Build An AUTOMOBILE WINDSHIELD-WIPER CONTROLLER

Novel circuit provides variable on and off time for windshield wipers

BY WILLIAM KRAENGEL

AUTO-WIPER, an add-on intermittent windshield-wiper controller, evolved as a solution to the shortcomings of conventional controllers. Built around the ubiquitous 555 timer and a handful of discrete components, it offers some unusual features not found in most commercial systems.

Conventional SCR controllers use the wiper motor internal cam switch to commute (turn off) the SCR as the wiper motor cam rotates out of its detent. The electrical power to complete the wipe cycle flows through the cam park switch and the wiper switch until the cam once more rotates into detent interrupting the power flow to the motor. After a pause, the SCR is again pulsed "on" to repeat its single cycle. This approach to control is called open-loop (no feedback), single-cycle operation.

In most SCR wiper controllers, the system continues to operate as long as the wiper switch is turned on and power is applied to the circuit. And, although most can be slowed down (for a very light rain), many cannot be made to automatically perform one "pass" and then "pause" for any appreciable amount of time. To create such a pause requires operation of the wiper switch. This may mean that the wipers stop at any place along the wiper arc and at the park position (where they do not hinder the drivers vision) only fortuitously.

Most modern wiper systems use dynamic braking to stop the wipers at the park position. To interface to these sys-

tems, the SCR controllers usually require additional relay switching, or the dismantling of the dynamic braking feature, both undesirable alternatives.

Auto-Wiper is designed to work with a modern wiper system through a simple interface. Bipolar power transistors eliminate the SCR and its need for external commutation, while providing the dynamic braking essential for proper wiper action. As shown in Fig. 1, by means of a pulse generated by the cam switch once each cycle, synchronization between Auto-Wiper and the windshield wipers is maintained. Furthermore, these feedback pulses allow varying the number of wipes between pauses to one, two, three, or more without resetting the PAUSE control.

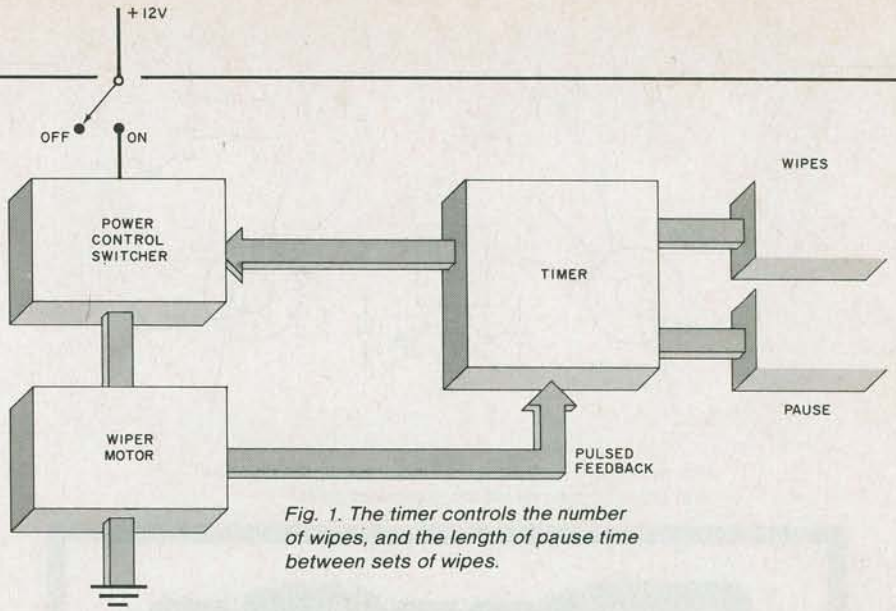


Fig. 1. The timer controls the number of wipes, and the length of pause time between sets of wipes.

How It Works. As shown in Fig. 2, the 555 timer, *IC1*, configured as a gated astable multivibrator with independently adjustable "on" and "off" times, derives its feedback from the voltage across the wiper motor. This voltage, governed by the park switch, pulses in synchronization with the wiper blades. Hence, the timer is controlled by the wipers themselves in addition to its "on" (WIPES, *R1*) and "off" (PAUSE, *R3*) time constants.

When *S1* (part of *R1*) is first closed, low voltage on pin 2 of *IC1* triggers the timer into its "on" state. Darlington power transistor *Q2* is cut-off but *Q1* is

PARTS LIST

C1—8.2-μF, 50-V, 10% solid tantalum capacitor (Sprague Q-Line #QDT1-61)
C2—0.01-μF, 50-V disc ceramic capacitor
C3,C5,C7—0.1-μF, 50-V disc ceramic capacitor
C4,C6,C8,C9—10-μF, 35-V upright (radial lead) electrolytic
D1,D2,D3—1N914 or similar diode
D4—1N4001 or similar diode
IC1—SE555 or MC1455 timer
Q1—2N6384 or MJ1000 transistor
Q2—2N6649 or MJ900 transistor
R1—1-megohm linear-taper potentiometer with push-pull switch (Mallory PP16L or similar)
R2—33,000-ohm, 1/4-W, 10% resistor
R3—10-megohm linear-taper potentiometer
R4—1000-ohm, 1/4-W, 10% resistor
R5,R6—120-ohm, 1/4-W, 10% resistor
Misc.—Heat sink (2) (RCA SK-KH3423 or similar), plastic case (Radio Shack 270-233 or similar), 1-inch diam. knob (2), pc board, IC socket or socket pins (optional), 6-ampere in-line fuse (see text).

Note: The following is available from CM Circuits, 22 Maple Ave., Lackawanna, NY 14218: etched and drilled glass-epoxy pc board for $4.25 plus $.50 postage and handling. Residents of New York state, add sales tax.

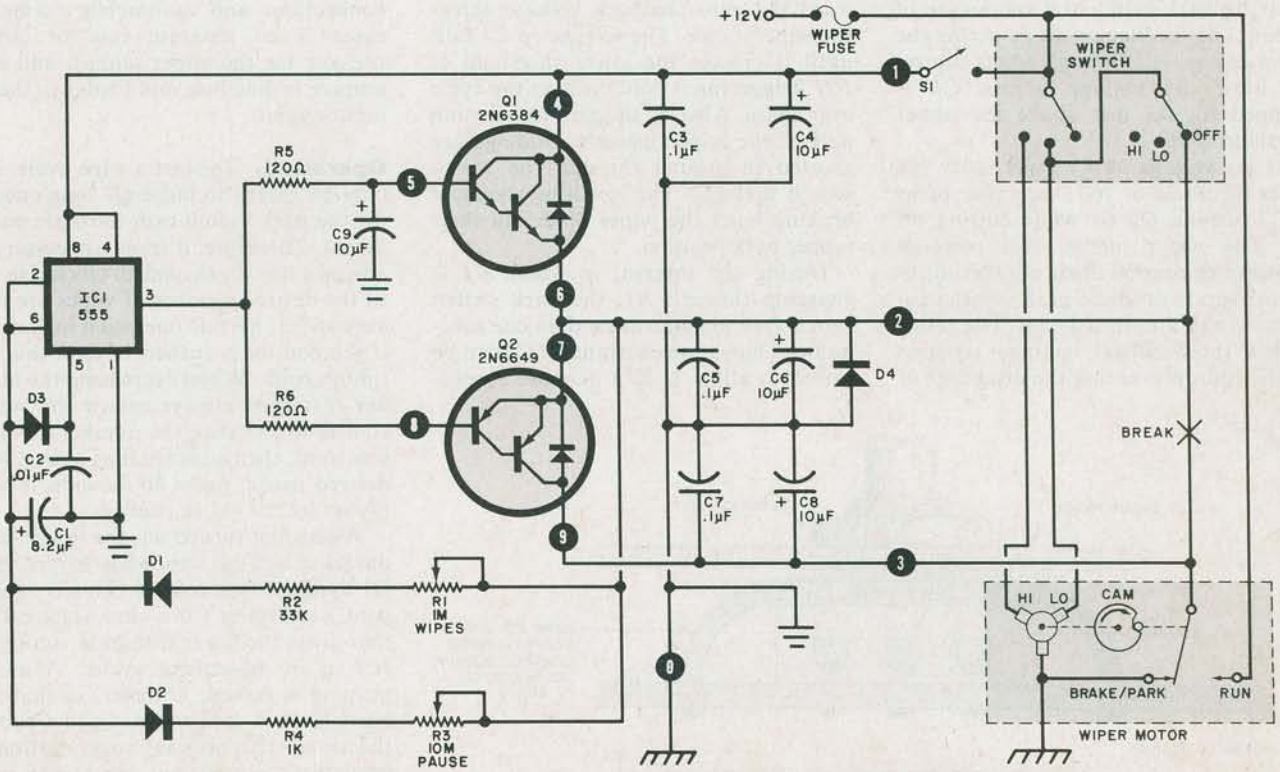


Fig. 2. The Auto-Wiper connects between the wiper switch and wiper motor after one lead is broken.

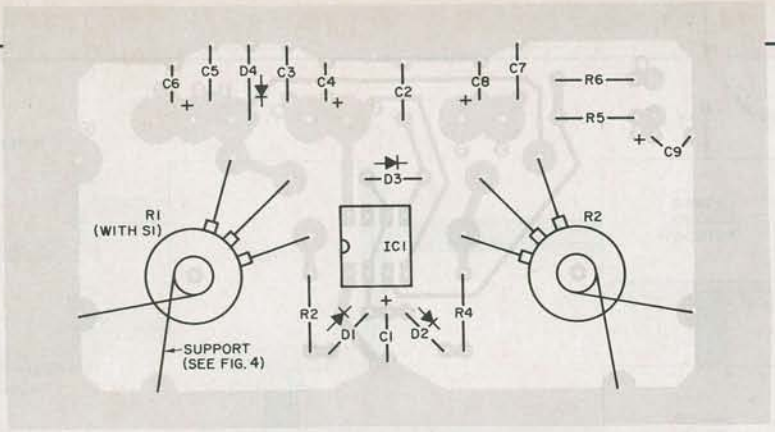
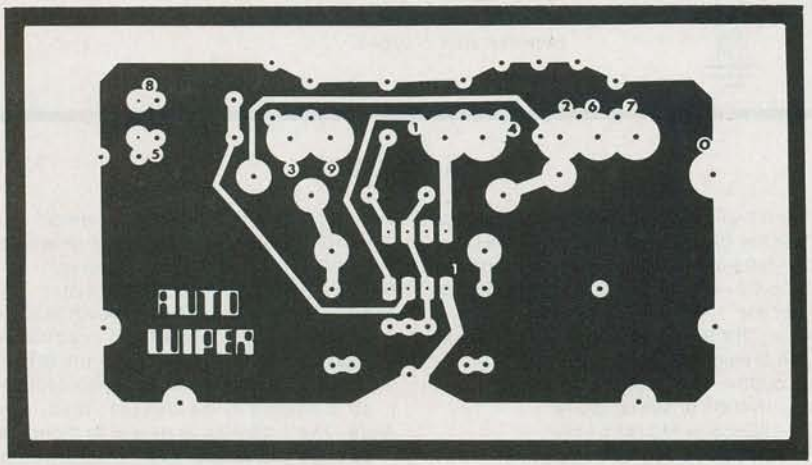


Fig. 3. The two transistors are mounted off the pc board with interconnections via the numbered pads.



turned on, allowing power to flow to the wiper motor. Power is also supplied to the motor through the internal diode of *Q2* as the park switch cam rotates out of detent. The feedback voltage across the motor charges *C1* through WIPES control *R1* until the voltage across *C1* is clamped by *D3* just above the upper threshold of *IC1*.

As the voltage on *C1* rises above the upper threshold of *IC1*, the timer turns "off", turning *Q2* on while cutting off *Q1*. The wiper motor, still powered through the internal diode of *Q2*, continues to operate until the park switch cam once more rotates into detent. The result is that the feedback voltage remains "high", thus preventing the discharge of *C1* until the cam rotates into detent. When this occurs, *C1* is freed to discharge through PAUSE control *R3* toward the zero feedback voltage across the wiper motor. The voltage on *C1* falls until it crosses the lower threshold of *IC1*, triggering it "on" to start the cycle over again. Also, as the cam rotates into detent, the wiper motor's windings are shorted to ground through the WIPER switch and *Q2*. The resulting dynamic braking halts the wiper blades in their proper park position.

During the interval in which *C1* is charging through *R1*, the park switch cam is free to make more than one revolution. Thus, time constant *R1C1* can be varied to allow 1, 2, 3 or more revolutions of the cam before the voltage on *C1* reaches the upper threshold of *IC1*. Similarly, as *C1* is discharged through PAUSE control *R3* toward the lower threshold of *IC1*, time constant *R3C1* varies the discharge time from zero to 60 seconds.

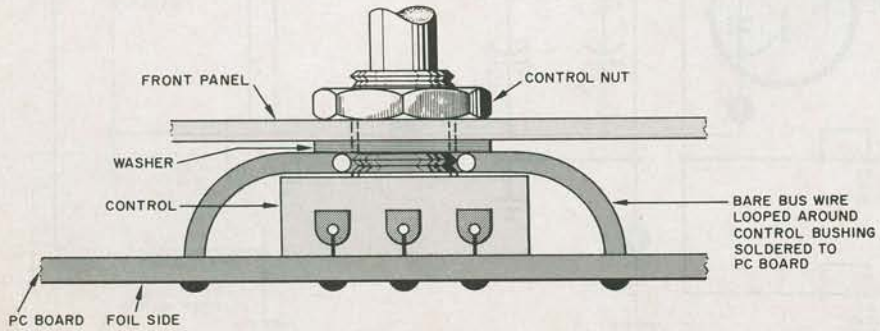


Fig. 4. How potentiometers are wired to board to provide support when mounted in case.

Construction. While there is nothing critical about the layout, construction is greatly facilitated if the pc board shown in Fig. 3 is used. The pc board is held in place by controls *R1* and *R3* which are fastened to the front panel of a small plastic case. If *S1* is attached to *R1*, it mounts through a suitable hole in the pc board. The controls are mounted to the board with short wire extensions from the terminals to the pertinent pc pads and with the bus wire straps shown in Fig. 4. The part specified for *R1* has a push-pull switch. Using this type of switch allows turning the Auto-Wiper on and off without changing the setting of *R1*.

It is suggested that a premium 18-volt 555 timer, such as an SE555 or MC1455 (RCA SK3564 or equal) be used rather than an ordinary 16-volt version since automobile primary voltages commonly exceed 15 volts. Transistors *Q1* and *Q2* are mounted on the rear of the case on individual heat sinks. If the heat sinks cannot be insulated from each other and/or ground, each transistor must be insulated from its heat sink.

Use 16-gauge or heavier wire from pc pads 0-4, 6,7 and 9 to the transistor collectors and emitters and to the wiper connections and automobile frame. If there is no separate fuse or circuit breaker for the wiper circuit, add a 6-ampere in-line fuse and holder to the *S1* input circuit.

Operation. To start a wipe cycle, it is only necessary to pulse *Q1* long enough for the park switch cam to rotate out of detent. Therefore, it is only necessary to advance the WIPES control clockwise until the desired number of wipes are reliably swept. Erratic operation may occur if the control is turned beyond this optimum point. When decreasing the number of wipes, always retard the WIPES control to less than the number of wipes you want, then advance it as above. Any desired pause, up to 60 seconds, is simply set by the PAUSE control.

When first turned on, the initial wipe duration will be somewhat longer than set by the WIPES control. This is caused by *C1* charging from zero volts rather than from the lower threshold voltage of *IC1* as in subsequent cycles. A useful purpose is served, however, in that the windshield is sure to be wiped clean at the start. The original wiper switch is normally not used, but can at any time override Auto-Wiper. ◇