

Optical shaft encoder pulls pulses in presence of vibration

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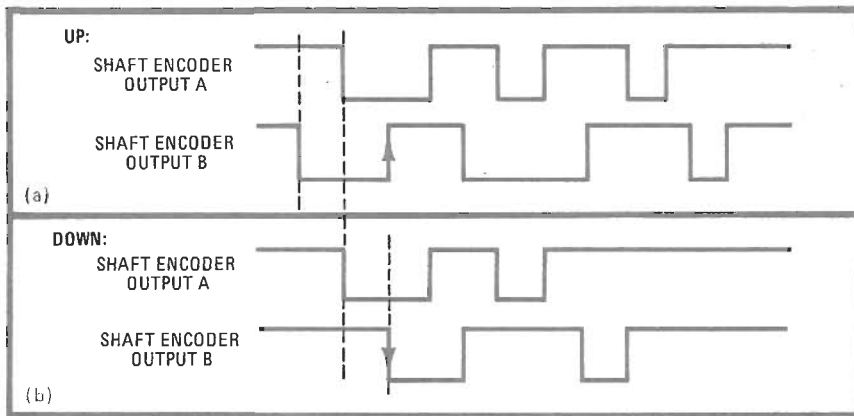
In stepper-motor applications, motor stability is an important consideration. Damped oscillations around its target position are produced when the motor single steps. At low speeds, where control pulses are far apart, these oscillations are especially bothersome. In addition to these oscillations, a stepper-motor system may be subjected to vibration. The output of an optical shaft encoder consists of square waveforms in quadrature. Unwanted vibrations produce a burst of pulses as the motor executes a step.

The waveforms of Fig. 1 reveal that the problem can be overcome by detecting a low-to-high (high-to-low)

transition in output B coincident with output A (A = high) preceded by the state A = high, B = low (A = low, B = high) to generate a valid up (down) pulse for input to a bidirectional counter.

Gates IC1A and IC1B (Fig. 2) provide the inverted and noninverted input combinations to gates IC1C and IC1D. Latch IC2A sets when A is high and B is low, thereby enabling the one-shot multivibrator IC3A. At the arrival of the low-to-high transition in B, the one-shot triggers to deliver a valid up pulse at its complementary outputs. As soon as both outputs return to their normally high state, IC2A and IC2B are reset. A valid down pulse is similarly generated through IC2B and IC3B. Outputs from both one shots are NORed through AND gate IC4B (De Morgan's Theorem), ready for inputting to an up/down counter with latch IC2C instructing the counter on the count direction.

Coincident pulses from the one-shots caused by excessive vibration constitute an error in the decoding; latch IC2D is then set, signaling the detection of an error. □



1. Waveforms. The circuit generates a valid up pulse (a) at the occurrence of a low-to-high transition in output B coincident with output A = low when preceded by A = high and output B = low. A valid down pulse is likewise produced with the similar logic shown in (b).

2. Extractor. At low speeds, vibrations can cause an optical shaft encoder to produce a burst of pulses as the stepper motor executes a single step. This circuit not only extracts up and down pulses; it also detects excessive shaft vibration from the outputs of an optical shaft encoder.

