

A Telephone-Operated

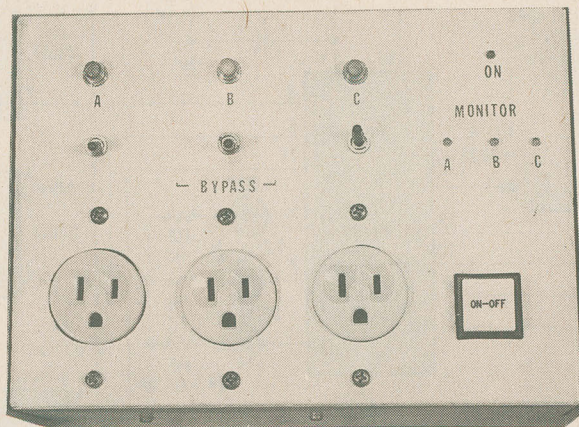
It seemed that every time I needed to work on my computer at home, the files I needed were usually on the hard drive at work. The problem was that the office computer was always off at night and during the weekends, so there was no way to download the information. I thought about leaving the office modem and console running overnight, but the wear and tear on the unit running for long periods of time seemed too much.

During one of my Saturday 30-minute drives to the office to work on the office computer, I realized that what was needed was a simple way to turn on the office modem and computer from a remote location. Then, using the right communications software, I could either remotely operate the office console from my home computer or simply download the needed files. Dubbed *Access III*, the simple circuit that follows allows you to do exactly that. The circuit is inexpensive, simple to build, and easy to operate.

About the Circuit. Figure 1 shows a schematic diagram of *Access III*. The circuit is basically a telephone-tone decoder that produces a binary code, which then can be used to remotely activate 117-volt AC devices individually using a tone code that's transmitted via the telephone line. Although the circuit shown will handle three power switches, only two would generally be required for most remote computer applications. However, some offices (or homes) might use an external hard-disk drive; the third switch could be used to apply power to that unit.

Access III is built around a SSI-202 telephone-tone decoder IC. The tones required by *Access III* are available at the speaker terminal of the average answering machine that has been set to the "call monitor" mode. *Access III* is connected to the answering machine speaker through a small coupling capacitor and a short length of shielded cable.

In order to activate the office com-



Power Switch for your Computer

*This simple project can
save you many a weekend
trip to the office to retrieve
data from, or do work on,
your office computer*

BY JIM STEPHENS

puter and modem from a remote location, the call is taken by the answering machine, which is set to answer the phone on the third or fifth ring. When the message recorder starts, you simply press the code that activates the modem followed by the code that activates the computer, and then hang up. The computer's boot-up disk must contain an auto-execute batch procedure that loads a communications program preset to automatically enter the answer mode.

The communications program must be instructed to avoid menus and go straight to the connect modem—a fairly simple task with a good program and a Hayes compatible modem. The

modem switches must be set to answer the phone on the first ring. A second call is then made by the communications program from the remote location to the now-ready office computer to establish the communications link.

The main player in that data link is the tone decoder, which accepts the DTFM tones (available from the speaker terminals of the answering machine), and converts (decodes) that signal, producing a binary output that's sent to U3 (a 74175 quad D flip-flop). Each time U1 receives a valid tone, a positive pulse is produced on the DAV (Data Available) line at 14. The DAV pulse is inverted and delayed by a pair of NAND gates, U2-a and U2-b.

That negative transition is used by U3 as the clock pulse to latch the data from U1. The output of U1 could be decoded into sixteen bits, but since all sixteen combinations are not needed, you will not have to go to that extra effort and expense. The \bar{a} outputs of U3 are then sent to three optoisolators/couplers (U4-U6) that are used to activate three 4-amp Triacs (TR1-TR3). The Triacs control the power to the modem and computer console.

It should be noted here that the computer monitor of the remote (office) computer does not have to be activated. Actually, it is better that the computer monitor be left off; like home television sets, they can and do sometimes cause fires.

The decoder circuit produces a separate high output for the DTMF tones, 1, 2, 4, and 8. Actually, all numbers on the touch pad are recognized, since all other numbers and symbols on the keypad are simply combinations of those four lines. So, if the modem was connected to channel 1, sending a 1 DTMF tone would activate the modem. If the computer was connected to the channel 2 line, pressing 2 would turn off the modem and activate the computer.

That's undesirable; to get around that problem you have to press 1 first, wait a few seconds for the modem to initialize,

modem switches must be set to answer the phone on the first ring. A second call is then made by the communications program from the remote location to the now-ready office computer to establish the communications link.

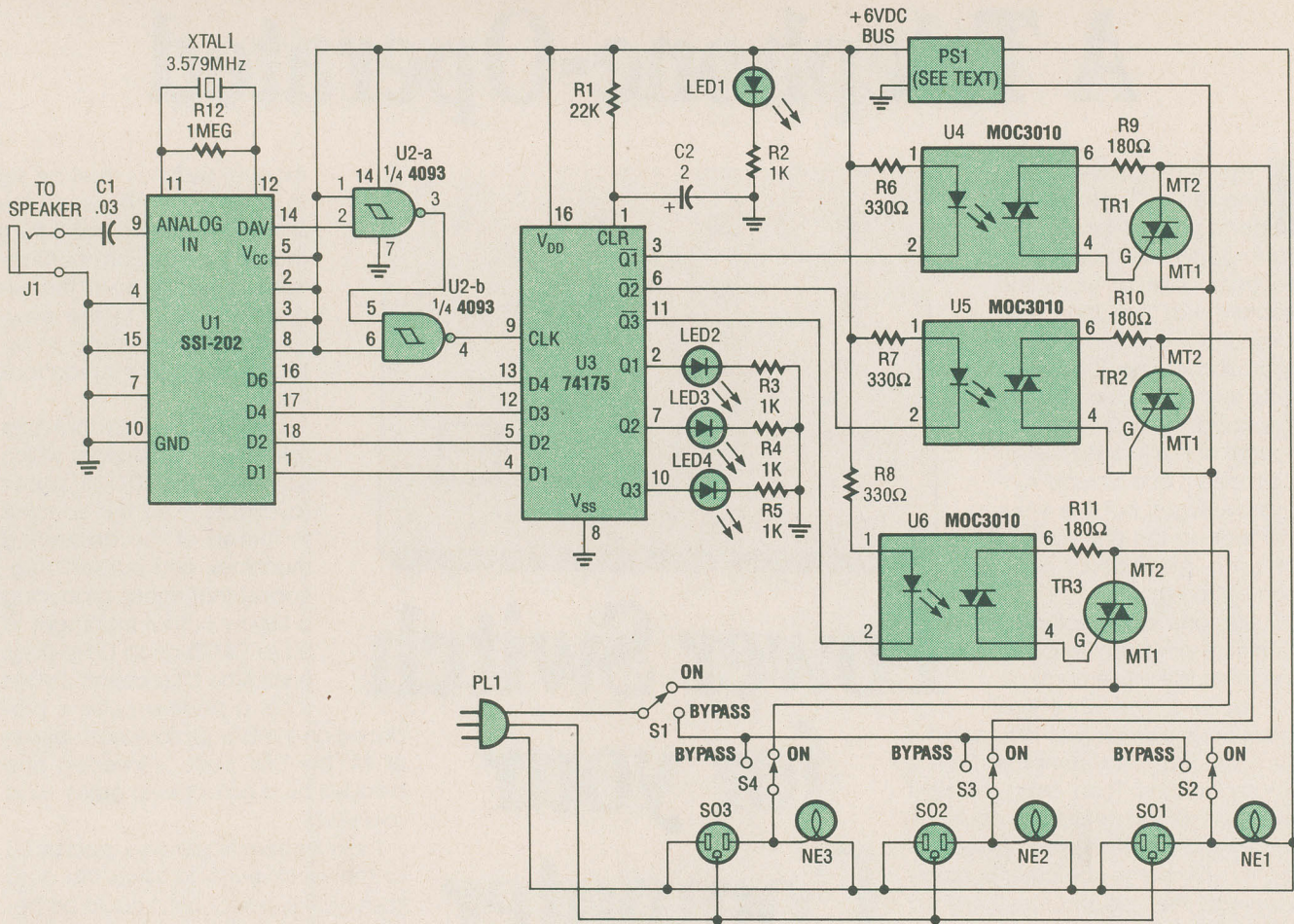


Fig. 1. Access III is essentially a telephone-tone decoder that produces a weighted binary output that is fed to D flip-flops, which are used to activate individual Triac circuits that apply power to the connected devices.

and then press 3 to leave the modem on and turn the computer on also. Pressing the 7 key would then activate the third channel, while leaving channel 1 and 2 on. All three channels should not be powered up all at once to minimize the surge on the line.

It is possible to decode several numbers that allow a code to be entered before the circuit can be activated. That would keep an unauthorized activation from occurring. That can get complicated and isn't really necessary because most remote-access programs include a password function that must be correctly entered before access is allowed.

False triggering due to noise on the line, or power-switch bounce could cause the latch to start with one or two of the channels already activated. So C1 and R2 have been added to the circuit to provide a delayed pulse at pin 1 of U3 when the decoder is first activated to prevent that condition.

Bypass switches (S2-S4) are included

in the circuit so that the equipment can be powered without having to disconnect power plugs from the circuit. In order for the bypass function to work, S1 must be placed in the bypass position. Then S2-S4 can be used to power up the desired device. Note that a neon lamp is connected in parallel with each socket. Those lamps indicate which socket has been activated. All switches can be neon lighted, but I chose separate neon indicators to save money on the switches.

Wiring the Circuit. Access III was built on two sections of perfboard; one section containing the decoder/latch portion of the project, and the other containing the optocoupler/Triac portion of the unit. Things were handled that way because the optocouplers and Triacs relate directly to the 117-volt lines and should be separated as much as possible from the low voltage components.

Caution: When working with a 117-

volt AC line, extra care is extremely important because house current can be dangerous to your health. If you are not experienced with high-current wiring, get help from someone more experienced.

Assemble the circuit guided by the schematic diagram in Fig. 1. The author used sockets for all of the IC's in the project; point-to-point wiring was used to interconnect the board-mounted components. Begin assembly by mounting the IC sockets to the board, and then wire the support components to the sockets. In the case of the optoisolator/coupler board, make sure that the connections between each Triacs' main terminals (MT1 and MT2), the receptacles, and the bypass switches use well-insulated, heavy, stranded, 12-gauge wiring, and all solder connections for those lines should be insulated with heat-shrink tubing.

The project should be housed in an all-metal case for safety. Note that the case should **not** be connected to the

ground wire of the 117-volt line. If your computer manual states that your computer should not be activated from a plug strip or surge protector, the power connections may be made at the computer switch terminals. You can check your manual for such requirements.

The power receptacles, SO1-SO3, should be standard, single-outlet, polarized, three-terminal, 15-amp AC types. Pay particular attention to the polarized wiring on the receptacles as it relates to the plug, PL1. The large holes on the receptacles go to the large prong on the plug. That keeps the system's common lead common. Since the output is capable of handling three devices, the power cord from the plug should be a heavy-duty, three-wire cord. Switch S1 must be connected in the line going to the small prong (the "hot" wire).

The Decoder Power Supply. Rather than build a complete power-supply circuit for the small amount of current needed by the decoder/latch circuit, the author opted to use a small 6-volt, 150-mA DC adapter. The adapter provides several times the power needed by the decoder/latch circuit. Use a VOM to make certain of the polarity of the wires before making the power connections to the decoder/latch board. A reversed connection to that section can damage the IC's.

Note that the ground lead from the adapter is shown as system ground. Only the low-voltage circuitry is grounded via that lead. The 12-volt circuit does not connect to the 117-volt AC ground in any way and should not be tied to the case.

In order to avoid yet another wire dangling from the case and another plug to plug in, the adapter was installed within the decoder case and wired directly to the main AC leads (which are wired to the Triacs and receptacles). That allows the decoder/latch circuit to be activated via S1. The small amount of heat produced by the adapter is no problem and is easily dissipated by the metal case.

Answering Machine Connection.

Only two wires connect to the answering machine: One wire comes from the decoder's analog-in terminal and the other is the low-voltage ground. If the distance from the answering machine to the decoder is over two feet, that connection should be made through

PARTS LIST FOR THE ACCESS III

SEMICONDUCTORS

- U1—SSI-202 DTMF tone decoder, integrated circuit
- U2—4039B quad 2-input CMOS NAND gate, integrated circuit
- U3—74175 quad D flip-flop with clear, integrated circuit
- U4-U6—MOC3010 Triac-driver optoisolator/coupler, integrated circuit
- TR1-TR3—6-amp, 400-PIV Triac
- LED1—Miniature red LED
- LED2-LED4—Miniature green LED

RESISTORS

(All fixed resistors are 1/4-watt, 5% units.)

- R1—22,000-ohm
- R2-R5—1000-ohm
- R6-R8—330-ohm
- R9-R11—180-ohm
- R12—1-megohm

ADDITIONAL PARTS AND MATERIALS

- C1—0.03- μ F, ceramic-disc capacitor
- C2—2- μ F, 16-WVDC, electrolytic capacitor
- J1—Phono jack
- NE1-NE3—Neon lamp
- SO1-SO3—117-volt 3-terminal AC socket
- PL1—117-volt 3-terminal molded AC power plug with line cord
- PS1—6-volt DC wall adapter
- S1-S4—SPST switch
- XTAL1—3.579-MHz colorburst crystal
- Perfboard materials, metal enclosure, wire, solder, hardware, etc.

Note: The SSI-202 DTMF tone decoder may be ordered for \$12.00, plus \$2.00 shipping and handling, from Syntronics, 2143 Guaranty Drive, Nashville, TN 37214; Tennessee residents please add 7 1/2% sales tax.

small-diameter, shielded, phono cable to minimize AC hum and RF pick-up, which could cause tone distortion and unreliable operation.

The answering machine case will need to be opened and a small phono jack installed that connects to the existing two speaker leads inside the case. Another phone jack in the decoder case accepts the other end of the cable.

There are other methods of automatic answering of the phone, but those get somewhat complicated and can be expensive if certified equipment is used to detect the ring and take the phone off-hook. I've seen several circuits of that type that use a neon bulb that activates a light sensitive diode and relay.

If you don't want to open up the office answering machine, it is possible to simply connect the tone through a small mike and op-amp. You could experiment on your own if an answering machine is not available, but the use of a certified answering machine as described simplifies the installation procedure and is a very reliable way of making that connection.

Turning the Computer and Modem Off.

The need to power down the modem and computer is just as important as turning it on. That's done by hanging up and calling the number back and pressing the 8 key on the telephone keypad. The tone produced by the 8 key places a high at the cathodes of the optoisolator/coupler internal LED's, thereby deactivating the optocouplers. That, in turn, removes the gate trigger from the Triacs, so that on the next transition of the AC waveform, the Triacs are deactivated. And that results in power being removed from the sockets and, by extension, the devices connected to the sockets.

That can be difficult since your decoder circuit is connected to the answering machine which no longer will get to answer the phone if your modem is answering on the first ring. You must instruct your modem by way of the Hayes "AT" software commands (while the computer is running) that you do not want it to automatically answer. The command for this is ATSO=O\$Od. There are several ways that this can be accomplished. Here's how I do it: I use Bitcom as my communications program, but others will work fine since many have the same file and switch capabilities.

The remote location's modem auto-answer switch is set to the "no auto-answer" position. The program must switch the modem over to automatic answer when it boots up. As stated previously, the autoexec.bat file at the start of the procedure begins by loading an automatic answer file that avoids the menus and goes directly to the connect mode with the automatic answer feature selected for the modem.

When you hang up the phone on your end of the communication link, the modem will use a hang-up string that resets the modem back to the switch settings. The modem will now not answer when the phone rings, and the answering machine will allow you to enter the power-down code. Press an 8

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COMPUTER SWITCH

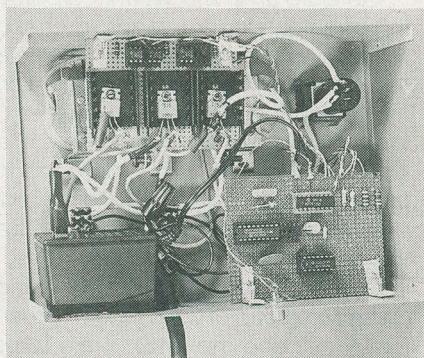
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and hang up. Your computer equipment will now be off and the decoder circuit will still be on and awaiting your next call.

Remote Access Software. The average modem communication software will not allow remote access to the computer's operating system. Several commercial software packages are sold specifically for that purpose. Two popular ones are Carbon Copy and PCAnywhere. There are even good shareware packages available that allow remote access such as Tandem and Telereplica, which can be easily downloaded from many bulletin boards. In any event, your selection should include one that has the password, answer, and hang-up string function.

Some programs called "doors" will attach to your regular communications software and will allow regular communications to provide a secondary function to allow remote-access capability. The host computer (the one being accessed) can then be controlled, searched, and files downloaded or uploaded while using your favorite modem program. Again, whatever modem program you use should be capable of setting both the answer string and the hang-up string, which can be used to control the auto-answer feature of the modem.

Check Out and Troubleshooting. It is most likely that the circuit will work properly on the first try. But just in case it doesn't, here are a few things to look for



Access III was built on two sections perfboard; one section containing the decoder/latch portion of the project, and the other containing the optocoupler/Triac portion of the unit. Point-to-point wiring was used to interconnect the board-mounted components.

if the circuit does malfunction! Of course, such things as chips inserted backward and leads going to the wrong pins could be possible causes. Those possible trouble sources should be checked out before powering up the circuit. (I learned to do this after blowing several expensive IC's by thinking that I could always check for those types of problems if the circuit failed to work.)

Double check to be certain that S1 is in the ON position. If so, check S2-S4 to make sure they are not in the "bypass" mode. Usually, the most common malfunction will be no activation of one or more of the Triacs when a tone is entered. A good logic probe can be used to show if the tone decoder (U1) is producing the DAV latch pulse at pin 14 each time a key is pressed. If not, press the 1 key on the keypad while the answering machine is recording a message and place the probe on pin 1 of U1. A high state should be produced each time the key is pressed.

Another probable cause of a malfunction is that the tone is not properly reaching U1. Try tuning up the volume slightly on the answering machine. If that doesn't help, try turning the volume down; the volume may be too high, distorting the signal. Then try a different capacitor value for C1. If U1 seems to be functioning properly, place your probe on pin 9 of U3 to verify that the DAV pulse fed through U2-a and U2-b is reaching the latch. If not, check the wiring on pins 3 and 4 of U2.

If each time the tone is released, LED's D2-D4 go out, check for a constant high at pin 1 (clear) of U3, which must have a high for the latch to hold the data. Otherwise, the latch just follows the clock.

The optoisolators/couplers (U4-U6) could be bad if data seems to be getting to them but they are not responding. If you are sure of your wiring and only one Triac seems to be malfunctioning, try switching them. Make sure the power is off before working on the Triac board.

Conclusion. Like the telephone, this can be a very useful device. It is not a toy and could be a very useful part of every serious communications system. The circuit will pay for itself the first time you don't have to drive to the office to get a file from the computer. But it also saves time, effort, and wear and tear on the computer and even more important, your nerves. ■