

An Infrared Remote Control Relay

\$10 project provides wireless VCR control to remote TV sets

By Joseph O'Connell

The Infrared Remote Control Relay is a simple project that can be built for under 10 dollars. It will send the command signals of a hand-held infrared remote-control unit from one room to another. Therefore, if you have a VCR and TV receiver in one room and a second TV set installed in another room, as in Fig. 1, this project will save you the time of running back and forth between the second TV set and the VCR machine that is controlling it. Without it, you'd have to leave the room just to change channels or operate the VCR.

This device isn't only limited to video systems. Stereo systems with infrared controls can also use the relay to send commands from another room. Even some computer keyboards, electronic scales, and household appliances transmit information over an infrared beam. With the RC Relay, one of those devices could be used in another room or the components could be kept farther apart than otherwise.

It would cost you about 50 dollars to buy a commercial device that does the same thing. But for one-fifth of that cost, you can make this device,

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which has somewhat less range, but is more versatile.

Although the relay box can be many rooms away from the VCR, the hand-held remote must be held within a foot or two of the relay for the control signal to be received properly. The relay box is small, though, and can be moved around easily, so this shouldn't pose much of a problem.

The restriction on range can't be avoided if the project is going to be simple because infrared intensity from a hand-held remote control di-

minishes greatly with distance. A range of more than a few feet would require a very sensitive receiver. Commercial remote-control devices have a shielded assembly containing a photodiode and sensitive high-gain circuitry that wouldn't be practical to build yourself. If long range is imperative, therefore, you'd be better off buying the required circuitry than making it yourself. But if the limited range of this project is tolerable, which it will be for most applications, a \$10 alternative and some fun building it is attractive.

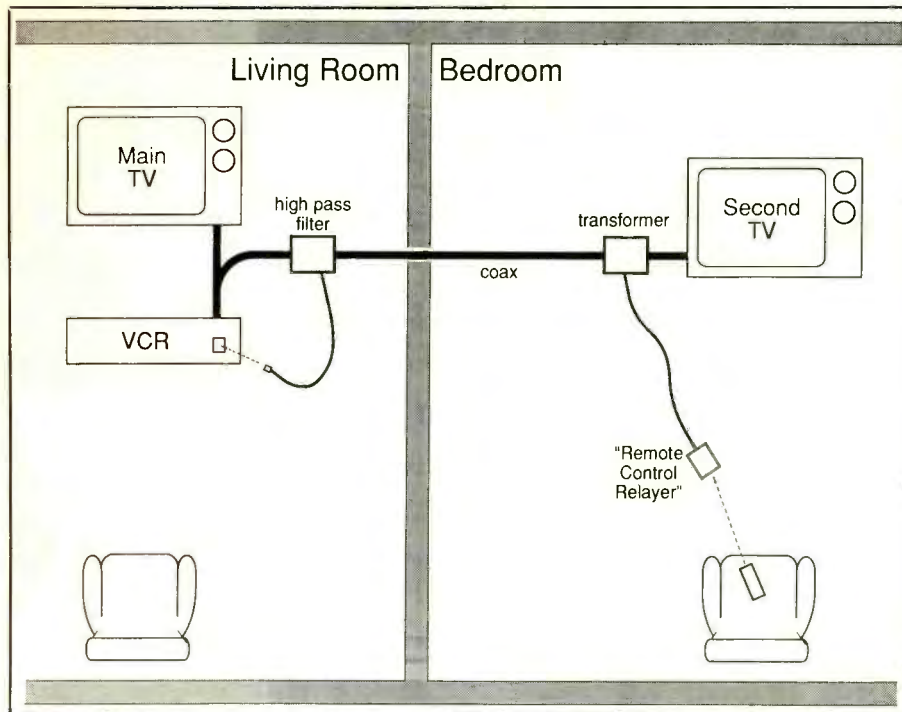


Fig. 1. The remote-control relay will send control signals from one room to another using the same wire that carries the video signals.

How It Works

Like its commercial competition, this project sends its control signals over the same coaxial cable that carries the video signal to the extension TV. (See Figs. 1 and 2.) This allows you to use the cable wire that's already installed, which is much easier than installing a new one. And just as the commercial models do, this device allows normal use of the remote control with the VCR or other video source at all times.

The circuit is quite simple. Figure 2 is the complete schematic. When power switch *S* is on, phototransistor *Q* modulates the current that flows through the infrared LED from the battery. Every pulse of infrared radiation received at *Q* is duplicated by the infrared LED's output.

The phototransistor is shielded from ambient light by a small piece of infrared filter plastic. This material looks dark red to the eye and is nearly opaque to visible light. It is

sold at low cost by some surplus dealers. If you can't obtain the correct filter material, a thin piece of translucent red plastic can be used instead.

The purpose of shielding is to ensure that the infrared phototransistor doesn't draw excessive current from the battery in response to visible light. Although the circuit is quite sparing of power when shielded this way, the switch extends the battery's life additionally if it is turned off when the relay is not in use.

The purpose of the transformer and the high-pass filter shown in the schematic is to block control signals from entering the video equipment. This is necessary so that the relay's control signals can travel over the same wiring as the video signal. There are two ways to split the control signal from the video signals. Either can be used at both ends, although the best way is to use a transformer at the TV end and a high-pass filter at the VCR end, as follows:

1. A Radio Shack high-pass filter

designed to eliminate amateur-radio interference from video signals can be slightly modified.

2. An ordinary 75-ohm to 300-ohm video matching transformer to block infrared signals to the TV set in addition to its usual function. Transformers are cheap, readily available, and often necessary anyway to match the 75-ohm output of modern video equipment to older TV sets.

Construction

Any small case can house the relay circuitry as long as it will block visible light falling on the phototransistor. The prototype shown in Fig. 1 used an enclosure sold by Radio Shack. It comes with a pre-drilled perfboard insert to which components can be mounted.

Using this enclosure or another suitable one, install the power switch so it can be reached from the front of the enclosure. Cut out a piece of the infrared filter material to glue behind a 1/2-inch hole in the front. Mount the phototransistor directly behind the filter. Be sure to observe polarity when connecting the components or the phototransistor may be damaged.

Run a piece of thin, two-conductor wire from the relay box to the high-pass circuit. Directions follow for hooking up the other end of that wire to each of the alternative high-pass filters, and for connecting the LED to the other filter.

Connections

Some video matching transformers provide two screw terminals as an FM output. These are the best transformers to use because the screw terminals are a convenient place to attach the wire connecting the relay to the coaxial cable.

To modify one of these transformers, open it up by removing the metal ring around the F-connector input. Cut away the thin transformer wires that go to the FM terminals. Now

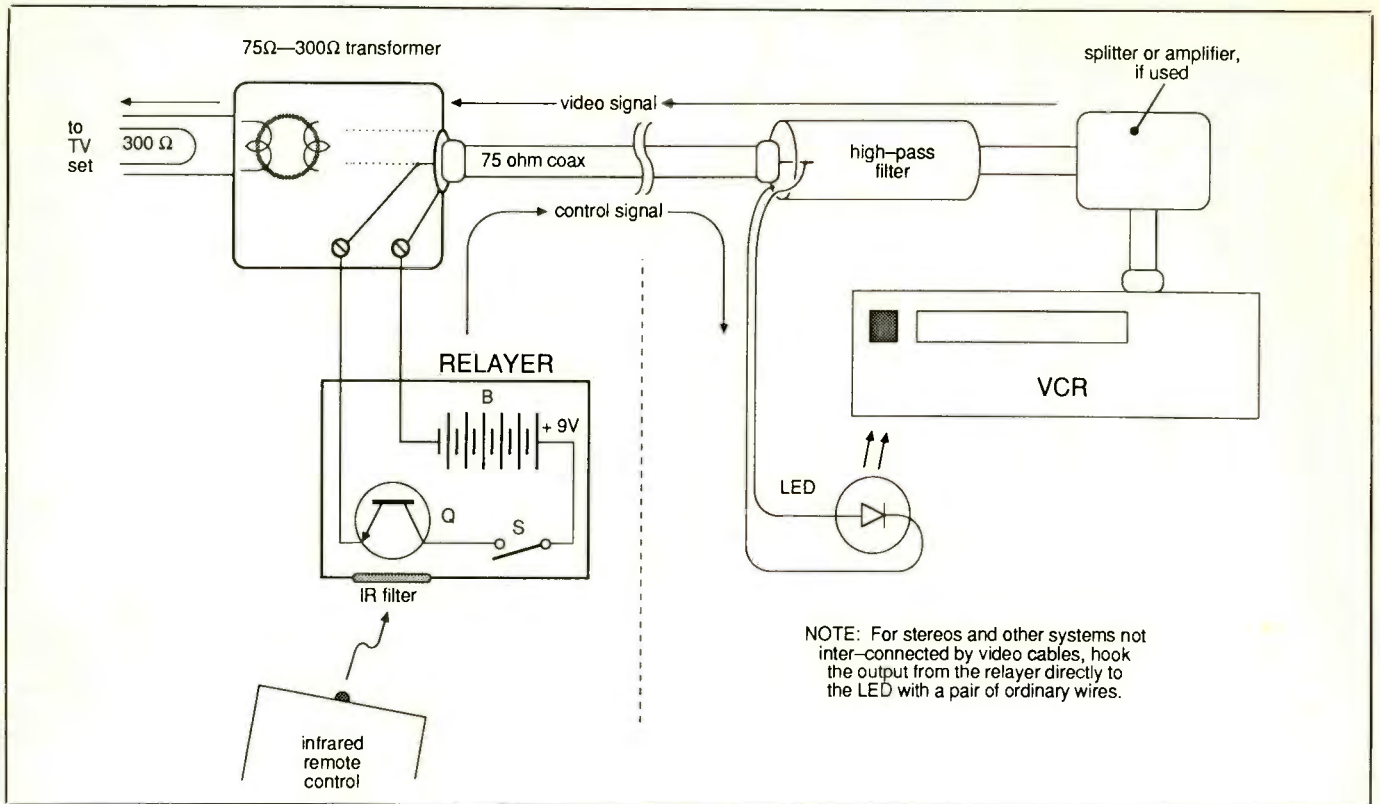


Fig. 2. The complete remote-control relay has a very low parts count.

PARTS LIST

B1—9-volt battery
 Q/LED—Infrared emitter/detector pair [Radio Shack Cat. No. 276-142. (For additional phototransistors, use TIL-414, Radio Shack Cat. No. 276-145 or equivalent)]
 S—Miniature spst toggle switch
 T—75-to-300-ohm video matching transformer (Radio Shack Cat. No. 15-1139 or similar)
 Misc.—High-pass filter (Radio Shack Cat. No. 15-579 or equivalent); suitable enclosure; snap connector and battery clip for B1; thin 2-conductor cable; hookup wire; solder; etc.

wire the F-connector directly to those terminals. Close up the case, leaving the rest of the internal circuitry untouched.

Connect the modified transformer between the VCR and the TV set on the end with the TV. The screw-type

FM-output terminals should be connected to the wire from the remote-control relay box.

To use a Radio Shack #15-579 or similar high-pass filter to split the infrared and video signals, you must open its case and connect a wire. First remove the outer plastic jacket that encloses the filter. Then use a knife to remove the rubber grommet from around the short length of coaxial cable protruding from one of the ends. This should reveal a metal washer fitted into the aluminum body of the splitter. Remove the washer with needle-nosed pliers, setting it aside. With a few taps on the F-connector at the other end, slide the inner circuitry out of the aluminum sleeve.

Observe that the circuitry is encased in some kind of potting compound and wrapped in plastic. Cut the plastic wrap off and chip away just enough potting compound

around the F-connector to make its terminal accessible. Solder a few feet of thin two conductor wire to the connector. This wire will later be connected to the infrared LED (or to the remote relay box if you are using a second of these splitters instead of the transformer described above). Using hot-melt glue or epoxy cement, re-pot the filter and place it back in its aluminum sleeve.

The wire you added should exit the case alongside the piece of coaxial cable. It should pass through the washer that previously held the grommet. Figure 4 shows this type of splitter modified and connected to an infrared LED.

Installation

Placement of the infrared LED depends on the VCR (or other equipment) it will be used with. It should be mounted a short distance from the sensing window on the equipment,

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but should be kept as unobtrusive as possible. It should not block the window totally since you will probably want to use the remote control directly. One possibility is mounting the LED in a flat piece of clear plastic, and taping or gluing the plastic to the side of the VCR. If the VCR is kept in a cabinet, the sides of the cabinet can make a good mounting surface for the LED.

Be sure to connect it the right way. The correct polarity can be determined by retracing the wiring back to the relay box or by trial and error using a visible-light LED as an indicator and having someone press the buttons on the remote controller in the remote location.

Due to its short range, the remote relay should be kept as close to one's favorite viewing position as possible. Its small size should make this easy to do. Leave the transformer mounted on the back of the TV set

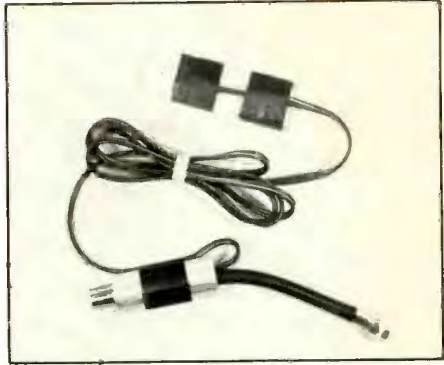


Fig. 3. Here is the Radio Shack Cat. No. 15-579 filter modified for use with the prototype.

to keep the video signal path as short as possible. The extra distance should be made up by the wire from the relay. If this wire is too long, it will get in the way. However, a long wire will allow the relay box to be moved to different locations within the room to overcome the range limitation.

If you have video signal splitters or a distribution amplifier connected to the output of your VCR, be sure to connect the infrared splitter after all that. The coax cable that runs between the high-pass filter at the VCR and the transformer at the TV end should have no interruptions.

Conclusion

More and more home electronic devices are being sold with infrared remote controls. This project can relay their control signals from room to room. The coax cable and the splitters aren't absolutely necessary, but in their place you will need a two-conductor wire to connect the relay to the LED. Correct polarity is still essential.

If you have more than one remote TV set playing off the same VCR, more than one remote control relay can be used with a single infrared LED. The signal splitters and relay boxes will have to be duplicated at each TV, of course, but only one LED is needed at the VCR end. **ME**

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