A device for simulating twilight in studies of animal activity¹

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A dimmer-timer device for producing gradual on-off and off-on lighting transitions (twilight simulation) is described. The basic circuitry is a 24-h timer wired to activate a cam-driven potentiometer at preset times to produce artificial twilight transitions.

Kavanau (1962a, b, 1969) suggested that laboratory studies of animal activity and rhythmicity should employ artificial twilight. He discovered that sudden on-off lighting elicited erratic wheel running behavior in weasels, chipmunks, and white-footed mice. Graham (Note 1) demonstrated that the activity of the painted

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turtle, *Chrysemys picta*, is also adversely affected by abrupt on-off lighting. As a solution, Kavanau (1962a) suggested the gradual reddening of incandescent lights at low intensities, since this appeared to simulate the progressive color change of direct sunlight caused by short wavelength scattering at low solar altitudes.

The dimmer-timer described here turns an incandescent bulb (or bulbs up to a maximum load of 1000 W) on or off at times preset on an inexpensive household-type 24-h time clock. The lights are slowly turned on or off at an even rate over a 20-min period. Illuminance at animal level is controlled by altering bulb height or by using bulbs of different wattages. We employ 40-W incandescent bulbs hung about 50 cm above the animal to produce 5 fc or 53.8 lux during the photophase. This, incidentally, is not full bulb brightness because the potentiometer is only turned up a portion of its potential travel each time the lights are brought on.

To illustrate operation: The 24-h timer switch shown in Figure 1 is in the "open" position. Power is directed through the normally closed contact of the SPDT relay to the 1-h timer motor (Industrial Timer, Model CM8 with A12 gear rack). The timer's cam is adjusted to a 50% duty cycle. The 1-h timer motor actuates the poten-

Figure 1. Schematic of the dimmer-timer (twilight simulator). An eccentric cam, driven by the 1-h timer motor, rotates the potentiometer shaft to gradually alter the light intensity. Solid dotted lines indicate mechanical switching actions. The load pilot operates in conjunction with the load (lights) to indicate to the experimenter when the lights are on.

Figure 2. The dimmer-timer module with the 24-h timer at the right. The 24-h timer activates the cam-driven potentiometer at preset times to produce artificial twilight transitions. Note the physical relationship between the microswitch, 1-h timer motor, potentiometer control arm, and potentiometer. The potentiometer shaft is longer than necessary but was not cut down from its stock length.

tiometer via a control arm to vary the amount of power going to the load (lights). At the end of $\frac{1}{2}$ h, the microswitch in the 1-h timer moves to the "open" position, thereby switching off the timer and arresting movement of the potentiometer control arm (see Figures 1 and 2). When the 24-h timer switch is next activated into the load (closed position), current is directed through the relay, which then switches to the normally open position (Figure 1). This reactivates the 1-h timer motor to

mechanically return the potentiometer to its original setting via the potentiometer control arm. This arrangement of the potentiometer and bidirectional triode switch (GE Triac Assembly, S100B3) controls the power available to the load (lights). In several hundred hours of operation, this dimmer-timer has functioned reliably.

REFERENCE NOTE

1. Graham, T. E. *Temperature-photoperiod effects on diel locomotor activity and thermal selection in the turtles, Chrysemys picta (Schneider), Clemmys guttata (Schneider), and Sternotherus odoratus (Latreille)*. PhD dissertation, University of Rhode Island, 1972.

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NOTE

1. The original circuit was designed by Werner Thiel, Engineering Technologist at the University of Toronto, with the assistance of Ken Jinde. This circuit was graciously provided by Dr. F. E. J. Fry of the University of Toronto. Roland DiSanto, technician in the Department of Electrical Engineering at the University of Rhode Island, provided working space and helpful suggestions during module assembly. Dr. Robert Haas, of the URI Department of Ocean Engineering, helped with the initial layout of the module, and Dr. Robert Kelley, of the Physics Department at Worcester State College, assisted with technical considerations concerning module function.