Bipolar current source maintains high output impedance at high frequencies

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Traditional current sources and voltage-to-current converters based on instrumentation and operational amplifiers offer high output impedances at low frequencies because of the amplifiers' good low-frequency CMRR (common-mode-rejection ratios). At higher frequencies, decreasing CMRR, inherent output capacitances, and slew-rate limitations prevent realization of high-quality current sources. Two 200-MHz line-receiver/amplifier ICs from Analog Devices, the AD8129 and AD8130, offer differential inputs and outstanding CMRR, making them strong candidates for building high-frequency constant-current sources. Al-

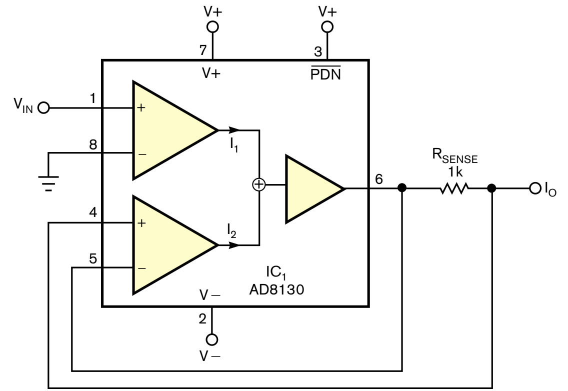

Figure 1 The 200-MHz AD8130 differential-input line receiver/amplifier can serve as a basic building block in a high-frequency-capable current source.

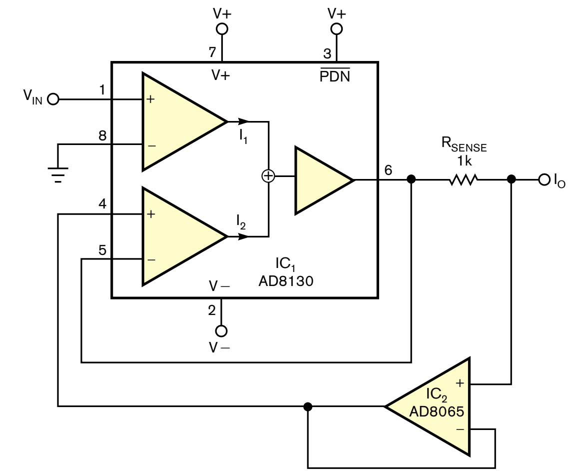

Figure 2 Adding an Analog Devices AD8065 buffer amplifier, IC_2, isolates the current-sampling resistor R_{SENSE} and reduces errors that IC_1's input-bias current contributes.

though the circuit in **Figure 1** provides a good starting point, the AD8130's relatively high input bias current can affect output-current accuracy at low current levels.

To overcome the problem, you can add a unity-gain buffer, IC_2, to isolate the current-sense resistor (**Figure 2**). In addition, you can use the buffer amplifier to measure the load voltage and bootstrap the output cable's capacitance. The circuit presents an output impedance of about 500 kΩ at 1 MHz and a current-compliance range of 0 to ±3V using ±5V power supplies.

Current sources that have capacitance-coupled loads benefit from a dc servo loop to stabilize the circuit's operating point (**Figure 3**). The value of output-coupling capacitor C_O depends on the desired low-frequency roll-off characteristic. Further improvements of the basic circuit enable compensation of output capacitance and increase the circuit's output impedance. A small, adjustable feedback capacitor, C_{COMP}, that's approximately one-half of the output's stray capacitances provides feedforward compensation and further reduces the effects of stray capacitance at the output (**Figure 4**). To prevent oscillation, the cable's shield-driver circuit's gain should be slightly less than unity. Note that reducing the output-current-sense resistor, R_9, to 100Ω compensates for the input attenuator formed by R_1 and R_2 and maintains a 1-mA/V characteristic. This voltage-to-current source's frequency range spans 20 Hz to 10 MHz. For best results, use high-frequency circuit-layout and power-supply-bypassing methods. **EDN**

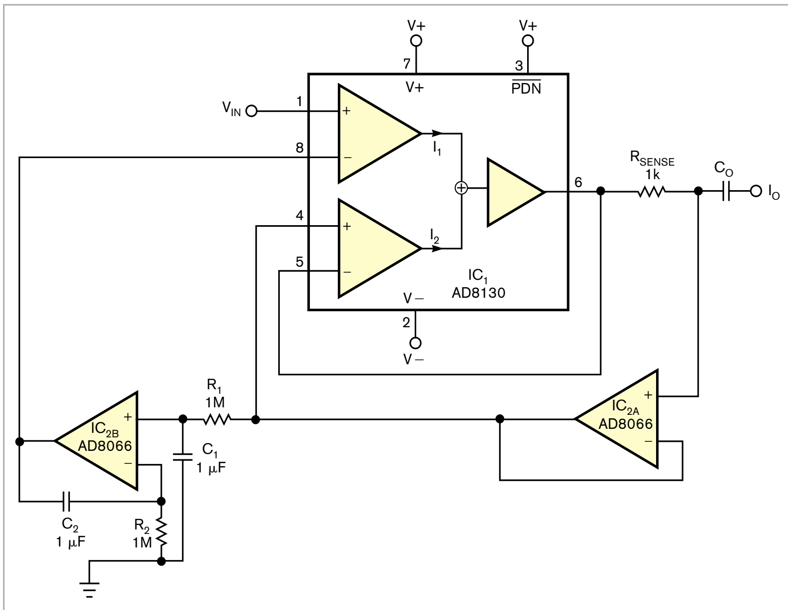

Figure 3 For an ac-coupled current output, add a dc-stabilization loop, IC_{2A} and IC_{2B}.

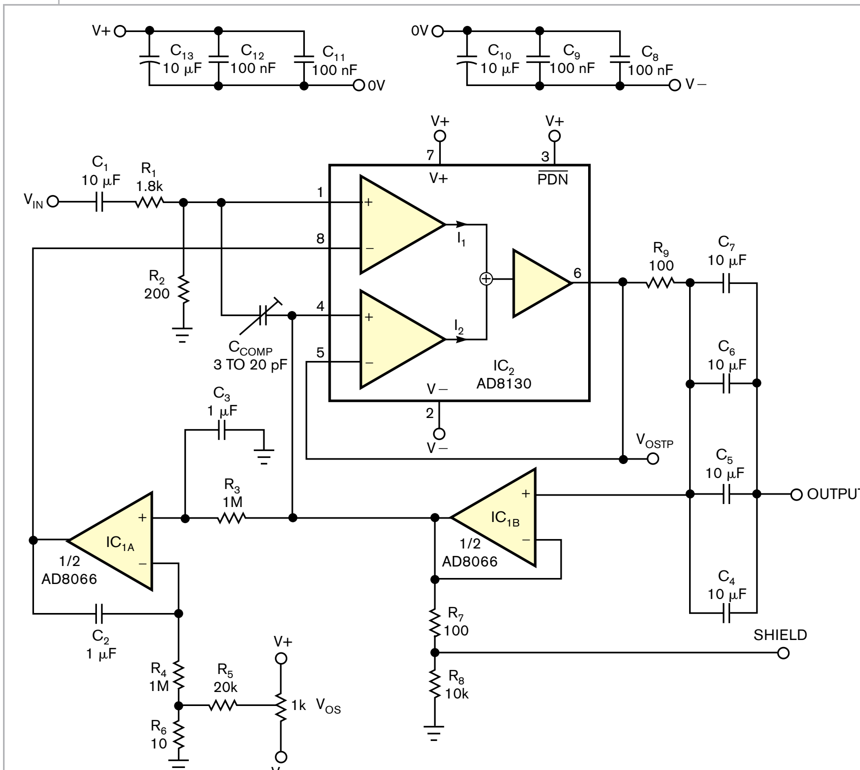

Figure 4 The complete circuit includes trimmer capacitor C_{COMP}, which compensates for stray capacitances in the circuit's packaged layout. Also, note wideband treatment of power-supply bypass capacitors.