Build this versatile printer power controller.

PRINTER-MINDER

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DO YOU DEBATE WHETHER TO TURN your printer on and off—or do you simply leave it on all the time? Perhaps you've got a remote data-logging or control application in which the printer need be on only occasionally.

Either way, Printer Minder can help. Printer Minder is an inexpensive printer controller that applies power to a printer whenever it receives a print request, and subsequently removes power following a one-hour delay after the printer has accepted the last character.

You can build Printer Minder from a kit for about $150. In case you wish to roll your own, we publish complete PC board patterns; in addition, bare boards are available separately.

Overview

You install Printer Minder between your computer and your printer, as shown in Fig. 1. When you first apply power to Printer Minder, it will prevent power from being applied to the printer. The reason is to protect the printer in the case of brownouts or power failures. Printer power remains off until the host CPU actually starts sending data. While in the power-off state, Printer Minder fakes the signals the computer needs to make it think that the printer is on and ready. That allows the computer to begin sending data without thinking there is a printer error. As soon as Printer Minder receives a character, it asserts a control signal to make the computer wait until Printer Minder gets through its power-up sequence.

When the printer does become ready, Printer Minder presents data to it, along with the necessary control signals. After the printer acknowledges the first character, Printer Minder drops out of the loop, and data simply flows through directly to the printer.

A retriggerable one-shot keeps power on to the printer for about one hour after the last character has been received. After the time limit expires, power turns off automatically. To help protect the printer from power-line transients, Printer Minder also includes several metal-oxide varistors (MOV's).

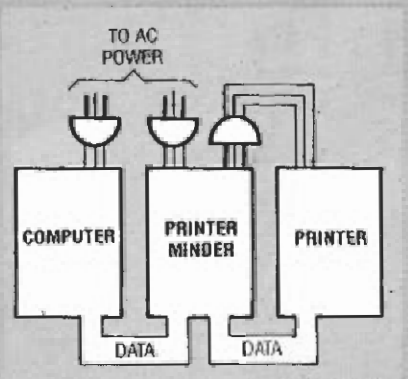


FIG. 1—PRINTER MINDER controls the flow of data and AC power to your printer. After a one-hour time-out, Printer Minder turns the printer off; as soon as data starts flowing again, it turns the printer back on.

How it works

Printer Minder consists of two main sections: AC Power Control and Logic Circuit. We describe each in turn.

Referring to Fig. 2, Printer Minder uses a relay (RY1) to control the power to the printer. Transistor Q1 drives the relay to handle the necessary current. The relay is a normally-open type; it is on only when IC8-a (the retriggerable one-shot) is active. The time constant of the one-shot is approximately one hour. What triggers the one-shot is a STROBE signal from the computer, labelled "BUF STB" in Fig. 2. After an hour passes, IC8-a times out, which de-energizes the relay, which in turn disconnects power to the printer. To indicate power status, LED1 lights up.

The one-shot also has a CLEAR input that is driven by a power-up signal (PUP), which is generated by C3, R13, and IC10-b; its purpose is to ensure that IC8-a remains clear (hence the printer remains off) when power is first applied to Printer Minder.

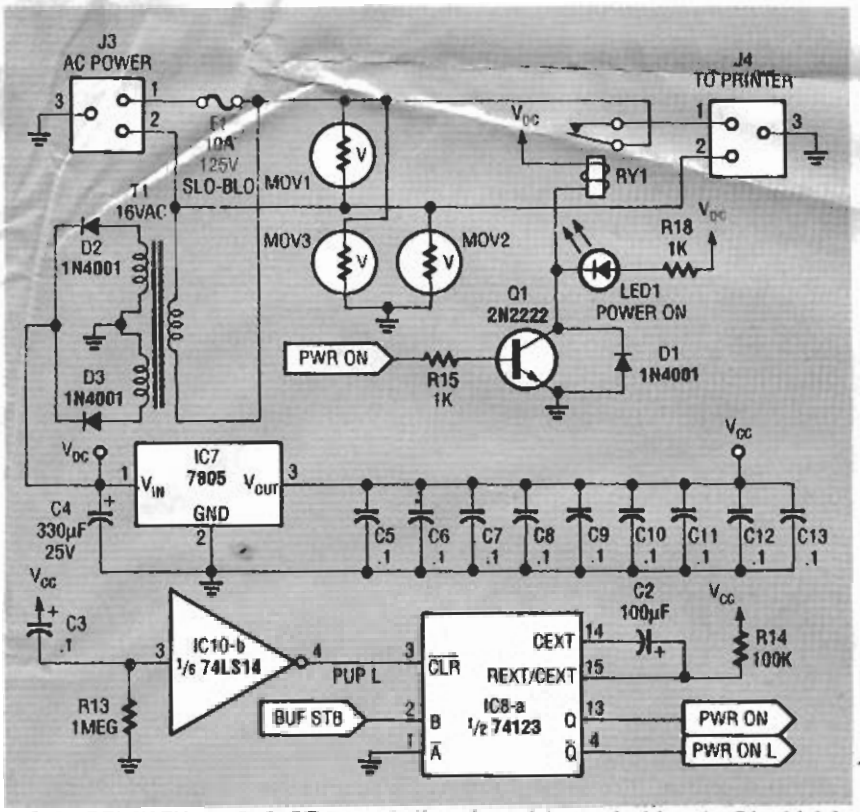


FIG. 2—RELAY RY1 controls AC power to the printer; it in turn is driven by Q1, which is driven by one-shot IC8-a.

Other components ... de three MOV's (MOV1–MOV ...at protect Printer Minder—and, more important, the printer—from voltage transients.

The power supply provides a regulated +5-volts DC (V_{CC}) for the logic circuit, and unregulated +12-volts DC (V_{DC}) to drive the relay and LED1.

Logic circuit

Let's discuss the simple case first; refer to Fig. 3. When printer power is on, Printer Minder simply routes the various control signals straight from the computer to the printer (for the STROBE signal), and from the printer to the computer (for the ACK, BUSY, PAPER OUT, and SELECT signals). Octal latch IC1 buffers the data lines, and should be sufficient in most cases. Buffer IC9 is optional; its purpose is to provide extra "oomph" when driving long or noisy transmission lines. The data inputs and outputs are shorted together on the PC

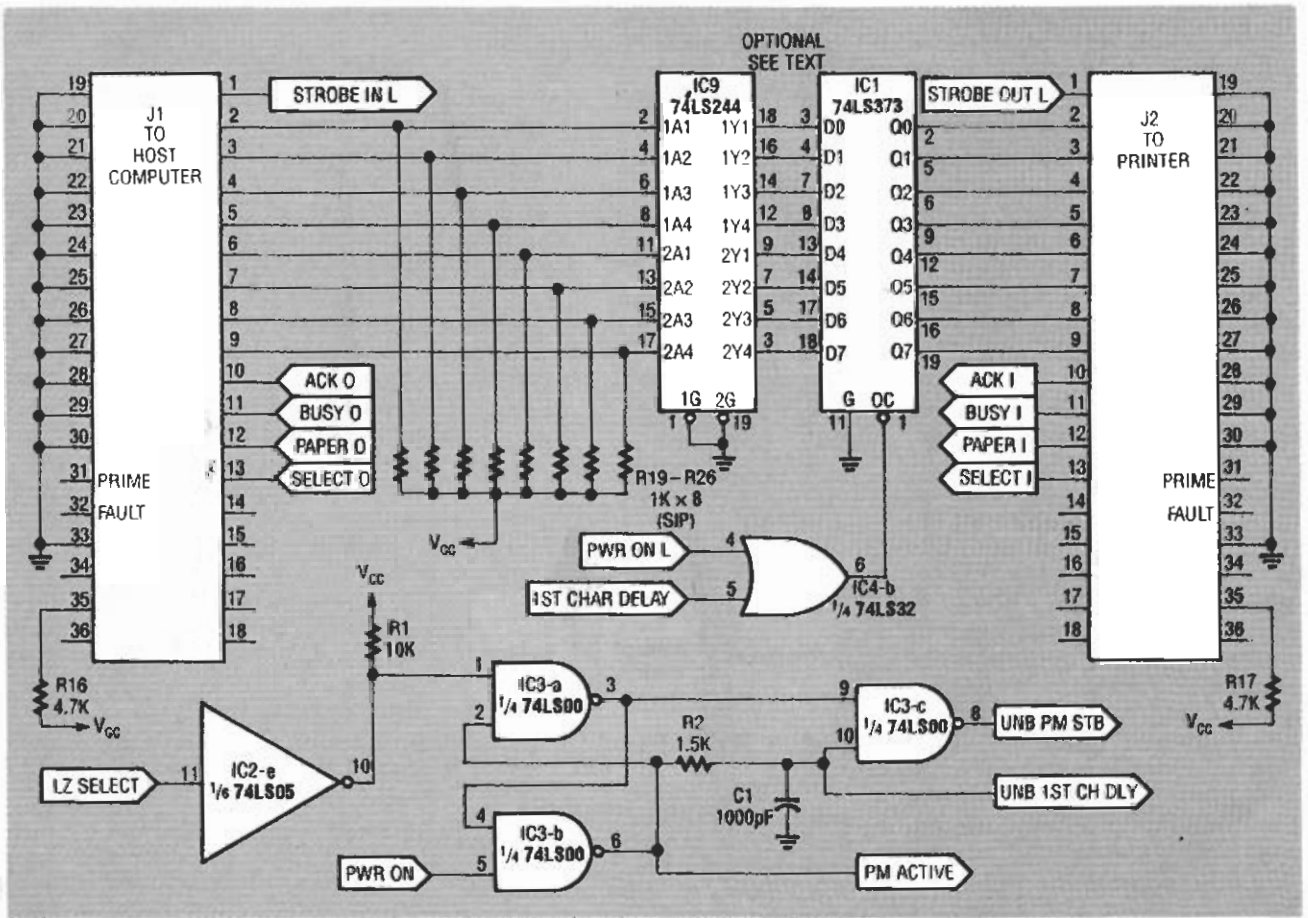


FIG. 3—OCTAL LATCH IC1 buffers data between Printer Minder and your printer. The latch is enabled by IC4-b.

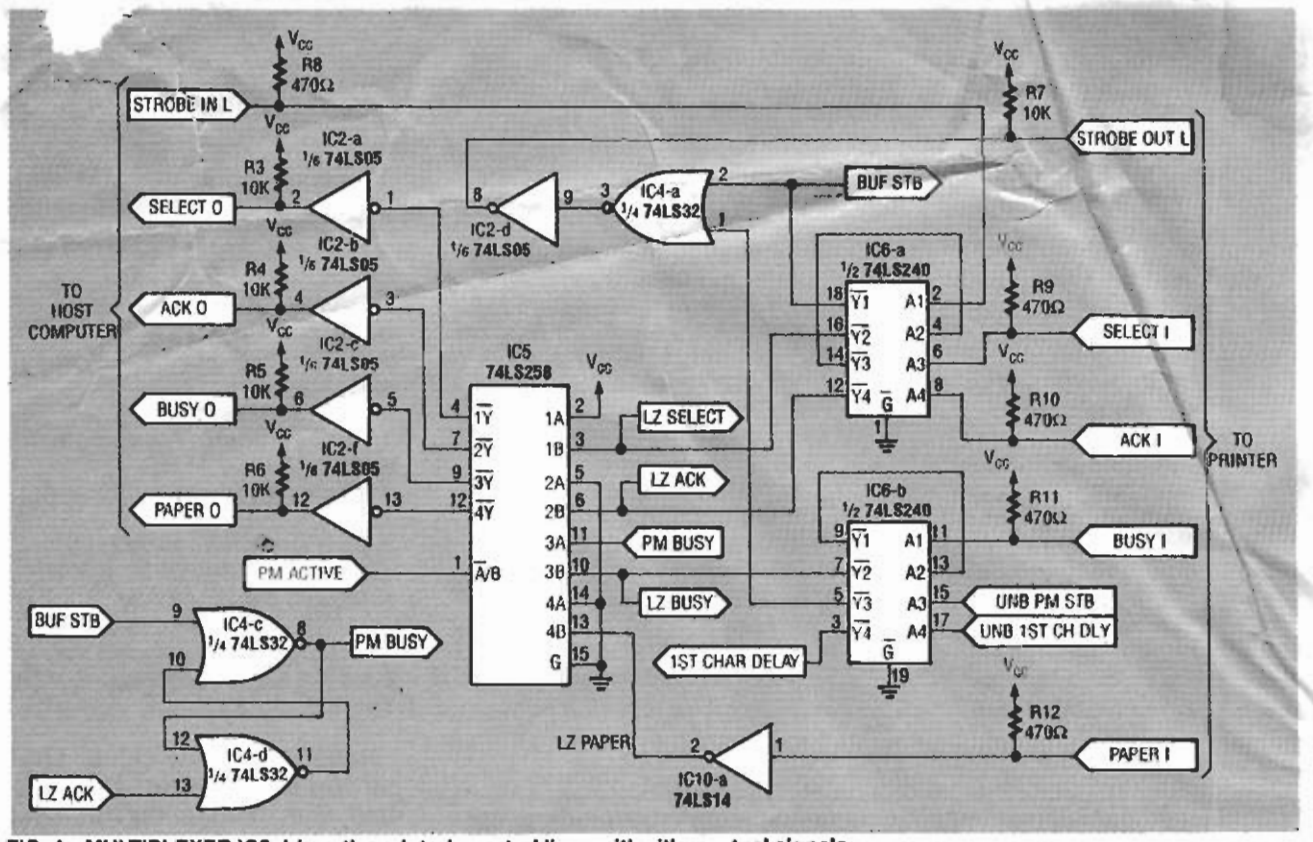
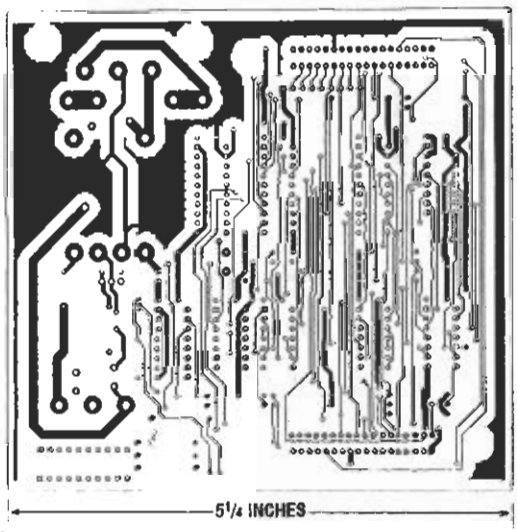
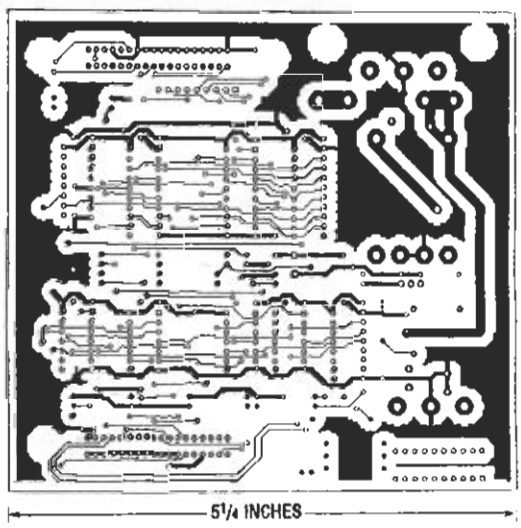


FIG. 4—MULTIPLEXER IC5 drives the printer's control lines with either actual signals (B inputs) or Printer Minder's simulated signals (A inputs) during power up.



COMPONENT SIDE for the Printer Minder.



SOLDER SIDE for the Printer Minder.

board; if you want to use IC9, you must cut those traces. Printer Minder does not process the FAULT and PRIME signals at all.

When the printer is powered down, the control logic has to "fake" the appropriate control signals, making it appear to the computer that the printer is on-line and ready, even though it's not.

Normally, when the printer is powered up and on-line, latch IC1 is "open," thereby allowing data to flow through. However, its function is different when the printer is powered off. OR gate IC4-b allows two signals, POWER ON LOW and FIRST CHARACTER DELAY, to enable IC1. POWER ON LOW comes from the one-shot (Fig. 2); it remains on continuously after the initial character has been received. FIRST CHARACTER DELAY is asserted only after the printer has come on-line and released its BUSY line.

Figure 4 shows how Printer Minder buffers and processes the four printer-status signals (ACKNOWLEDGE, SELECT, BUSY, and PAPER OUT). All four are routed through multiplexer IC5, which selects between the "live" signals (B inputs) coming from the printer and the "fake" signals (A inputs) generated by

PARTS LIST

All resistors are ¼-watt, 5%, except as noted.
R1, R3–R7—10,000 ohms
R2—1500 ohms
R8–R12—470 ohms
R13—1 megohm
R14—100,000 ohms
R15, R18—1000 ohms
R16, R17—4700 ohms
R19–R26—1000 ohms, 10-pin SIP
Capacitors
C1—1000 pF
C2—100 µF, 16 volts, Mylar
C3, C5–C13—0.1 µF
C4—330 µF, 25 volts, electrolytic
Semiconductors
IC1—74LS373, octal three-state latch
IC2—74LS05, open-collector hex inverter
IC3—74LS00, quad two-input NAND gate
IC4—74LS32, quad two-input OR gate
IC5—74LS258, quad three-state 2-to-1 data selector
IC6—74LS240, three-state octal buffer
IC7—LM7805, 5-volt regulator
IC8—74HC123, dual retriggerable monostable multivibrator
IC9—74LS244, three-state octal buffer (optional, see text)
IC10—74LS14, hex Schmitt trigger
Q1–2N2222 NPN or equiv.
D1–D3—1N4001 diode
LED1—standard red light-emitting diode
MOV1–MOV3—120-volt metal-oxide varistors
Other components
F1—10A, 125V, slow-blow fuse
RY1—SPST relay, 12 volts, 10 amp contacts
T1—Dual 8-volt winding power transformer (PSS2-16 or equiv.)
J1, J2—36-pin Centronics connector
J3—AC power input connector (IEC female)
J4—Switched AC power connector (IEC male)
Miscellaneous: PC board, enclosure, wire, sockets, etc.
Note: The following items are available from Jim Cooke, P.O. Box 834, Pelham, NH 03076, (603) 882-4460:
- **PC board only—$29**
- **PC board with all components—$99**
- **Silk-screened enclosure—$39**
- **Data and power cables—$19**
- **Complete kit with all parts, case, and cables—$149**

Add 5% for shipping. MC and Visa accepted. New Hampshire does not require sales tax.

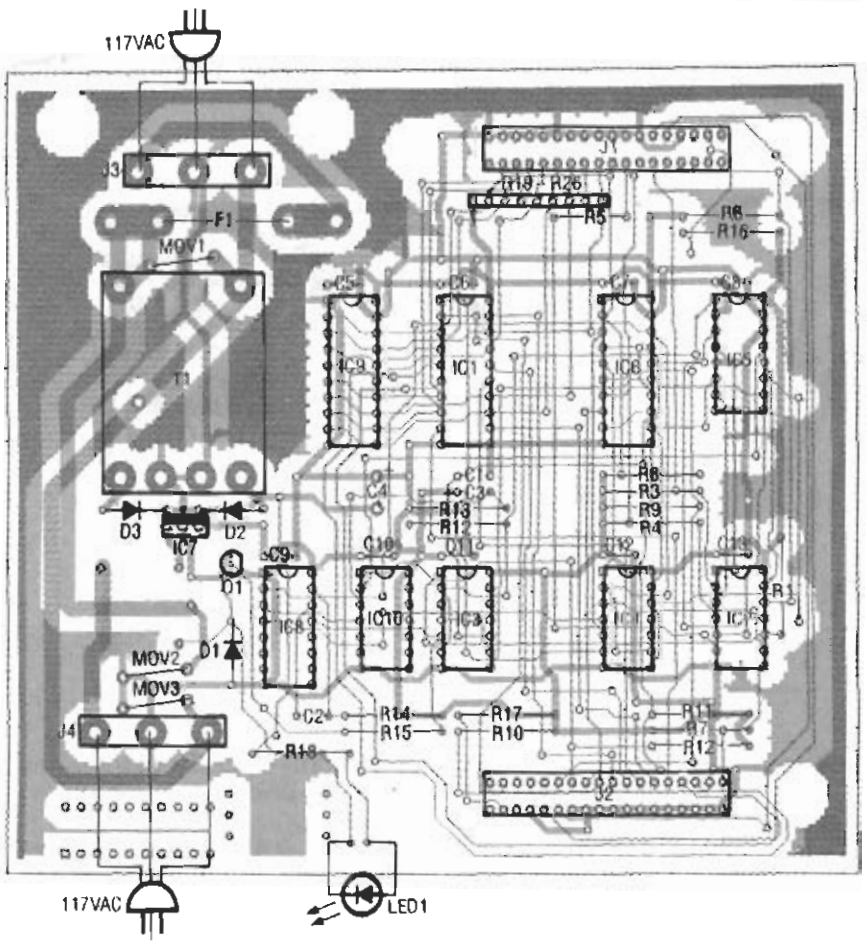


FIG. 5—Mount all components as shown here.

Printer Minder. The PM ACTIVE signal selects the A or B input; that signal is essentially a latched version of the printer's SELECT output. The latch consists of two cross-coupled NAND gates, IC3-a and IC3-b, as shown back in Fig. 3.

Returning to Fig. 4, that portion of the circuit also handles the STROBE signal that latches each byte of data into the printer. After buffering by IC6-a, STROBE drives the one-shot (IC8-a, Fig. 2) that keeps Printer Minder awake for one hour following the last character received.

Assembly and testing

This circuit is moderately complex, so we recommend the use of a PC board. Suitable patterns appear here; you can also purchase a commercially prepared board from the source listed in the Parts List.

Figure 5 shows how to stuff the board. Except for off-board AC power connector J4, all components mount on the component side of the board. Use sockets for the IC's and check all connections carefully, especially those around the AC power section. *Use care when working on this project, as it contains an exposed source of 120 VAC!*

Because of the height restrictions of the enclosure, AC output connector J4 could not be PC-mounted, so we used a snap-in, panel-mount device with push-on connectors. Take care to properly connect the AC neutral line and safety ground to

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this connector. Perform the following tests before installing the board in a case:

1. With no power applied, use an ohmmeter to verify that there is more than 20 ohms resistance between +5 volts and ground.

2. Apply AC power and ensure that the +5-volt source is accurate. It's convenient to measure across pins 20 and 10 of IC1.

3. Without connecting the printer, verify that LED1 (Printer On) is off. Attach one end of a test lead to pin 1 of J1 (STROBE IN). Momentarily ground the other end of the lead (e.g., to pin 19 of J1). The LED should illuminate, and should remain on for about one hour. While it's on, there should be 120 VAC across power connector J4.

4. With the LED still on, verify the power-fail feature by momentarily removing input power. The LED should go out, and J4 should lose power.

If any of those tests fail, correct the source of the trouble before proceeding.

The last step is to mount the board. If you use a case like our prototype, slide it in the tracks extruded into the wall of the case, and then seal the case with two end caps.

Hooking up

Now you're ready to connect Printer Minder between your computer and your printer. To understand the wiring scheme, refer back to Fig. 1, and perform the following steps:

1. Unplug the AC cable from your printer; it will be used later.

2. Unplug the data cable from your printer and connect it to J1 of Printer Minder.

3. Now connect another data cable from J2 of Printer Minder to the input port of your printer.

4. Connect an AC extension cable from J4 of Printer Minder to the printer's AC input.

5. Now apply power to Printer Minder by connecting the AC cable removed from the printer in Step 1 to J3.

6. Verify proper operation by printing a file. Ω