Current transmitter suits extremely high temps

Here's a simple current transmitter that was tested at 210°C and 225°C.

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Electronic circuits specifically developed for high-temperature operation are required by automotives, avionics, downhole drilling and other industrial applications. The availability of integrated circuits rated beyond 200°C, however, is severely limited.

The **figure** shows a functional block diagram for a simple current transmitter that was tested at 210°C and 225°C. It uses two low-noise, high-performance AD8229 instrumentation amplifiers (in-amps), which are manufactured on an advanced dielectrically isolated silicon-on-insulator (SOI) process and offered in an 8-lead ceramic side-brazed dual-in-line package (SBDIP). Carefully designed for extremely high-temperature operation, the architecture compensates for low base-emitter voltages at high temperatures. The manufacturing process minimises leakage currents at high temperatures and includes robust thin-film resistors that provide excellent matching and tracking over temperature to maximise common-mode rejection (CMR).

In this circuit, in-amp A rejects the input common-mode voltage (V_{CM}) and in-amp B converts the differential input voltage (V_{IN}) to current by the mean of resistor R1. With gain-setting resistor R_G open, the transfer function of the AD8229 is $V_{OUT} = (V_{IN+} - V_{IN-}) + V_{REF}$. Thus, OUTB = +INB and OUTA = V_{IN} + OUTB. V_{IN} = OUTA – OUTB = R1 × I_{OUT}, so $I_{OUT} = V_{IN}/R1$.

The bias current of AD8229 is kept very low (200-nA maximum at 210°C), causing a negligible loss at the output. With R1 = 1kΩ, the circuit has an input-output signal scale factor of 1 mA/V.

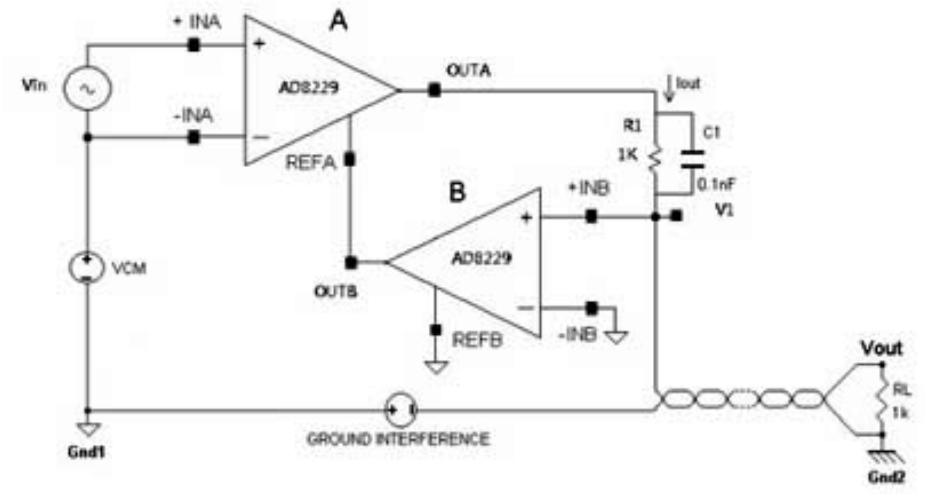

Figure: Current transmitter operates at extremely high temperatures.

The low offset voltage and high CMR over frequency make this circuit an excellent candidate for strain gages, pressure transducers, and bridge measurements, with the bridge or transducer connected directly to the inputs in-amp A. Featuring low noise and low drift, it is ideal for diagnostic applications.

Many systems use current signals to control remote instruments. The output current is linear with respect to the input voltage, and the interference between the transmitter and remote grounds is rejected, providing this circuit with the ability to operate properly even if the two grounds are not at the same voltage. With the voltage difference between GND1 and GND2 set to 2 V, the total output current error as V_{IN} sweeps from –5 V to +5 V is less than 80 ppm.

Note that the instrumentation amplifier is specified for operation up to 210°C. Good test data was obtained at 225°C, but operation at this temperature cannot be guaranteed. ■

About the author

Chau Tran joined Analog Devices in 1984 and works in the Integrated Amplifier Products (IAP) Group in Wilmington, MA. In 1990, he graduated with an MSEE degree from Tufts University. Chau holds more than 10 patents and has authored more than 10 technical articles.