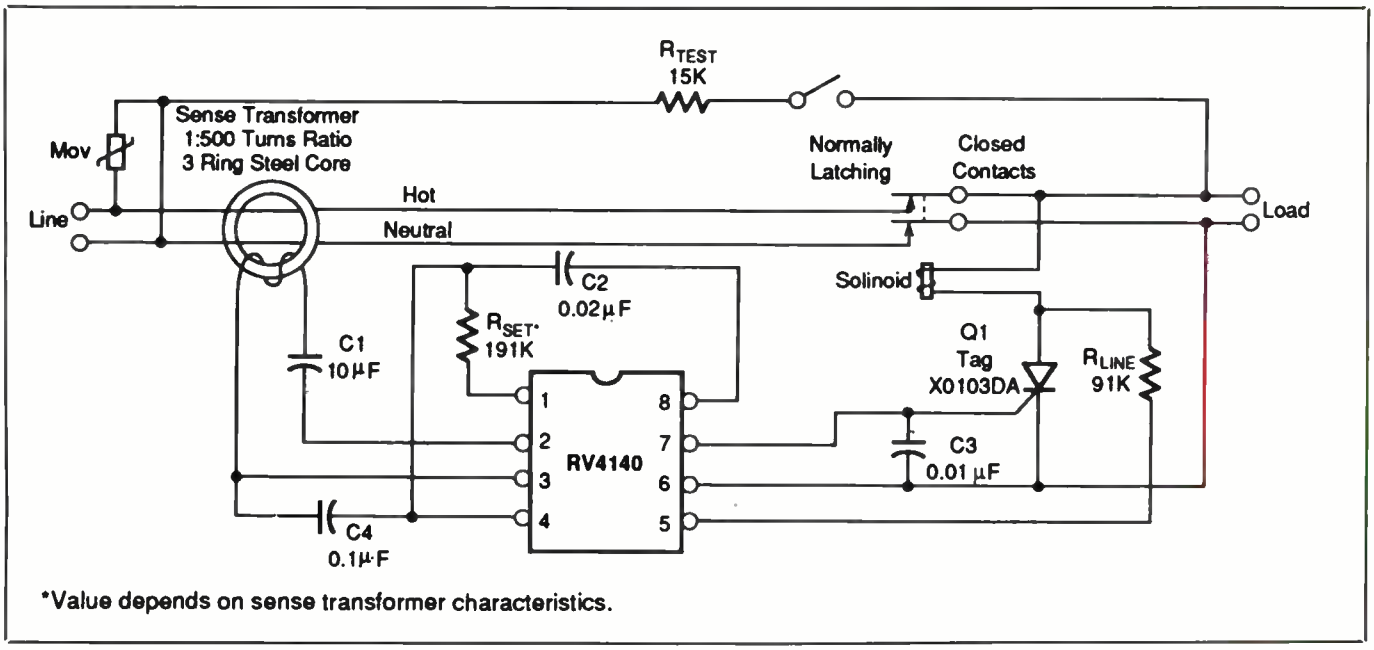

Fig. 1. Schematic details of a typical appliance leakage detector circuit application.

(350 Ellis St., P.O. Box 7016, Mountain View, CA 94039) has augmented its line of ground-fault interrupter (GFI) controller ICs with the RV4140, a low-power, two-wire GFI. The RV4140 is for use in home appliances such as hair dryers and curling irons, where it detects hazardous current paths to ground and prevents electrical shock.

Raytheon's existing line of GFIs is widely used in electrical wall receptacles in bathrooms, kitchens and outdoors around swimming pools. A new law, which goes into effect January 1991, will require electrical personal-care products used in bathrooms to include a leakage-detection device to prevent electrical shock. The RV4140 provides the control portion of a leakage-detection device.

The RV4140 has taken many of the external components typically found in GFI controllers and included them internally. Internal components of the RV4140 include a diode bridge rectifier, a 6.5-volt zener shunt regulator, an op amp, time-delay circuit, latch and SCR driver. External components include a sense transformer, SCR, relay, two resistors and four capacitors.

The following is a description of how a typical GFI works (Fig. 1). The RV4140 contains a 6.5-volt zener diode as part of an internal bridge rectifier. This is divided to create an internal reference of 2.9 volts connected to pin 3. The secondary of the sense transformer is ac coupled to the inverting input of an internal sense amplifier at pin 2; the noninverting input is referenced internally to pin 3. A current feedback loop around the sense amplifier ensures a virtual ground will be presented to the secondary of the sense transformer. In this manner, it acts as a current transformer instead of a voltage transformer. In this mode, transformer characteristics are very predictable.

The sense transformer has a toroidal core made of laminated steel rings or solid ferrite material. The secondary of the transformer is 500 to 1,000 turns of No. 40 wire wound through the toroid. The primary is one turn made by passing the ac "hot" and neutral wires through the center of the toroid. When a ground fault exists, a difference occurs between the current flowing in hot and neutral wires. The difference primary current, divided by the number of secondary turns, flows through the secondary wire of the transformer.

The ac-coupled transformer secondary current then flows through the sense amplifier's feedback loop, creating a full-wave rectified version of the secondary fault current. This current passes through the RSET input at pin 1, generating a voltage that is compared with the reference voltage at pin 3.

If the voltage at pin 1 is greater than that at pin 3, an internal comparator charges *C2* through a 29-µA current source at pin 8. If the voltage at pin 1 exceeds that at pin 3 for longer than a specified delay time, a 400-µA current pulses between pins 6 and 7 and triggers the SCR's gate.

If the voltage at pin 1 exceeds that at pin 3 for less than the delay time, the SCR will not trigger. The fault current at which the controller triggers the SCR is dependent on the value of RSET and the time delay determined by the value of *C2*.

UL 943 requires that the circuit interrupter trip when the ground fault exceeds 6 mA and not trip when the fault current is less than 4 mA.

The RV4140 has a built-in diode bridge

rectifier that provides power to the chip that is independent of ac-line polarity. This eliminates the external rectifier required for previous GFI controllers.

The SCR used in the circuit must have a high dV/dt rating to ensure that line noise (generated by electrically noisy appliances) does not falsely trigger the SCR. Also, the SCR must have a gate drive requirement that is less than 200 μA. Noise filter *C3* prevents high-frequency line pulses from triggering the SCR.

The relay solenoid used should have a 3-ms or shorter response time to meet the UL 943 timing requirement. Magnetic Metals Corp. (Camden, NJ) supplies a full line of ring cores and transformers designed specifically for GFI and related applications.

The RV4140 is available over the industrial operating temperature range in an 8-lead plastic DIP and an 8-lead plastic small-outline package. Pricing in 100-piece quantities starts at 68 cents.