AC Circuit Breaker

Our next circuit is presented in response to a reader's request for an *AC Circuit Breaker* to go along with the DC breaker circuit presented a few months ago. The circuit in Fig. 3 just might be the answer to your AC fuse-blowing blues. With the component values given, the Breaker can be set to open at current levels of from 0.25-amps to 5-amps. Resistive or inductive loads can be connected to the circuit.

The AC neutral line (white wire) connects directly between the line and the operating load. The hot line (black wire) connects through a special current transformer and a triac control circuit. As the load current fluctuates, so does the voltage at the secondary of T1. The secondary voltage of T1 is rectified by D1. Capacitor C1 is then used to filter out some of the ripple content of the resulting DC voltage. Resistor R1 provides a constant 1000-ohm load to the output and also offers a fast discharge path for C1.

The desired trip current is set by R12, which has its wiper connected to the base of Q1. As long as the voltage at the wiper of R12 remains below 1.2 volts, Q1 and Q2 remain off, and the load is unaffected by the Circuit Breaker. Resistors R7 and R8 supply current to the internal LED of U1 (an MOC3010 optoisolator/coupler). As long as the LED is activated, the U1 gate current to TR1, maintaining the normal operation of the connected load.

When an overload condition occurs, the voltage at the base of Q1 rises above the 1.2-volt trigger level, turning it on. That, in turn, causes transistor Q2 to turn on, supplying a positive bias to the gate of SCR1, triggering it into conduction. That pulls SCR1's anode voltage to near ground potential, robbing the optoisolator/coupler's LED drive. That opens the optoisolator/coupler's output circuit, which turns off the bias to the triac and opens the Circuit Breaker. When conditions are back to normal, S1 can be pressed to re-set the circuit.

The Circuit Breaker contains only one item that's not common; the current transformer. The current transformer is easily fabricated from a 12–24-volt, 1–2-amp power transformer. The selected transformer must be of the kind that has the secondary as the outermost winding. Carefully remove the secondary winding and replace it with 7 or 8 turns of #16 solid or stranded wire. The new winding is connected in series with the AC load; see Fig. 3. The 117-volt primary winding now becomes the secondary that connects to D1.

The remaining circuitry can be meshed together on a small perfboard. It's a

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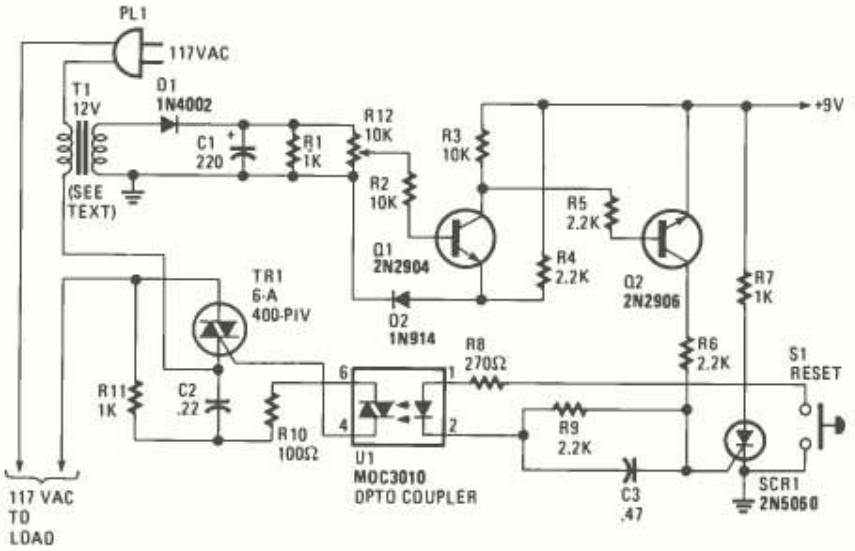

Fig. 3—The AC Circuit Breaker, with the component values shown, can be set to open at current levels of between .25 and 5A.

PARTS LIST FOR THE AC CIRCUIT BREAKER

U1—MOC3010 optoisolator/coupler, integrated circuit
TR1—6-A, 200-PIV triac
SCR1—2N5060 low-power, silicon-controlled rectifier
Q1—2N2904 general-purpose NPN silicon transistor
Q2—2N2906 general-purpose PNP silicon transistor
D1—1N4002 100-PIV, 1-A rectifier diode
D2—1N914 small signal silicon diode
R1, R7, R11—1000-ohm, ¼-watt, 5% resistor
R2, R3—10,000-ohm, ¼-watt, 5% resistor
R4–R6, R9—2200-ohm, ¼-watt, 5% resistor
R8—270-ohm, ¼-watt, 5% resistor
R10—100-ohm, ¼-watt, 5% resistor
R12—10,000-ohm potentiometer
C1—220-μF, 25-WVDC mylar capacitor
C2—0.22-μF, 400-WVDC mylar capacitor
C3—0.47-μF, 100-WVDC mylar capacitor
T1—117-volt primary, 12-volt secondary transformer (modified, see text)
S1—Normally-open pushbutton switch
PL1—117-VAC molded plug and line cord

Printed circuit or perfboard materials, enclosure, IC socket, 117-VAC socket, 9-volt power source, wire, solder, hardware, etc.

good idea to use an IC socket for the optoisolator/coupler. For long-term service, a small aluminum heat sink for TR1 wouldn't hurt. Either a 9-volt battery or a simple AC-derived power supply can be used to power the circuit.

To use the Circuit Breaker, turn the wiper of R12 to ground, connect the load, and apply AC power. Operate the load at its maximum current and slowly back off R12 to the point where the circuit trips off. From that setting, turn R12 up an additional eighth of a turn for resistive loads, and a quarter turn or more for inductive loads.

Resistor R12's trip setting can be roughly calibrated by connecting a 100-watt light bulb for the load and marking the trip point for slightly less than one amp, a 200-watt lamp for about 2 amps, a 300-watt lamp for 3 amps, and so on up to 5 amps. For a greater operating range, increase the wire size on T1 and use a triac with higher current rating for TR1.

Well that's about all the space allotted to us for this month. But be sure to join us next month when we'll have another set of circuits that, hopefully, will entertain you and train you in the ways of electronics. So until then, good luck and may the flow be with you. ■