or impedance is very mall, operating near the maximum voltage is not possible. In such a case, a series resistor may be used (Figure 2).

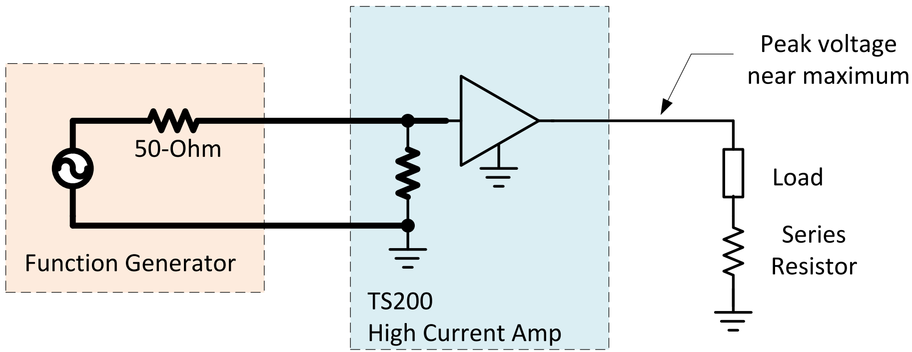

Figure 2. A series resistor increases the TS200 operating voltage achieves the maximum possible current.

For example, the TS200-0x can output 5A peak (AC waveform >60Hz). If the load is 0.25-ohm, a 1.25V peak output voltage is needed. At 1.25V and 5A peak, the TS200-0x is dissipating excess heat internally. To reduce excess heating, it is better to add a 1-ohm series resistor to make the total resistance 1.25-ohm. At 5A output current, the TS200-0x peak output voltage is now 6.25V which is closer to the maximum output voltage. Higher output voltage near the maximum resulted in better performance (less internal heating). Table 1 shows the recommended TS200 peak output voltage for maximum output current. For maximum output current, add a series resistor to bring the peak output voltage to the recommended level in Table 1.

Table 1. Recommended peak voltage for maximum output current

Model	Voltage Range (V)	Peak Current (A)*	Recommended Peak Voltage (V)**
TS200-0x	-10 to +10	±5.0	±7
TS200-1x	-20 to +20	±3.8	±17
TS200-2x	-20 to +45	±2.0	+26 to +42
TS200-3x	-10 to +70	±2.0	+50 to +66
TS200-4x	0 to +15	±3.5	+10
TS200-5x	-40 to +40	±2.0	±26 to ±38

* Less than 10ms or greater than 100Hz.

** Set the TS200 output to the recommended peak voltage to achieve the optimum maximum output current.

Selecting the Series Resistor

The series resistor will dissipate significant amount of heat. The amount of heat dissipated by the series resistor is given in the equation below.

$$P = (I_{RMS})^2 * R$$

Warning: The series resistor may be hot!

where I_{RMS} is the RMS (root-mean-square) current and R is the series resistance. For example, a 5A peak (3.5A RMS) and 1-ohm series resistor will dissipate 12.25W power.

The series resistor must be rated for that power dissipation. If high power resistor is not available, you can parallel several resistors to get the desired resistance and increase the total rated power dissipation. For example, you can use three 3-ohm resistors connected in parallel to get 1-ohm total resistance. If each resistor is rated 5W power dissipation, the resulting 1-ohm resistor can handles 15W power dissipation.

Current Monitoring

As shown in Figure 3 (top), the series resistor can also be used for current monitoring. Place the resistor on the low-side, one side is connected to ground, allow you to measure current with one oscilloscope channel. For best accuracy, connect the oscilloscope probe to the resistor in 4-wire Kelvin sensing configuration. The load current is proportional to the voltage across the series resistor given in the below equation.

$$I = V/R$$

where I is the load current, V is the voltage across the series resistor, and R is the series resistance.

If the load is ground referenced, load must be connected to the ground, swap the position of the series resistor as shown in Figure 7 (bottom). You still can measure the current, but needs two oscilloscope channels and configure them differentially (for example, channel 1 minus channel 2).

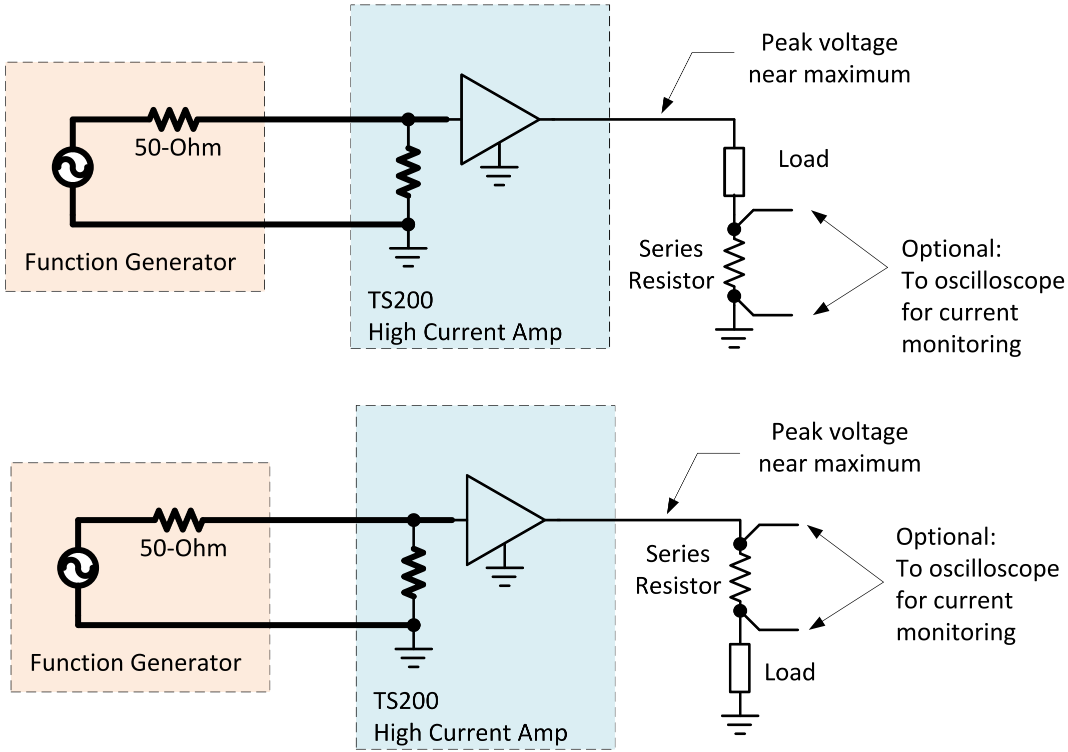

Figure 3. (Top) Low-side series resistor can also be used for current measurement. (Bottom) high-side series resistor for current monitor that requires two oscilloscope channels.

TS200 High-Current Amp Features

Figure 4 is the TS200 high current amplifier functional equivalent diagram. It features a selectable AC or DC coupled input. It also feature an adjustable DC offset voltage output which is useful if a fixed DC bias voltage is required. Two versions of the TS200 are available, the A-version has unity gain and the B-version has 20dB gain.

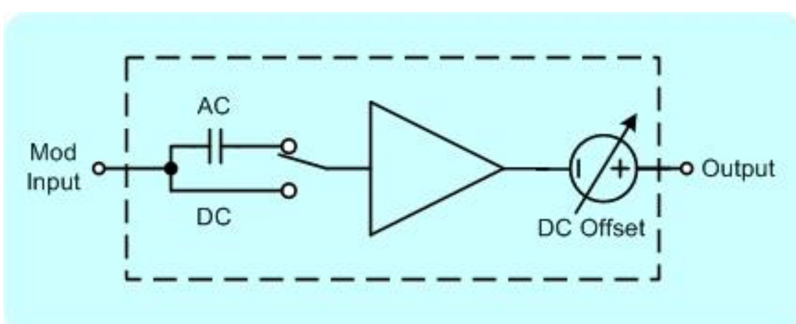

Figure 4. TS200 high-current amplifier functional equivalent circuit.

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