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NOTES

A running wheel tachometer

JOHN J. PORTER, ANN M. FURBER,
and EDWIN G. GEISE
University of Wisconsin–Milwaukee
Milwaukee, Wisconsin 53201

A photocell-actuated tachometer for running wheels is described. The number of counts generated per revolution of the wheel is a function of the number of trip wires inserted in the hub of the wheel axle. The circuit is presented in configurations that actuate relay contact closures and as a direct driver of TTL logic.

The running wheel has been used to monitor activity for many years (cf. Brown, 1961; Finger, 1969; Moskowitz, 1959; Wang, 1923). The typical running wheel records only complete revolutions by means of a mechanical counter or sometimes an electric switch (Bolles, 1970). Direct observation of animals during the first few sessions in the running wheel often reveals that the animals make partial revolutions and, frequently, reverse direction without completing a revolution of the wheel. Similarly, in startle testing in running wheels, we have observed similar partial revolutions, freezing, and partial reversals (Schick, 1979). The device described here may be used to record any desired part of a wheel revolution. A photocell tachometer circuit is used that can be interfaced to any equipment that can detect relay contact closures. Or, by simple modifications, the tachometer circuit may be used to directly drive TTL-level logic or computer inputs sensitive to changes in TTL logic levels.

APPARATUS

Running wheel motion is detected by the movement of a 1-mm-diam wire through the photobeam of a General Electric H13B2 photon-coupled interrupter module, shown in Figure 1. This U-shaped module, 9 mm high and 12 mm wide at its base, is formed with a photocell in one arm and a light source in the other arm. The interrupt wires are inserted into a 4.5-cm-diam rubber cork section, 1.5 cm thick, fastened to the central axle of the Wahmann LC-34 activity cages. The interrupt wires extend 20 cm from the periphery of the rubber mount and 6 cm into the U of the photomodule. The number of interruptions is, of course, a function of the number of wires inserted in the cork.

The upper section of Figure 2 shows the pulse-forming circuit, which sends its timed pulse through the points of the SPST relay. As shown, the normally open relay points are held closed for 35 msec, and the circuit may be used with any device that can respond to a

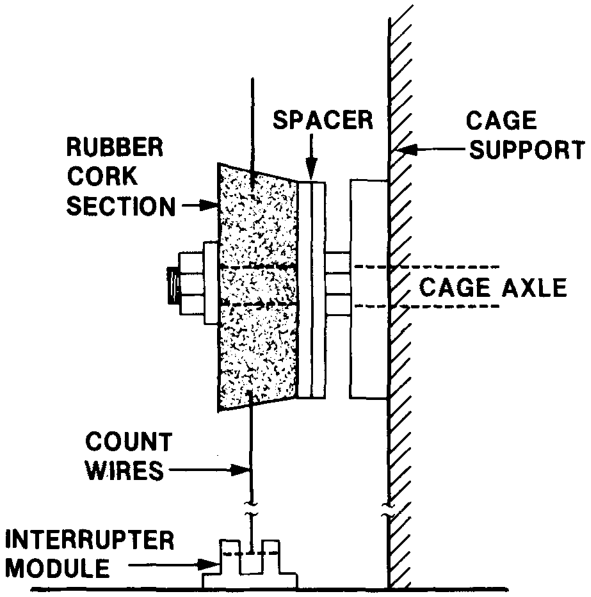

Figure 1. Side view of the tachometer, showing the layout of components. The cork section is spaced and mounted to the axle of the Wahmann LC-34 activity cage. The GE photocell module and the circuit are mounted above the activity wheel holding cage.

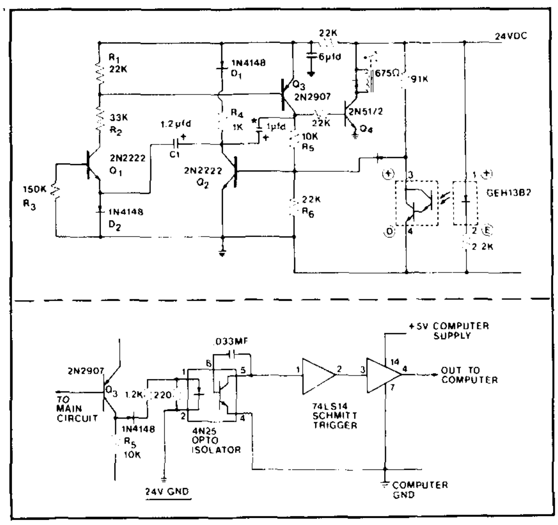

Figure 2. The upper portion of the figure shows the circuit layout in which the output pulse is taken from the points of the SPST relay. The one-shot pulse length can be changed from 35 msec to 100 msec by changing C_t to 3.3 mF, or to 150 msec by changing C_t to 6 mF. The lower part of the figure starts at Q_3, and this circuit removes the 22-KB resistor and Q_4, as well as the relay. The 4N25 Opto-Isolator and Schmitt trigger substitute and serve as TTL-level output.

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35-msec closure. The output pulse width is directly proportional to the value of C_t, currently 1.2 mF, but only approximately proportional to R_2. By reducing C_t, pulses as short as 5 microsec can be generated.

The lower sections of Figure 2 depicts the changes needed to produce a direct "ground" pulse while working with 5-V TTL logic. These pulses are input to a Rockwell AIM-65 microcomputer. The circuit modifications start to the right of Q_3, where the relay and attached driving circuity are replaced with 4N25 Opto-Isolator and Schmitt trigger.

These tachometer circuits have been in use for more than 3 years on four running wheels. They are durable, immune to noise, and simple to use.

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