

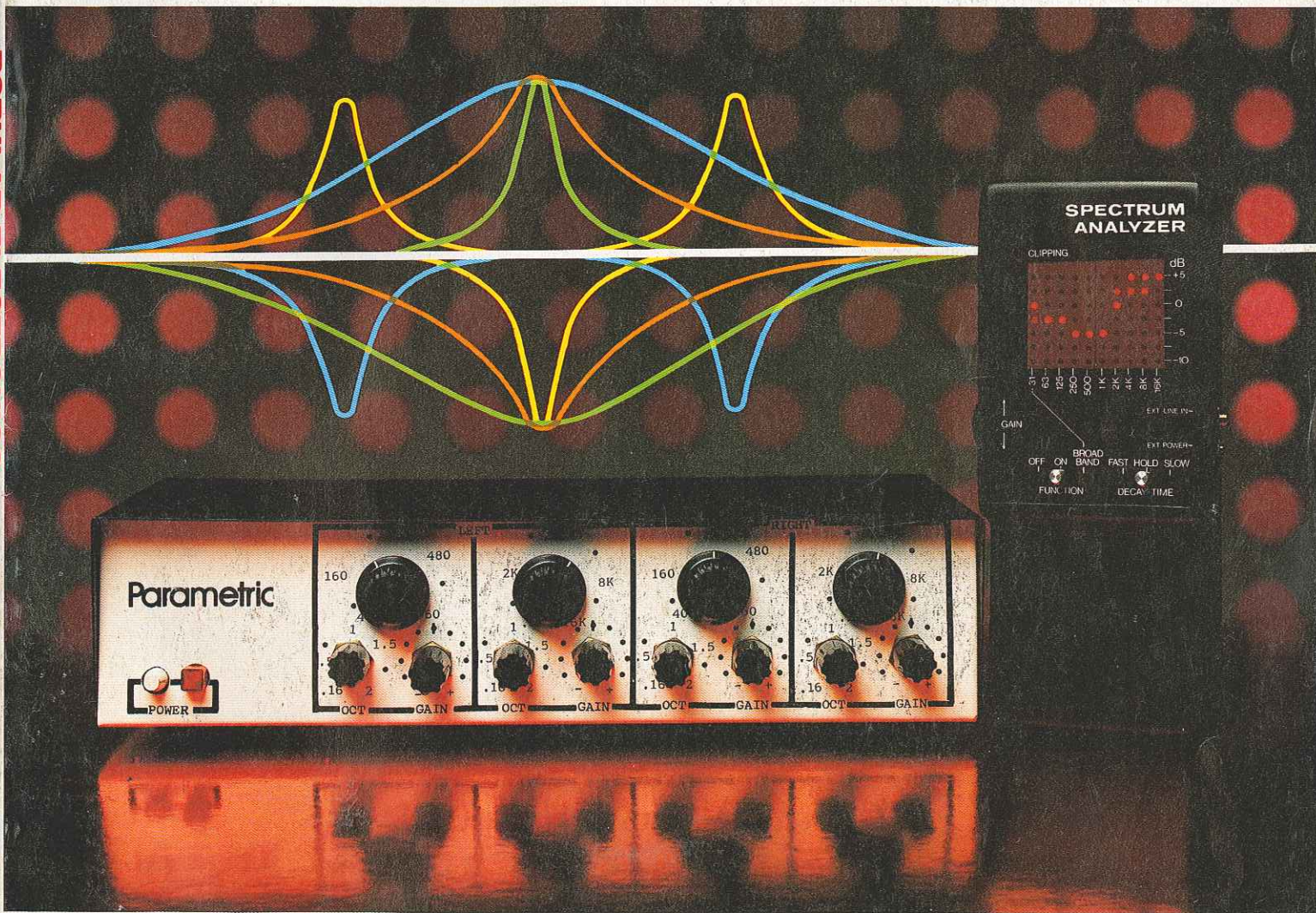
Popular Electronics®

WORLD'S LARGEST-SELLING ELECTRONICS MAGAZINE SEPTEMBER 1979/\$1.25

A Monostable Catalog for Experimenters
Simple Computer Control Interfaces

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BY CASS R. LEWART

Make Your Computer Work As a Control Center

Simple circuits enable small-computer owners to perform a variety of external operations.

ONCE YOU tire of playing graphic games on your home computer, have solved all the mathematical problems you care to, and exhausted your list of favorite tunes, you may start thinking about new applications for that wonderful machine. Some of the more attractive uses for a home computer are in the controlling of appliances. In this article, we will present a few simple and proven inexpensive circuits that allow your computer to turn on the coffee pot in the morning, turn lights on and off while you are away to confuse a potential burglar, or control your slide projector and tape recorder in response to various cues.

The great advantage of using a computer to control appliances is its flexibility. No more relays driving relays, where the slightest change in the logic may require redesigning and rewiring your circuit from scratch. A simple change of a few instructions in your program can

now accomplish the same objectives relatively painlessly.

Computer Interface. The computer interacts with the outside world by means of I/O (input/output) ports. These ports consist of a connector where specific pins can assume either a high or a low logic status. In most cases, a high corresponds to approximately +5 volts, while a low corresponds essentially to 0 volt (ground). Specific instructions in your program (BASIC or machine language) are used to set voltages to the required values.

As a rule, computer ports can supply only a very small amount of current, usually on the order of 1 mA. Therefore, in order to control any device drawing appreciable power, it is necessary to have interface circuits that translate logic signals from computer ports into relay-contact operations, LED activation, or ac appliance and motor movements.

Because program instructions to control I/O ports differ from one computer to the next, we will not go into details of port programming. Instead, we will assume you are familiar with the programming of your particular computer and know how to set logic signals at its ports low or high.

Some computers use separate ports for input and output, while others use the same ports for both, depending on program instructions. Consult the port operation section in the programming manual for your computer.

In general, when you interface the computer, the program will provide timing and logic for whatever you are doing. Input ports connect to sensors, such as door switches, thermostats, light sensors, etc, while output ports interface to relays, LEDs and solid-state switches. The interface circuits discussed and illustrated in this article deal with computer output ports only.

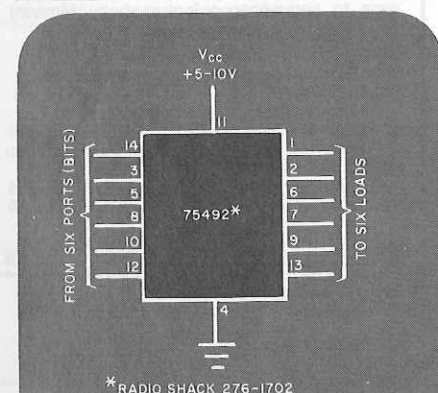


Fig. 1. Six inverters in 75492 can sink up to 200 mA each.

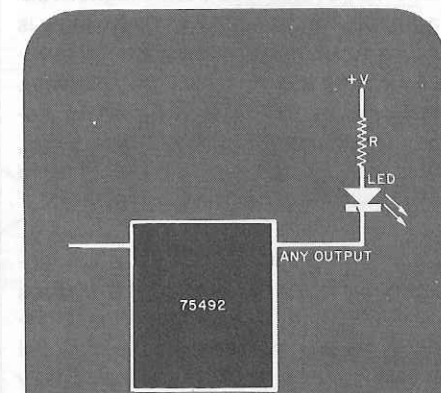


Fig. 2. LED interface circuit used to compute resistance, R.

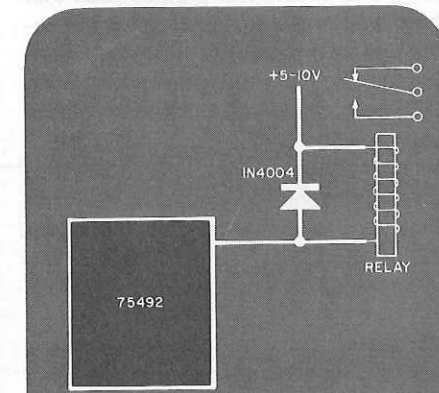


Fig. 3. Low-power relay interface requires protective diode.

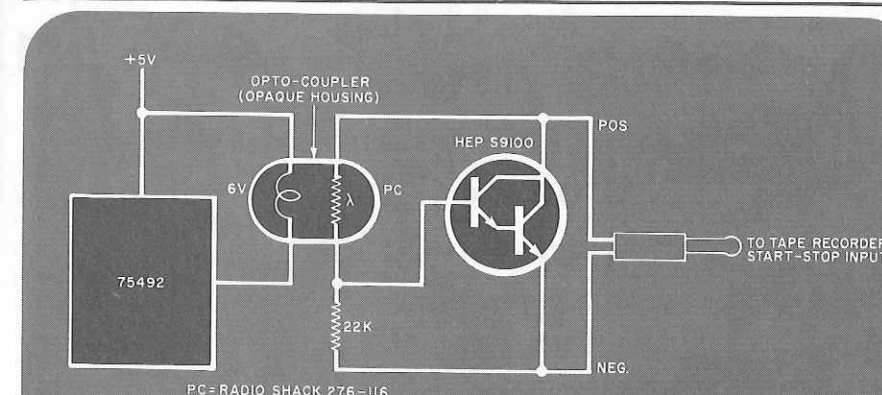


Fig. 4. Relay interface can be replaced by an optoisolator. Here is a homemade version.

Basic Interface. A basic output interface, an inexpensive SN75492 MOS LED-driver IC, is shown in Fig. 1. Six computer output-port pins connect directly to the inputs of the device which can sink up to 200 mA on each of its six outputs. This current is sufficient to directly drive a small relay, LED, or optoisolator. All of the interface circuits given in this article employ the SN75492 as the basic building block.

If more than six ports of a computer are being used for control, more than one SN75492 IC can be used. The same port can also drive more than one output (for example, an ac load and a LED to indicate an on condition).

LED Interface. Shown in Fig. 2 is a typical LED interface circuit. To compute the values of the dropping resistor in the external circuit, use Ohm's Law: $R = E/I$, where R is the dropping resistor's value, E is the supply voltage, and I is the current through the LED. Remember to take into account the one-diode voltage drop of the inverter in the IC and the drop across the LED.

As an example of calculating the resistor's value, assume $E = 10$ volts, $I = 20$ mA, the voltage dropped across the LED is the typical 1.5 volts, and 0.7 volt is dropped across the internal diode of the inverter. The value of the dropping resistor is $R = E/I = (10 - 1.5 - 0.7) / 0.02 = 390$ ohms. To determine the resistor's power rating, use the formula $P = I^2R$. Plugging in values, we obtain $P = (0.02)^2 \times 390 = 0.156$ watt, which means you can safely use a standard 1/4- or 1/2-watt resistor.

DC Relay Interface. A low-voltage relay whose coil draws less than 200 mA of current can be operated through the output of the IC, as shown in Fig. 3. Make sure that the current demand of the relay's coil does not exceed 200 mA, and install a diode as shown to protect the IC from back-emf spikes.

The relay's contacts can be used to turn on and off power for almost any electrical device whose demands are less than the volt-ampere (VA) or current (at the load's operating voltage) rating of the relay's contacts. For heavy

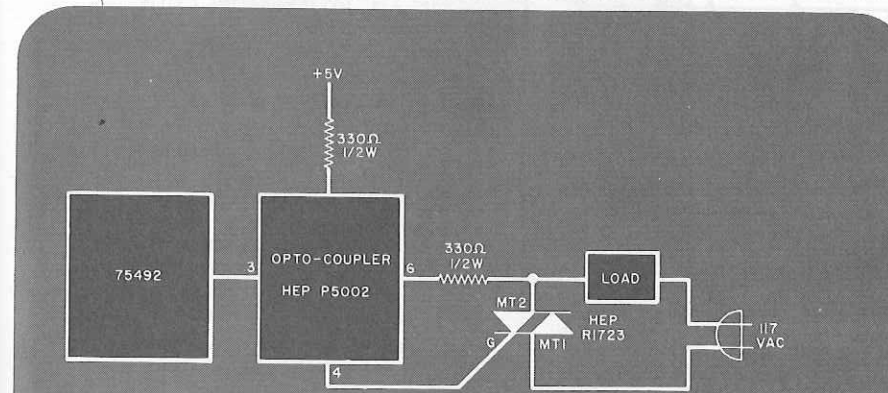


Fig. 5. This circuit, using an infrared optoisolator and a triac, can be used to control loads up to 600 watts.

loads, the low-power relay can be used to control a power relay with heavy-duty contacts.

Tape-Recorder Interface. Turning on and off a tape recorder under computer control can be very useful for color-slide presentations. Other attractive applications include loading programs from a cassette deck into a computer and storing of programs on tape. The tape deck you wish to control must be equipped with a start/stop control system accessed by way of a jack—usually located near the microphone jack. To turn the tape deck on and off one can connect contacts of a relay (Fig. 3) to a plug inserted in the on/off jack on the tape recorder. If you wish to eliminate the relay, an alternate circuit shown in Fig. 4 uses a Darlington transistor and an optoisolator consisting of a cadmium-sulfide (Cds) photocell and a low-voltage lamp in a light-tight housing. Because this circuit is polarized, it may be necessary to reverse the leads to the tape deck's plug to make the circuit work.

The reason for using an optoisolator in this and the following circuit is to keep the computer and the circuit it controls electrically separate. This is to provide protection for the computer. High insulation resistance between the computer and the ac power line will safeguard low-voltage logic circuits and, not incidentally, the human operator.

Control of AC Appliances. An alternative to a relay or simple light coupler is shown in Fig. 5. The Motorola HEP P5002 is an optoisolator that houses an infrared diode and a small triac. The low power triac, in turn, controls a larger triac, such as the HEP R1723 that switches the ac power to the load. The rating of the larger triac determines the maximum wattage that can be controlled. For example, the HEP R1723 will work with appliances consuming up to 600 watts. Pulsing the appropriate port under program control will result in partial power being delivered to the appliances, allowing the computer to dim lights and run motors at variable speeds.

In Conclusion. The foregoing are just a few possible schemes for interfacing your computer with practical appliances. After you familiarize yourself with these circuits and their capabilities, other schemes may suggest themselves. You may even devise interfaces that you wish to keep permanently connected. ◇