1.5-VOLT POWERED ISOLATED PRESSURE MEASUREMENT

National Semiconductor Application Note 298 May 1982

Figure 8 diagrams another pressure measurement circuit. This circuit presents a frequency output which is fully isolated by the transformer indicated. The entire circuit may be powered from a 1.5-volt supply, which may be derived from a battery or solar cells. The potentiometer output of the pressure transducer used is fed to a voltage-to-frequency converter circuit. In this V-F circuit, an LM10 op amp acts as an input amplifier, and forces the collector current of Q1 to be linearly proportional to VIN for a range of 0 to +400 millivolts. Likewise, the reference amplifier of the LM10 causes Q2's output current to be stable and constant under all conditions.

The transistors Q3-Q10 form a relaxation oscillator, and every time the voltage across C1 reaches 0.8-volt, Q6 is commanded to reset it to zero volts differential. This basic circuit is not normally considered a very accurate technique, because the dead time, while Q6 is saturated, will cause a large (1%) nonlinearity in the V-to-F transfer curve. However, the addition of RX causes the reference current flowing through Q2 to include a term which is linearly proportional to the signal, which corrects the transfer nonlinearity.

The NSC MM74C240 inverters are employed because this IC has the only uncommitted inverters with such a low (0.6 to 0.8V) threshold that they can operate on a supply as low as 1.2 volts.

The 49.9k resistors which feed into Q2's emitter act as a gain tempco trim, as Q12's Vbe is used as a temperature sensor. If the output frequency is 100ppm/C too fast/hot, you can cut the resistor to 20k. If f is too slow/hot, add more resistance in series with the 49.9k. Total current drain for this circuit is about 1 milliampere.