



[Maxim](#) > [Design Support](#) > [Technical Documents](#) > [Application Notes](#) > [Amplifier and Comparator Circuits](#) > APP 4523

[Maxim](#) > [Design Support](#) > [Technical Documents](#) > [Application Notes](#) > [Circuit Protection](#) > APP 4523

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#### APPLICATION NOTE 4523

# Constant-Power Driver Is Simple, Efficient, and Inexpensive

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*Abstract: A combination current-sense amplifier and multiplier (MAX4211F) senses both the current through and voltage across the load, and supplies at one of its outputs (POUT) a voltage proportional to the continuous product of those variables, i.e., proportional to the load's instantaneous power. External op amps generate a corresponding PWM (pulse width modulated) output signal that controls a p-channel MOSFET in series with the load.*

A similar version of this article appeared in the April 25, 2008 issue of *PET*.

Actuators and sensor systems sometimes include a resistive load that requires a controllable, constant-power drive regardless of the load's resistance value. If that value changes with operating conditions, and perhaps with its recent operating history as well, then a simple control and regulation of the applied voltage or current is not sufficient to assure the delivery of constant power. The circuit of **Figure 1** provides constant power by exploiting the resistive properties of such loads, and delivers a chopped-DC drive of variable duty cycle, implemented with simplicity, low cost, and high efficiency.

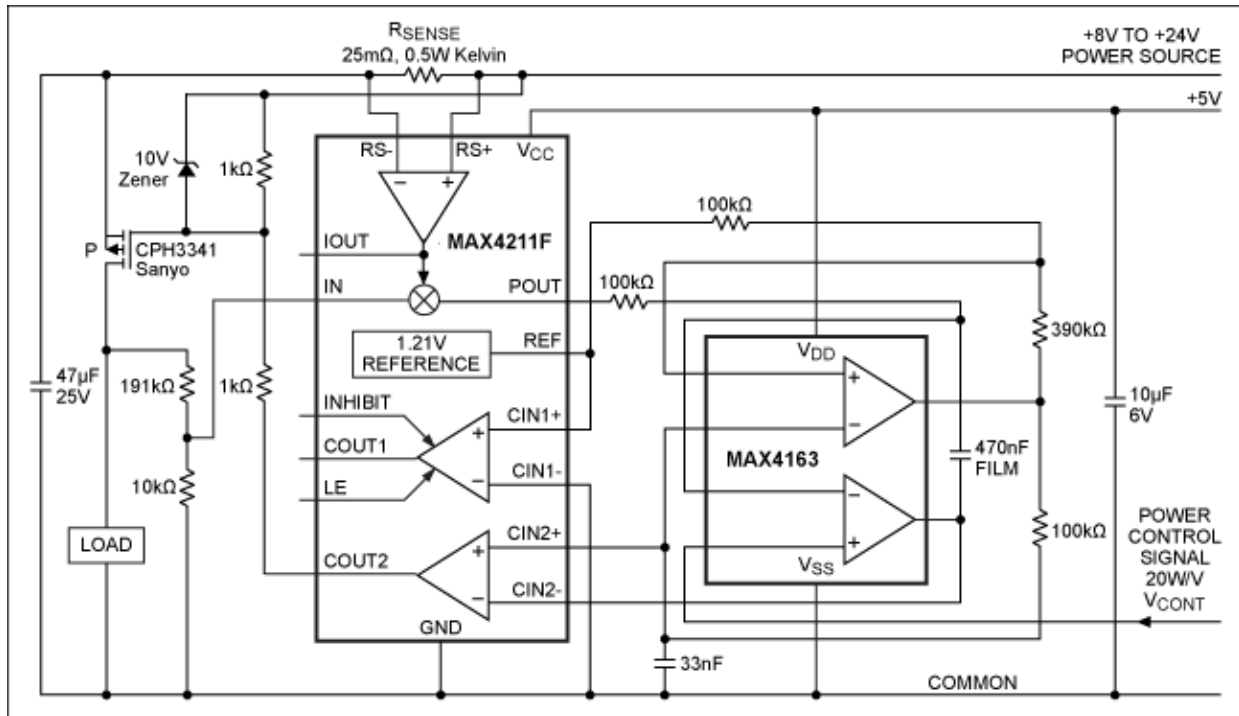


Figure 1. This circuit delivers constant power to the load, within limits as described in the text.

A combination current-sense amplifier and multiplier (**MAX4211F**) senses both the current through and voltage across the load, and supplies at one of its outputs (POUT) a voltage proportional to the continuous product of those variables, i.e., proportional to the load's instantaneous power.

One half of a dual op amp (**MAX4163**) generates a pseudo-saw-tooth signal of constant frequency (about 300Hz), which connects to the noninverting input of an auxiliary comparator in the MAX4211F. The other op amp (the lower half) serves as an error amplifier that averages the power signal and then compares it with the control reference, while amplifying the difference. The error-amplifier output connects to the inverting input of the auxiliary comparator, which in turn generates a PWM (pulse width modulated) output signal. This PWM signal drive a P-channel MOSFET in series with the load.

Circuit applications are simplified because the load has one side to ground, and because the control input is a low-level DC signal (or a microcontroller-generated PWM control signal). The control circuitry demands about 1mA, which is delivered by a +5V power supply.

Power limits for the circuit are defined by the power source operating-voltage range, the maximum allowable peak load current under which it can operate, and the load resistance values. The power source voltage range is 8V to 24V, set by the MOSFET characteristics and the dynamic voltage range of the MAX4211F input (IN). (That range covers most of the DC supplies for industrial and instrumentation systems.) The peak load current is 4A, fixed by the combined effect of the voltage dynamic range at the MAX4211F current-sense input, and the chosen value of the current-sense resistor (25mΩ in this case).

Given a desired power level, the voltage and peak-current limits set boundaries for the load resistance in each case. The minimum allowable load resistance is given by the ratio of maximum-power voltage expected to the peak current limit (4A). The maximum load power the circuit can regulate is approximately the square of the minimum-power voltage expected divided by the maximum load resistance expected.

Under any conditions, the maximum power loss in the circuit is 0.4W in the sense resistor plus 0.8W in the power MOSFET, for a total of 1.2W. With the control voltage input (VCONT) at 0.5V, the circuit as shown

delivers a regulated 10W to a 6Ω load, and is stable within ±1% as the supply voltage is swept from 8V to 24V. It can deliver a regulated 60W ±0.2% to the same load (with  $V_{CONT} = 3V$ ), but only through a supply-voltage range of 19V to 24V. From 22V to 24V and with  $V_{CONT} = 4V$ , it delivers up to 80W ±0.2%.

With a supply voltage of 16V and  $V_{CONT} = 0.5V$ , the output power remains at 10W ±1% while the load varies from 4Ω to 12Ω. Most of the changes in power-regulation value caused by supply voltage or load changes are attributable to non-linearity in the MAX4211F multiplier, and are within the error limits specified for that IC. For more information on the MAX4211F and MAX4163 ICs, including detailed data sheets, please go to [www.maximintegrated.com](http://www.maximintegrated.com).

#### Related Parts

<a href="#">MAX4163</a>	SOT23, Micropower, Single-Supply, Rail-to-Rail I/O Op Amps	<a href="#">Free Samples</a>
<a href="#">MAX4211</a>	High-Side Power and Current Monitors	<a href="#">Free Samples</a>

#### More Information

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