4-20mA Bridge Sensor Interface

February 2001 **Circuit Solution**

In electrically noisy environments, such as factory floors, it is often better to transmit analog information in the form of a current, as opposed to a voltage. Using current as a signaling medium provides several other advantages in addition to noise immunity. The first is that small voltage drops occurring along long cables are no longer an issue. Additionally, small differences in the 'ground' potential between transmitter and receiver also do not significantly affect the signal.

Figure 1 provides an example of a current-signaling system. The receiver provides a bias voltage across a pair of wires to a remote sensor, and the sensor at the other end varies its current proportional with its measurement value. One popular standard for this kind of signal transmission scheme is the 4-20mA current loop. The low end of the measurement scale is represented by 4mA of current drain, while the high end is represented by 20mA. Defining the low end of the scale as 4mA makes it possible for the receiver to distinguish a low-scale measurement from an open-circuit fault. Appropriate receiver circuitry can also detect short-circuit and other fault conditions.

Figure 1. A Remote Sensor in a Current-signaling Loop

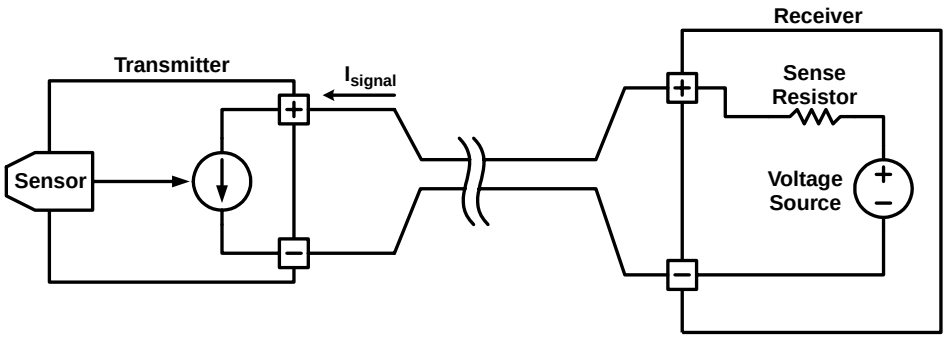
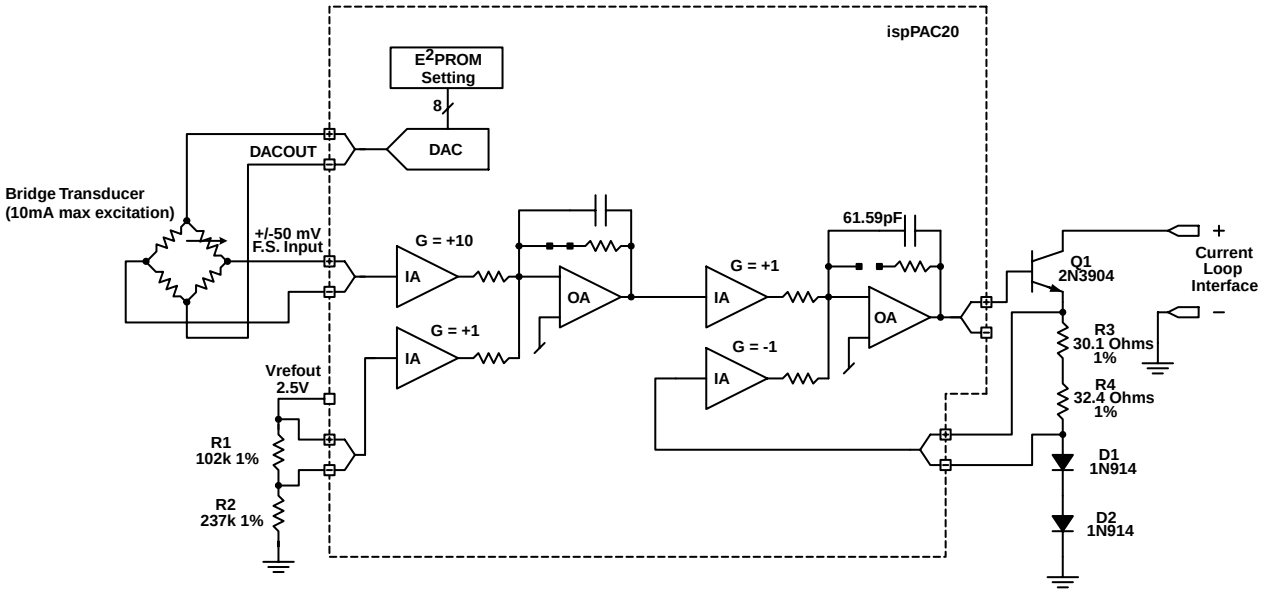


Figure 2 shows a circuit that will provide constant-voltage DC excitation to a resistive bridge sensor, such as a strain gauge, and also convert the bridge's output voltage (over a +/-50mV span) into a 4-20mA current output signal. This circuit can be implemented with a single ispPAC®20 device, four precision resistors, two small-signal diodes (e.g. 1N914) and a single NPN transistor (e.g 2N3904). The ispPAC20's DAC provides a user-programmable excitation for the bridge. Since the DAC output can provide up to +/-10mA of output current, it is capable of directly biasing many kinds of common bridge transducers such as strain gauges and pressure sensors. Resistors R1 and R2 are used to provide a precise 0.75V reference voltage. This reference voltage is used to offset the output to 12mA for a zero-voltage bridge condition. By offsetting the output in this way, a negative full-scale input (50mV) will result in 4mA of output current, while a positive full-scale input (+50mV) will result in 20mA of output current.

The output of this circuit appears at the collector of transistor Q1, and the output signal is this transistor's collector current. This current also flows through by R3 and R4, developing a proportional voltage. A feedback loop monitors this voltage in order to provide the proper output signal. D1 and D2 are included to ensure that the feedback signal from R3 and R4 is within the common mode input range of the ispPAC input amplifier.

Figure 2. 4-20mA Bridge Interface Circuit Using ispPAC20



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