

Ground Fault Interrupter

The LM1851 from Raytheon Semiconductor (350 Ellis St., Mountain View, CA 94043) is a controller for ac outlet ground fault interrupters. The device detects hazardous grounding conditions (for example, a pool of water and electrical equipment connected to opposite phases of the ac line) in consumer and industrial environments. The output of the LM1851 triggers an external SCR, which, in turn, opens a relay circuit breaker to prevent a harmful or lethal shock.

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The LM1851, by complying with U.S. UL943 timing standards, ensures maximum immunity to false triggering due to line noise. Additionally, there is circuitry to reset a timing capacitor in the event that noise pulses introduce unwanted charging currents. A flip-flop is included to ensure firing of even a slow circuit breaker relay on either half-cycle of the line voltage when external full wave rectification is used.

The LM1851 can be configured to detect both normal faults (an unintentional electrical path, between the load terminal of the hot line and the ground, as shown by the dashed lines in Fig. 4A) and grounded neutral faults (an unintentional electrical path between the load terminal of the neutral line and ground, as shown by the dashed lines in Fig. 4B).

A typical ground fault interrupter circuit is shown in Fig. 5. It is designed to operate on 120 V ac line voltage with 5 mA normal fault sensitivity. A full-wave rectifier bridge and a 15,000-ohm/2-watt resistor are used to supply the dc power required by the LM1851. A 1-microfarad capacitor at pin 8 used to filter the ripple of the supply voltage is also connected across the SCR to allow firing of the SCR on either half cycle.

When a fault causes the SCR to trigger, the circuit breaker is energized and the line voltage is removed from the load. At this time, no fault current flows and the timing capacitor (C_T) discharge current increases from threshold current I_{th} (the value of current set by the external resistor R_{SET}) to 3 times I_{th} . This quickly resets both the timing capacitor and an output latch on the chip. The circuit breaker can be reset and the line voltage again supplied to the load, assuming the fault has been removed.

A 1000:1 sense transformer is used to detect the normal fault. The fault current, which is basically the difference current between the hot and neutral lines, is stepped down by 1,000 and fed into the input pins of the operational amplifier through a 10-microfarad capacitor. The

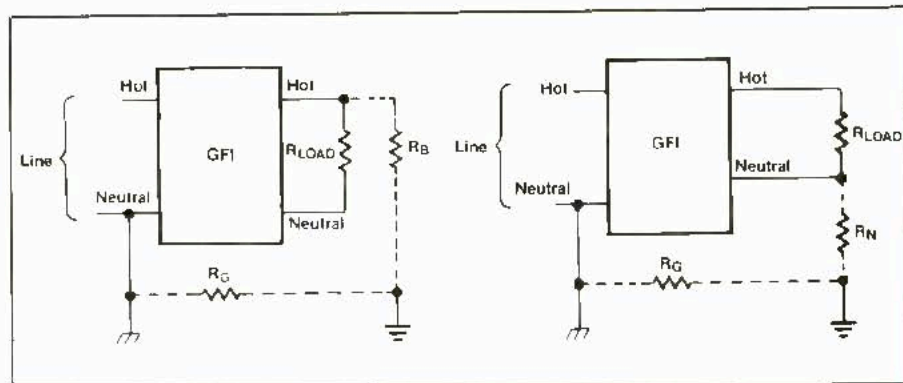


Fig. 4. Raytheon's LM1851 ground fault interrupter chip can be configured to detect (A) normal unintentional electrical-path faults between the load terminal of the hot line and ground and (B) grounded neutral faults where an unintentional electrical path exists between the load terminal of the neutral line and ground (dashed line.).

0.0033-microfarad capacitor between pin 2 and pin 3 and the 200 picofarads between pins 3 and 4 are added to obtain better noise immunity. Normal fault sensitivity is determined by timing capacitor discharging current I_{th} (set by R_{SET}).

Grounded neutral detection is accomplished by feeding the neutral coil with 120-Hz energy continuously and allow-

ing some of the energy to couple into the sense transformer during neutral fault conditions.

The LM1851 is available in an 8-lead plastic DIP and an eight-lead small-outline package. Pricing is \$1.19 in 100-piece quantities. Transformers can be obtained from Magnetic Metals (21 St. and Hayes St., Camden, NJ 08101). **ME**

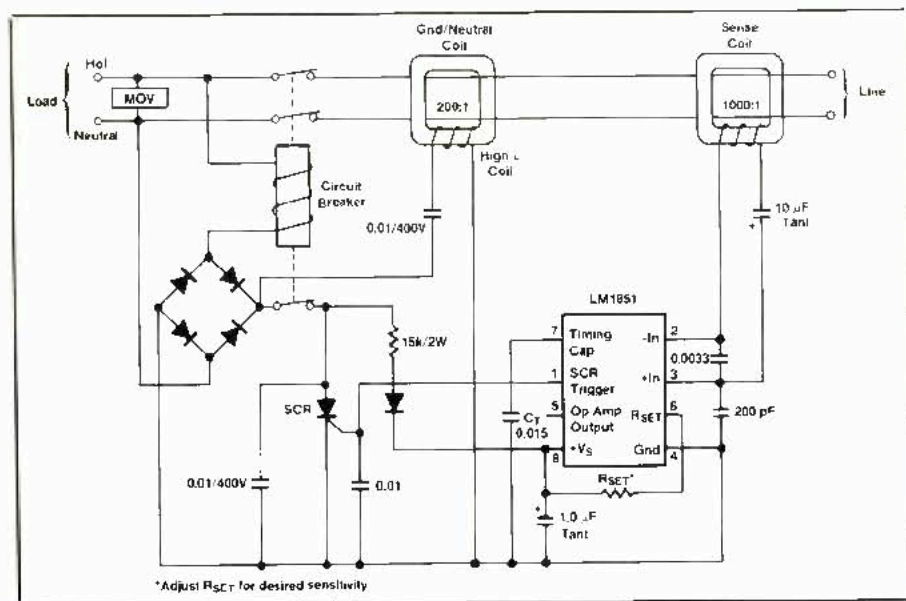


Fig. 5. A typical ground fault interrupter circuit.