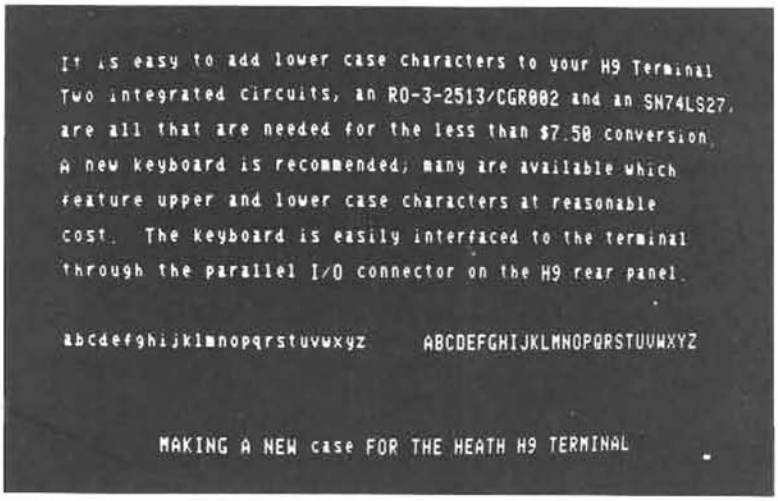

FIGURE 1

Have you wondered if it would be possible to display lower case alphabetic characters on your Heath H9 Terminal? If one reason you invested in a computer is to take advantage of word processing programs, a display restricted to upper case is as useful to you as a one octave piano is to a composer.

After studying the circuitry, I found it would be easy to modify the H9 to include the missing characters. The keybord on the H9 would be difficult to convert, but Heath has provided a convenient parallel I/O connector on the rear panel of the terminal, through which an external keyboard having upper and lower case can communicate.

This article describes how you can add the integrated circuits and keyboard to your H9 to make it a full upper/lower case terminal. A photograph showing the results of the modification is shown in figure 1.

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665 Maybell Avenue
Palo Alto, California 94306

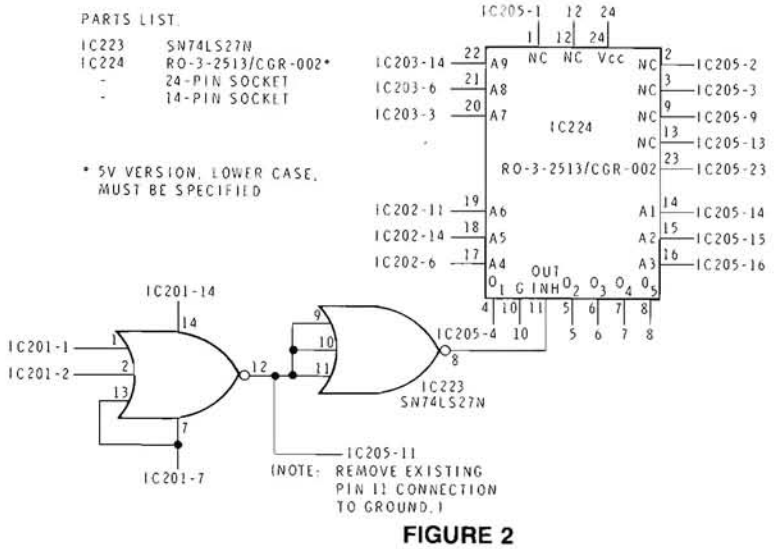

FIGURE 2

CIRCUIT MODIFICATIONS

A circuit diagram and parts list for the changes to the H9 Character Generator Circuit Board are shown in Figure 2. Two integrated circuits, an RO-3-2513/CGR-002 and an SN74LS27, must be added to generate the new characters.

The lower case memory, an RO-3-2513/CGR-002, has a surprise in store for the unwary. For some reason (probably perfectly logical) the addresses on the input of the CGR-002 chip are inverted with respect to its upper case twin. The H9 modification would have been simplified had the address formats of the two character generator chips corresponded. The General Instrument catalog lists a version of the 2513, the CGR-005, which has correct address levels, but this device is not readily available through mail order outlets. Fortunately, the required inverted addresses are available on the inverted Q outputs from IC202 and IC203. The outputs from the character generator chips are directly compatible.

The outputs from the character generator chips can be made active or high impedance, depending on the level of the enable inputs on pin 11 of each chip. When pin 11 is low the outputs of the corresponding chip are active.

IC223, and SN74LS27 Triple NOR Gate, has been added to the character generator board to select which chip will be active. When bits 6 and 7 of the incoming ASCII character are high, IC223 recognizes that a lower case character is present and enables the lower case character generator chip. At all other times the upper case chip is enabled by the same IC.

WIRING THE TWO INTEGRATED CIRCUITS

The two new Integrated Circuits are piggy-backed onto host IC's on the Character Generator board. A photograph of a modified board is shown in Figure 3. I found the easiest way to add the devices was to mount a socket on the original chip, and then to mount the new IC in the socket. A total of 7 external connections must be made to the character generator chip through pins on the socket which have been bent out at right angles from the socket.

Once the socket pins have been bent, place the socket over the existing chip (which you should remove from the board while performing the surgery) and solder the remaining pins to the corresponding pins on the IC. Note that the chip enable, pin 11, is also bent out from the original upper case chip. This is the only pin on an IC which must be bent as part of the modification.

IC223 is attached to IC201 in the same manner. For this IC, however; only pins 1, 2, 7, and 14 are connected to the host chip. All other pins on the socket must be bent so they do not touch the host chip below.

The wiring of the two integrated circuits is completed by connecting the six address lines to IC202 and IC203, and the two chip enable inputs to IC223 as shown in the schematic.

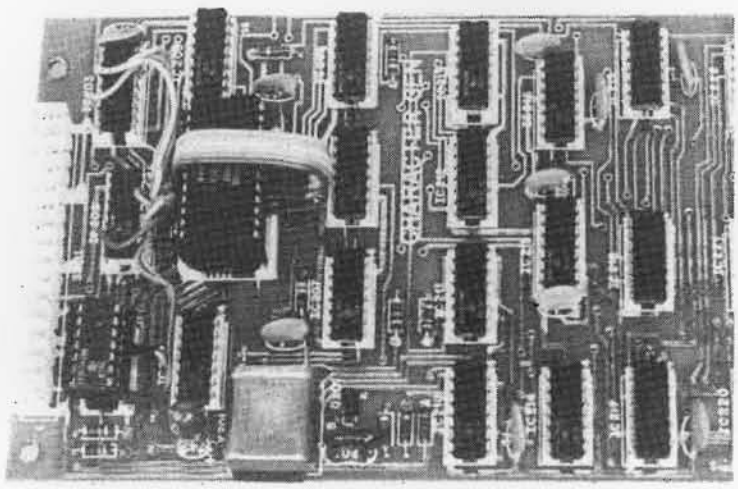

FIGURE 3

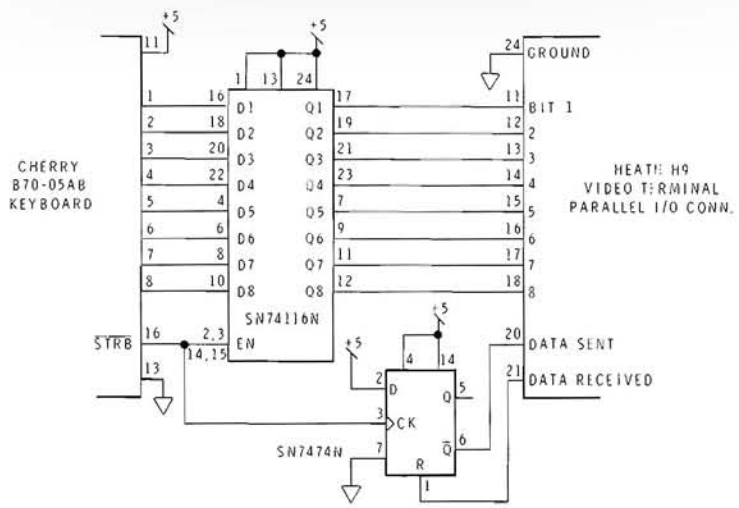

FIGURE 4

KEYBOARD INTERFACE

A variety of keyboards which provide lower case alphabetic characters are available at reasonable cost. Look for one which has a parallel output port and provisions for locking the alphabetic characters in upper case during the times when you don't want lower case. I chose the new Cherry "Pro" which offers much flexibility in addition to meeting the minimum requirements.

The Cherry "Pro" has five user defined keys which you can wire to provide any output character you desire. I am using four of them to provide Control-I (TAB), Control-S, (Stop), Control-Q (Go); and Control-C. By adding an SN74123N dual monostable multivibrator IC, the keyboard has a "Typamatic" mode which repeats all keys if they are held down for more than a half second.

A schematic for the wiring between the keyboard and the terminal is shown in Figure 4. The data transfer handshaking requires that the parallel data from the keyboard be present from the keyboard strobe until the terminal has sent back a signal saying that the data has been accepted. This handshaking takes two additional IC's on the output of the keyboard to latch the data.

SOFTWARE

Heath software will support lower case characters. The Text Editor (Ted-8) and Extended BASIC are the two programs which can make the most use of the new capabilities of your terminal. Ted-8 is easily adapted to accept both upper and lower case characters by typing "L" while in the command mode, and then answering "Y" to the computer's question "LOWER CASE CHARACTERS (Y/N)"

Extended BASIC must be configured to accept lower case characters. Start with the distribution tape and add any required patches. Then follow the instructions in Appendix A of the BASIC section of your software manual. Type the prompt L, to which the computer will respond "LOWER CASE (Y/N)?" A "Y" response will configure the software to accept both upper and lower case characters as String Data.

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