CONSTRUCTION

Protect Your AIR CONDITIONER WITH A "COMPRESSOR GUARD"

Add-on device prevents compressor damage due to sudden loss and reappearance of electric power and low-voltage conditions.

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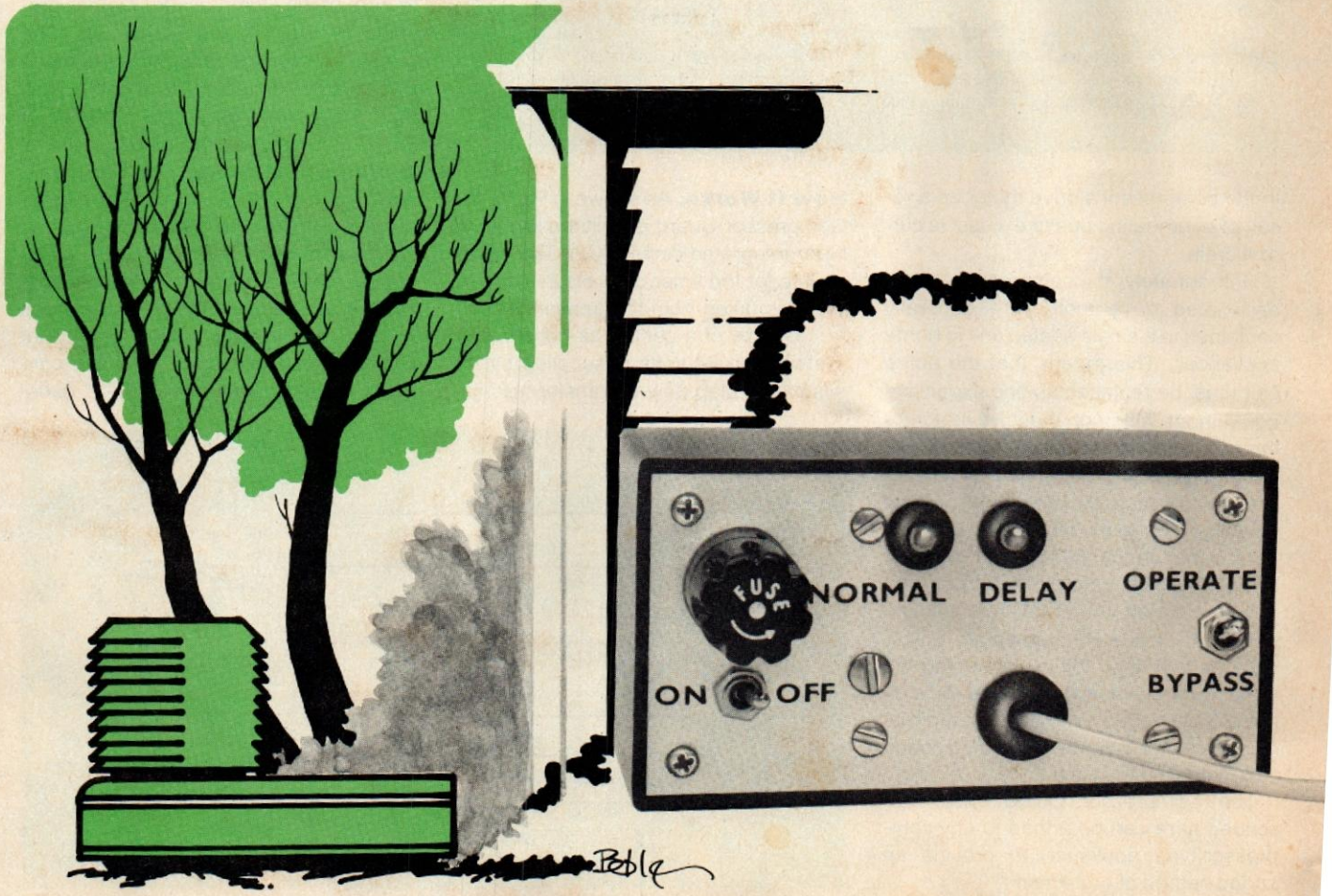
POWER BLACKOUTS and brownouts, especially during hot spells when the demand for power is at its peak, can cause damage to air-conditioners, refrigerators, and freezers. You can protect your compressor-type appliances from damage due to fluctuating power with the "Compressor Guard" described in this article. It costs about $15 to build and is easily installed.

Problem Defined. If power to the compressor is suddenly lost and reapplied before system pressures can be equalized, such as during a momentary power outage, damage to the system compressor can result. A low-voltage condition, commonly called "brownout," can also cause damage. In both cases, the damage usually takes place



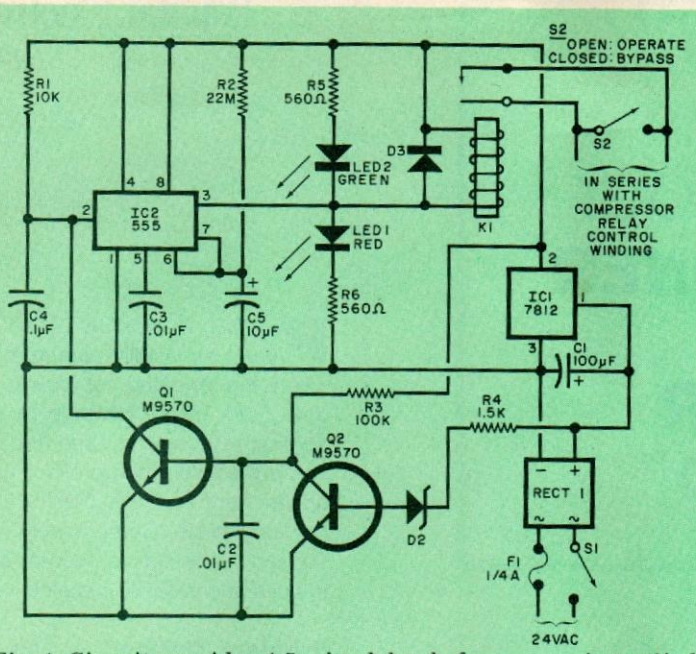


Fig. 1. Circuit provides 4.5 min. delay before power is applied.

PARTS LIST

C1—100-μF, 50-volt electrolytic
C2,C3—0.01-μF disc capacitor
C4—0.1-μF disc capacitor
C5—10-μF Tantalum capacitor
D2—Zener diode (see text)
D3—1N4001 rectifier diode
F1—¼-ampere fast-blow fuse and holder
IC1–7812 voltage regulator
IC2—555 timer
K1—Spst relay with 12-volt coil and 1-ampere contacts (Radio Shack No. 275–003 or similar) or appropriate substitute (see text)
LED1,LED2—Discrete light-emitting diode (one red, one green)
Q1,Q2—M9570 or similar npn transistor
The following resistors are ¼-watt, 10%:
R1—10,000 ohms
R2—22 megohms
R3—100,000 ohms
R4—1500 ohms
R5,R6—560 ohms
RECT1—50 PIV bridge rectifier assembly
S1,S2—Spst switch
Misc.—Socket for IC2; chassis; 4-conductor cable; rubber grommets; machine hardware; hookup wire; solder; etc.

in the compressor's drive motor as a result of overheating due to excessive current drain.

Unfortunately, the compressor and its associated drive motor are generally contained in a single sealed unit in home appliances. This means that the entire unit must be replaced as one expensive component. Although the drive motor for the compressor is usually equipped with a thermal circuit breaker, it takes time for it to sense an overload condition and disable power to the motor. The problem here is that during the time the overload condition exists, before is is sensed and power is cut off, the motor can stall and burn out. Repeated momentary power outages take their toll in weakening the motor, with the result that the motor is ultimately damaged even with the thermal circuit breaker in proper operating condition protecting the circuit.

The Compressor Guard circuit described here can be added to any compressor-type appliance to provide an added degree of protection.

How It Works. As shown in Fig. 1, the Compressor Guard is built around a 555 timer integrated circuit (*IC2*). The power source for the timer circuit is 24 volts ac, which is taken from the appliance itself. In the case of a central air-conditioning system, the 24 volts is supplied by the system's step-down transformer, as shown in Fig. 2. This transformer is part of the air-conditioning control circuitry and supplies power to the compressor's control relay through the contacts of the house thermostat. If the house is too warm, the thermostat closes and energizes the control relay, which in turn supplies power to the compressor unit. (Note: If the compressor system operates at a higher voltage, a separate 24-volt source and a relay with contacts rated for high voltage and current must be used in addition.)

The 24 volts ac is converted to regulated dc by *RECT1*, *C1*, and *IC1* in Fig. 1 to supply power for the timer circuit. Approximately 4.5 minutes after power is applied, pin 3 of *IC2* switches low and energizes relay *K1*. The period is controlled by *R2* and *C5*. With the *K1* contacts closed, a series circuit with the system's thermostat is completed. The compressor can then energize. If a momentary power outage occurs, a minimum of 4.5 minutes must lapse before power can be reapplied to the compressor. This period of time is all that is needed to allow system pressures to equalize and the compressor to be safely started once again.

The low-voltage brownout protection feature of the Compressor Guard is provided by the *Q1* and *Q2* circuits. The breakdown voltage rating of zener diode *D2* is approximately 7% to 10% less than the normal dc output potential of *RECT1*. As long as the output potential from *RECT1* is greater than the breakdown point of *D2*, *Q2* is in a state of conduction and *Q1* is held at cutoff.

If system line voltage drops, a resultant decrease in the output potential from *RECT1* will occur. If the potential drops to less than the breakdown voltage of *D2*, *Q2* goes into cutoff and *Q1* conducts. This grounds pin 2 of *IC2*, caus-

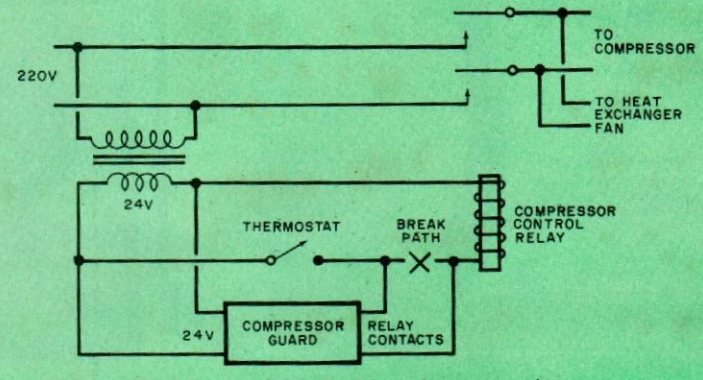
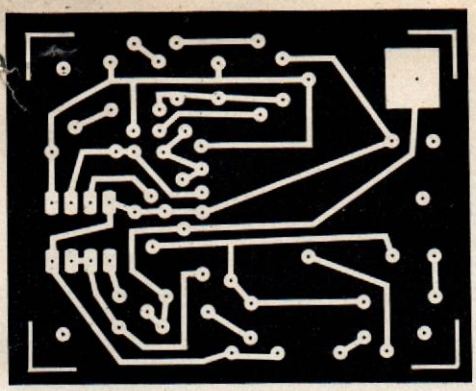


Fig. 2. Circuit showing how to wire Compressor Guard to existing system.



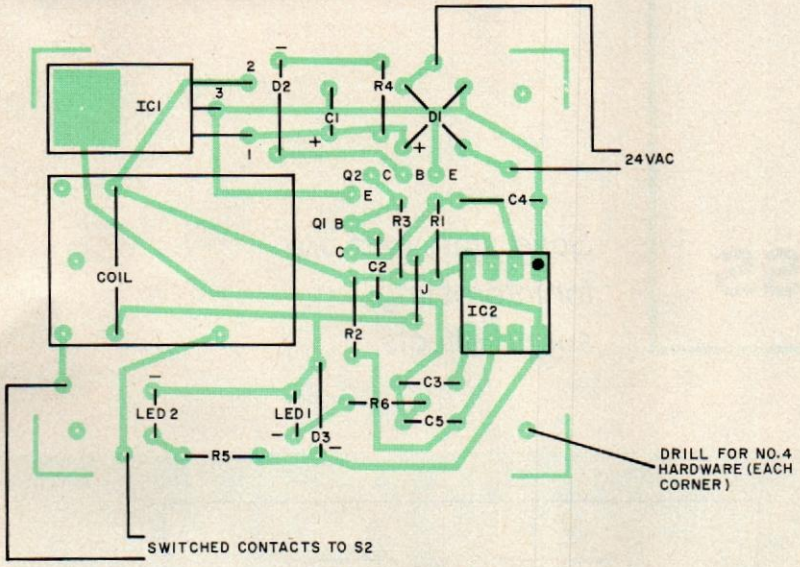


Fig. 3. It is best to assemble the circuit on a printed circuit board. An etching and drilling guide is at top with component placement guide shown below it.

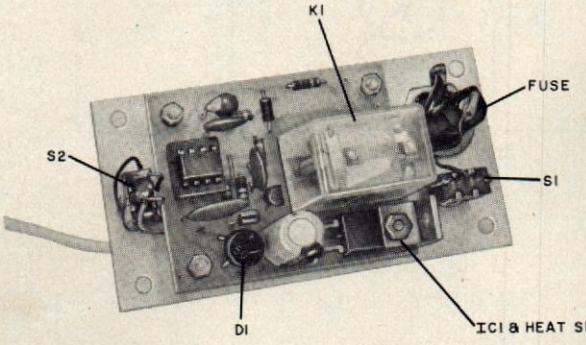


Fig. 4. Photo of prototype printed circuit board removed from enclosure.

ing pin 3 of *IC2* to switch high and deenergizing *K1*. As long as the low-voltage condition exists, *K1* remains deenergized and interrupts power to the compressor. About 4.5 minutes after the brownout condition clears, *K1* energizes to once again supply power to the compressor system.

Status indication of the timer circuit is provided by *LED1* and *LED2*, which are red and green light-emitting diodes, respectively. While the timer is cycling *LED1* is on. Then, when *K1* is energized, *LED1* extinguishes and *LED2* comes on. The LED's and resistors *R5* and *R6* are not essential to the circuit and can be omitted if desired.

The Compressor Guard can be bypassed by closing *S2*. This shorts out the contacts of *K1*. Switch *S2* is included in the circuit to allow system maintenance to be performed.

Construction. Most of the circuit is best assembled on a printed circuit board, the etching-and-drilling guide and component-placement diagram for which are shown in Fig. 3. A small right-angle bracket is used as a heatsink for regulator *IC1*.

Since the pc board assembly mounts behind the front panel of the cabinet in which the circuit is housed, *LED1* and *LED2* (if used) should be mounted on the foil side of the board. Leave enough lead length on the LED's to permit the lenses to fit into small rubber grommets in the front panel when the board is mounted in place with spacers and machine hardware. The fuse holder for *F1*, POWER switch *S1*, and OPERATE/BYPASS switch *S2* should also be mounted on the front panel.

The 24-volt power and relay contact lines can be contained in a four-conductor cable that enters the cabinet through a rubber-grommet-lined hole in the front panel. The assembled printed circuit board is shown in Fig. 4.

To install the Compressor Guard in a system, use the diagram shown in Fig. 2 as a guide. Although Fig. 2 is the representation of the typical scheme used in most central air-conditioning systems, check your system closely to insure compatibility with the Compressor Guard's circuitry. Also, if you are using the Compressor Guard to protect a refrigerator or freezer that does not have the stepped-down 24 volts required, be sure to use a separate 24-volt supply and a heavy-duty relay.

With the Compressor Guard turned on and the compressor running, measure the dc output potential from *RECT1*. Then multiply the figure obtained by 0.93 or 0.90 to obtain the approximate breakdown value of the zener diode required for *D2*. If you cannot obtain a zener diode with the proper breakdown voltage, use two zener diodes that, when connected in series, yield a breakdown characteristic that is as close as possible to the required value.

One Last Note. The Compressor Guard presented here has been designed for inside installations. If you plan to use it in an outside air-conditioning installation, be sure to provide adequate weather proofing to protect the circuit from the elements. ◇