Pressure and Force Sensors

Pressure or Force Switch Circuits – Note #7

INTRODUCTION

MICRO SWITCH solid state pressure or force sensors offer significant advantages over mechanical switches in such areas as stability, repeatability, long life, and adjustability. In addition, they provide the capability of multiple switch points.

Using MICRO SWITCH 140/160/180 and 240PC amplified pressure or force sensors as inputs (V_i), pressure switch circuits can be readily constructed. If you are using an unamplified pressure or force sensor, 120PC or FS, then you must construct a circuit from the application information on Bridge Amplifiers found on page 109. The output from that circuit then becomes your input for (Vj).

Figure 1

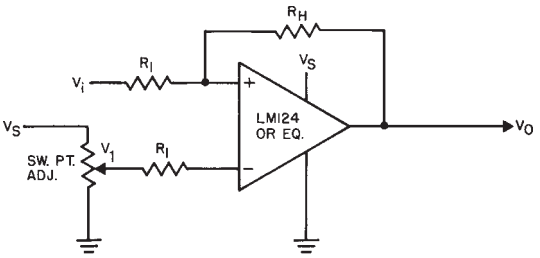


Figure 2

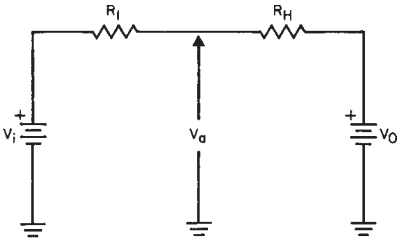


Figure 3

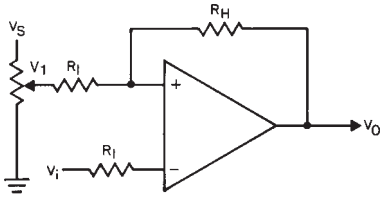
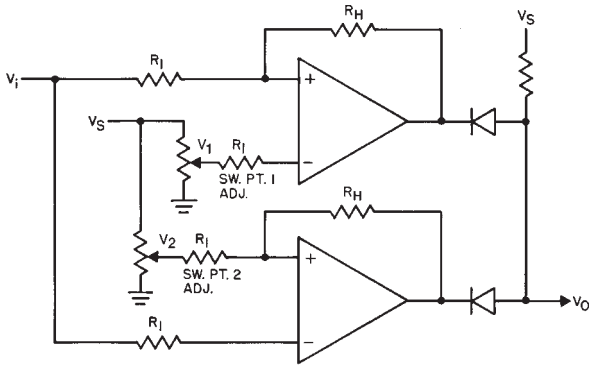


Figure 4



Configuration Of The Basic Force or Pressure Switch

An op amp with positive feedback to provide hysteresis **(Figure 2)** is the basic element of the switch. Its output (V_o) switches from zero volts to the high state (V_s – 1.5V) for $V_i \geq V_{pot}$ wiper.

In this circuit, R_I should be chosen to minimize loading of both the sensor output, and the potentiometer used to adjust the switch point. If a 2K pot is used, R_I = 20k is suitable. R_H is selected to provide enough hysteresis to eliminate noise-induced jitter at the switch point. The amount of hysteresis can be calculated using the equivalent circuit in **Figure 2.**

When the output (V_o) is in the low state ($V_o \cong 0$),

$$V_a(L) = \frac{V_i R_H}{R_H + R_I} \cong V_i \text{ for } R_H >> R_I$$

When the output (V_o) is in the high state.

$$V_{a(H)} = V_{a(L)} + \frac{V_o R_I}{R_I + R_H} \cong V_{a(L)} + \frac{V_o R_I}{R_H} \text{ for } R_H >> R_I$$

The hysteresis is given by $\Delta V_a = V_{a(H)} - V_{a(L)} \cong \frac{V_o R_I}{R_H}$

If the LM124 op amp is operated from a 10V supply, V_o = 8.5V, and R_H = 5 megohms yields a hysteresis of 34 mV.

Other Configurations

1. Output switches from high to low state for: $V_i \geq$ V pot wiper **(Figure 3).**

2. Output switches from low to high for switch point $1 \leq V_i \leq$ switch point 2 (window detector) **(Figure 4).**

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