

Simple solenoid driver is adaptable and efficient

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Solenoid loads generally exhibit large hysteresis. Application of the rated voltage actuates these loads. Once they are in position, however, you can use a significantly lower voltage to thereafter reliably hold them on. A lower sustaining voltage results in less

heat production and higher efficiency.

The circuit in **Figure 1** operates solenoid-driven air valves in the 4.2m Discovery Channel Telescope. The 24V-dc solenoid coil has a resistance of 72Ω . Diodes D_1 and D_2 and capacitor C_1 act as a ladder-type voltage multi-

plier. When Q_1 is off, they charge C_2 to approximately 1.5 times the peak-to-peak voltage of the transformer's secondary. The circuit in the **figure** shows approximately 24V.

When Q_1 turns on, the 24V on C_2 fires the solenoid. The solenoid current

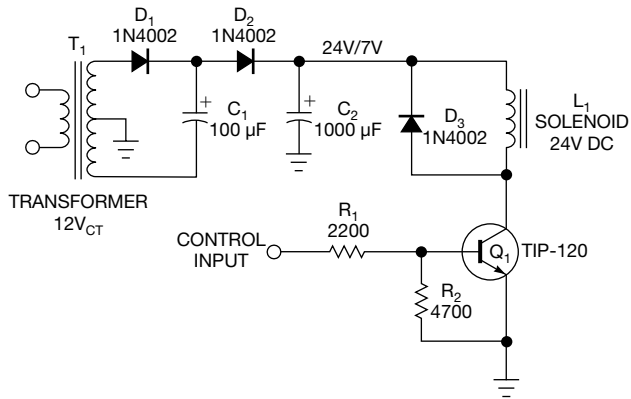


Figure 1 Capacitive-voltage division sets the precharge and sustaining voltages for efficient solenoid operation.

reduces the voltage on C_2 to a sustaining level of approximately 7 to 8V.

The selection of C_1 controls the sustaining voltage and the recharge time. Use an oscilloscope to confirm

that, when the circuit is on, the voltage across C_1 remains positive throughout its cycle. If it is not, use a larger capacitor or substitute a nonpolarized unit. Once off, the circuit recharges rapidly,

and the solenoid can fire again within 1 sec. Note that capacitor selection should be for $\pm 20\%$ -value tolerance or better.

The most attractive feature of this circuit is that C_1 , a purely reactive component, accomplishes the voltage drop to the sustaining voltage; therefore, no power is dissipated. C_1 and C_2 should have voltages higher than the firing voltage; this circuit uses 35V capacitors. With appropriate tweaking, you can use this circuit for many solenoid-driver applications.

The 4.3m Discovery Channel Telescope incorporates this circuit in its guider and wavefront-sensor systems to insert alignment masks into the light path. Work on the telescope is nearing completion, and it will come online this summer, complete with its own TV special on the Discovery Channel. Find details at the Lowell Observatory Web site (www.lowell.edu).**EDN**