FIRMWARE CARD

Build this and you don't have to store everything above RAMTOP.

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■From teletext terminals to solar heating controllers people seem to discover new uses for the Timex/Sinclair 1000 and its upgraded successors. Those who write the software for these applications often forego BASIC and program either partially or completely in machine code. Such programs not only have precise control of the computer and fast execution times, but lend themselves perfectly for placement on a firmware card.

How do you know that your program has been written completely in machine language? If it loads into the BASIC area and then transfers itself above RAMTOP, it probably is. The area above RAMTOP is not the only place to put machine code programs. USR calls can be directed to any location in the 0-32K area.

The firmware card described here lets you place either a 2K or 4K EPROM anywhere in the USR memory area. It can serve as an interface card for custom projects. It fits into Radio Shack's smallest project box and operates much like an Atari game cartridge. Once you plug it in, all that is necessary is to call the program.

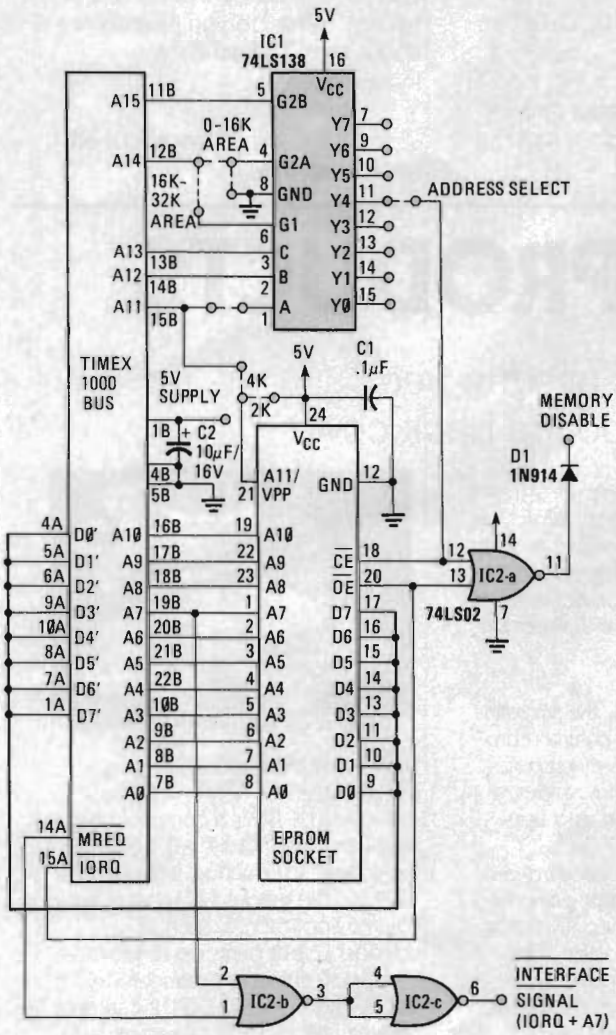

Fig. 1—SCHEMATIC DIAGRAM OF FIRMWARE CARD can easily be modified by cutting certain of the trace lines to suit your needs. See the text for additional information.

Circuit operation

The schematic diagram is shown in Figure 1. The one-of-eight decoder, IC1, reads address lines A11-A15 and provides a decoded output. Just a few jumpers allow this IC to activate the EPROM anywhere in the USR area.

When a 2K EPROM is used, address A11 is jumpered to the decoder's least significant address input, pin 1. The decoder's eight outputs will then each represent a 2K block of memory. Address A14 is jumpered to either pin 4 or pin 6 of the decoder, allowing these eight outputs to activate for addresses in the 0-16K or 16-32K areas, respectively.

For a 4K EPROM, the decoder's pin 1 is left open and A11 is jumpered to the most significant EPROM address pin. With this jumper configuration, the decoder activates only the odd-numbered of the eight outputs, each of which represents a 4K block of memory.

Usually the decoded address signal is ORed with /MREQ (computer's memory request) before being fed to the EPROM's /CE (chip enable). Such a configuration provides for the least power dissipation possible. In this case, however, the decoded address signal is connected directly to /CE, and /MREQ is connected to the EPROM's /OE (output enable). For a rare compromise in power, access time is then extended allowing even the slow 480ns memories to work.

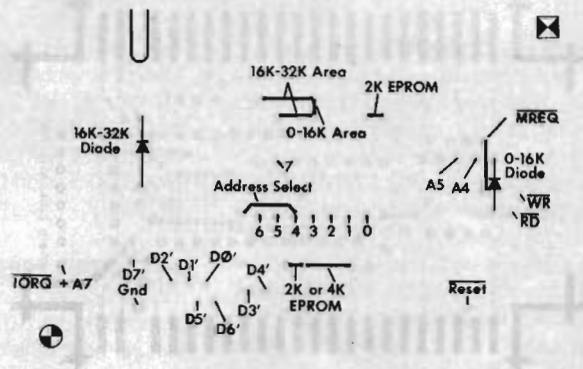

FIG. 2—SIGNAL LOCATIONS are called out on diagram above. Refer to text for further clarification.

Project interface

For those readers who have built custom add-ons such as those described in "Interfacing The ZX-81" (see Radio-Electronics, July-September, 1984) or "Machine Code Development System" (see ComputerDigest, January and March, 1985) the firmware card allows you to interface your project and keep the computer bus

too. To separate the display and printer commands from the project's I/O signals, the computer's /IORQ and address A7 have been ORed to provide an interfacing signal. The locations of this and other useful signals on the firmware card is shown in Figure 2.

Memory disable

In order for the firmware card to work properly, it must disable any other memory device working in the same area. A memory disable signal is made by NORing (via IC2a) the decoder's output with /MREQ and then connecting the NOR output through diode D1 to the control line of the memory to be disabled.

As shown in Figure 2, D1 can be placed to disable either the ROM (0-16K) or the RAM (16K-32K) of the computer's internal memories. The firmware card can also disable an external RAMPAK that cannot be manually switched off in the card area. This is done by replacing the /MREQ trace with a 680-ohm resistor and then connecting the 16K-32K diode's cathode to the end of that resistor. The RAM is then plugged in behind the firmware card.

PARTS LIST

D1—1N914 or 4148 Switching Diode
IC1—74LS138 One-Of-Eight Decoder
IC2—74LS02 Quad 2-input NOR gate
C1—.1μF Disc or Metalfilm Capacitor
C2—10μF 16V Electrolytic Capacitor
Miscellaneous—Edge connector, 24-pin socket, circuit board, project case, hardware.

An etched, drilled and cut printed circuit board is available for $12.95 (price includes shipping and handling) from WILDONICS, Box 1763, Boise, ID 83701. For custom cards, write.

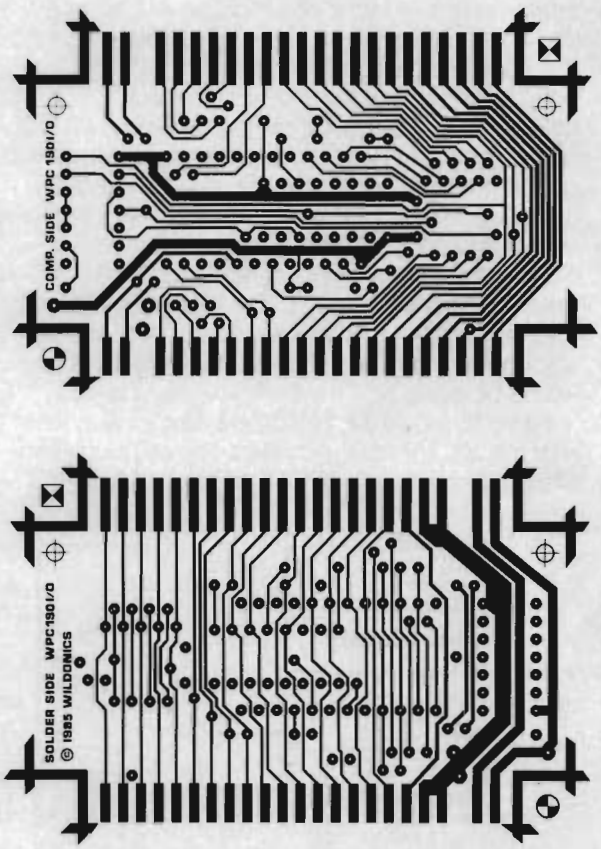

FIG. 3—IF YOU'D LIKE to make your own circuit board, full-size patterns are offered here for both sides. Above is the component side, below, the solder side.

Contruction

The component and solder sides for the firmware card are shown in Figure 3. This circuit board can be made at home or can be ordered from the supplier given in the parts list. The pattern shown includes jumper traces that place a 2K EPROM in the 8K-10K memory area. To change the EPROM size or memory placement, these traces must be broken and wire jumpers used as shown in Figure 2.

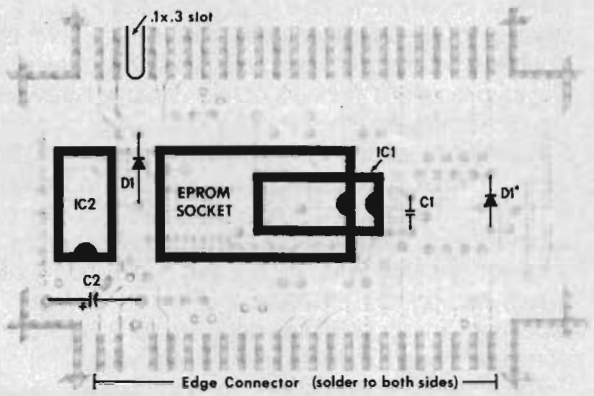

FIG. 4—PARTS PLACEMENT is shown here. Note that IC1 is mounted directly to the board beneath the EPROM. See text.

The parts placement is shown in Figure 4. Note that IC1 is mounted directly to the board under the EPROM. To allow space for this IC, the EPROM socket can be modified on one end, resulting in a U-shaped socket.

Once wired, the firmware card can be placed inside Radio Shack's smallest project case. This case should be sprayed on the inside with aluminum paint and then cut ½-inch up on each side to allow for the edge connectors. On one end of the aluminum cover place adhesive foam. On the other end, two holes should be drilled ¼-inch away from parallel with the two case holes. Plastic ¼-inch spacers and ½ x 4-40 screws thread directly into the board to complete the assembly.

Other uses

The firmware card can provide many other useful functions missing on the Timex computer. A nice accessory, for instance, would be a Reset button that can be made by connecting a normally open, momentary contact switch between /RESET and ground.

The EPROM socket can also hold an HM6116 2K RAM by changing pin 21 from 5V to the /WR signal. This makes the card ideal for writing custom software in the 8K-16K area.

The interface output can also be used to power a piezo element. A little experimentation with short bursts of output commands should result in some unique sounds and musical tones.◀CD▶