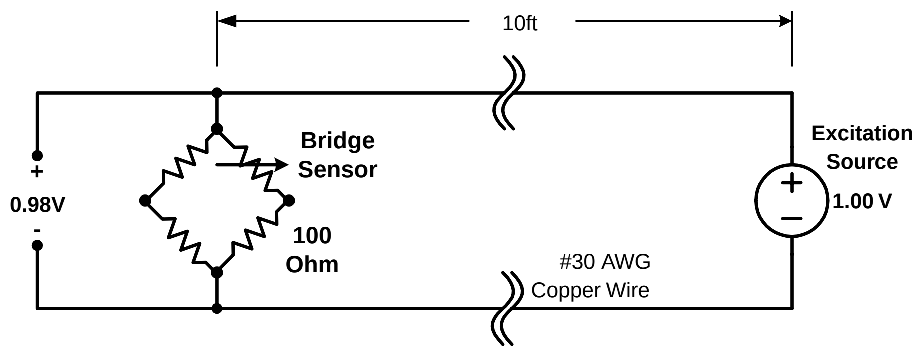
6-Wire Bridge Sensor Interface

February 2001 Circuit Solution

When providing voltage excitation for low-resistance bridge-type sensors (Rin < 100Ω), resistance in the excitation connections can reduce the effective sensitivity. Both the wire resistance and the resistance of any connectors used contribute to this problem. For even relatively short runs, wire resistance can become a significant source of error. As an example, 10 feet of #30 AWG copper wire has ≈1Ω of resistance. If a 100Ω bridge were driven through this cable, it would experience nearly a 2% reduction in sensitivity, as illustrated in Figure 1. In addition to errors caused by wiring resistance, the contact resistance in 'connectorized' wiring schemes also contributes to this problem.

Figure 1. Excitation Voltage Drop from Wiring Losses

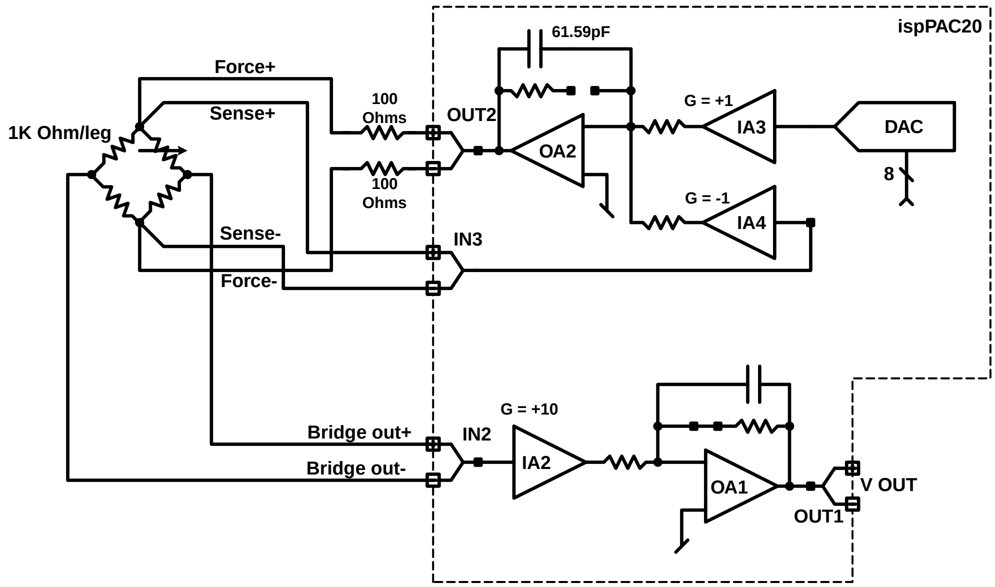


One way to compensate for the effects of wiring and connector resistance is to use a '6-wire' interface. A 6-wire bridge interface uses 2 wires to sense bridge output voltage and 2 wires to supply excitation. Additionally, the 6-wire technique uses 2 'Sense' wires to measure the bridge excitation voltage, right at the bridge. Because these two sense leads carry little or no current, there are minimal voltage drops along them. By monitoring the actual value of the bridge excitation at the bridge, the excitation source can then be adjusted through negative feedback to maintain a desired bridge excitation voltage despite voltage drops along the wires. Figure 2 shows an implementation of a 6-wire bridge interface, using an ispPAC®20 device. The ispPAC20's DAC is used to establish the excitation voltage setpoint, allowing for a wide range of adjustability. One PACblock is used to establish force-sense excitation, where the Output amplifier (OA) used to provide excitation voltage, and one of the input amplifiers (IA) is used to monitor the actual excitation voltage at the bridge. The ispPAC20 output amplifiers are capable of supplying +/-10 mA of output current, which is sufficient excitation current for many types of bridges. A pair of 100 Ohm resistors are placed in series with the OA's output to increase stability when driving a capacitive load.

A second PACblock is used as a 10X low-offset (20µV typical) preamplifier. Because the amplifier inputs are very high impedance (1 GΩ in parallel with 2pF), the amplifier will not significantly load down most types of resistive bridge sensors, which tend to be low-impedance devices, with resistances ranging from a few Ohms to a few thousand Ohms.

This circuit can also be implemented with a few minor modifications with the ispPAC10. Because the ispPAC10 doesn't have an on-board DAC, the setpoint for the bridge excitation voltage must be provided externally. This can be done either with an external DAC or precision voltage reference.

Figure 2. 6-Wire Force-Sense Bridge Sensor Interface Using an ispPAC20 Device



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