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MOS BRIEF 8

DIGITAL DISPLAY SYSTEMS

TTL-compatible MOS storage circuits solve a dilemma that has plagued display designers: the question of how to generate the display. Eliminating digital-to-analog conversion allows a data system to remain digital right up to the display drivers, but may exchange one economic headache for another. If the data source generates the digital control signal, its cost and that of communications links rise. Doing the job in the terminal, on the other hand, has made displays costly in the past.

MOS read-only memories reduce, to a few relatively inexpensive integrated circuits, the hardware required to convert a character communications code to signals that will control a display. Display rates fast enough for most applications can be achieved, when the MOS ROMs are controlled by bipolar logic circuits. And when the ROMs and bipolar ICs can be coupled directly, without the use of special voltage translators, the character generator becomes that much more inexpensive.

Two cases in point are shown in Figures 1 and 2. The MOS read-only memories can be bought for less than 2¢ per bit of storage. A small additional investment in MOS registers and TTL counters will produce a display-control system, such as the one in Figure 3. This system adds data buffering, message storage and display refresh to the basic character-generation function.

Ordinarily, read-only memories are custom-made and programmed for special applications. A large order must be placed to amortize the setup costs and bring the price below 2¢ per bit. These ROMs are different. They are mass-produced as preprogrammed, off-the-shelf kits. Each kit contains three 1024-bit ROMs programmed to generate 64 alphanumeric display symbols when addressed by the ASCII code. The kit for raster-scan displays is SK0001 and the kit for vertical scanning is SK0002. Figure 4 shows how the characters in the raster-scan font look on a television-type display.

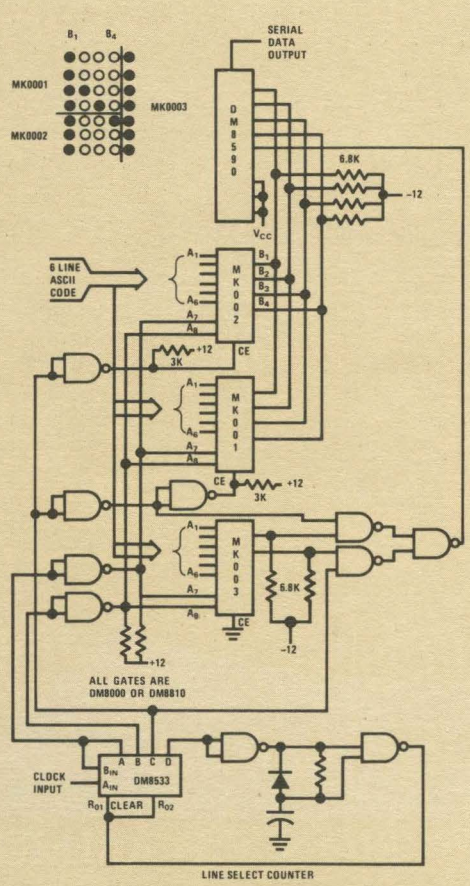

FIGURE 1. Raster-Scan MOS/TTL Display Character Generator. (SK0001)

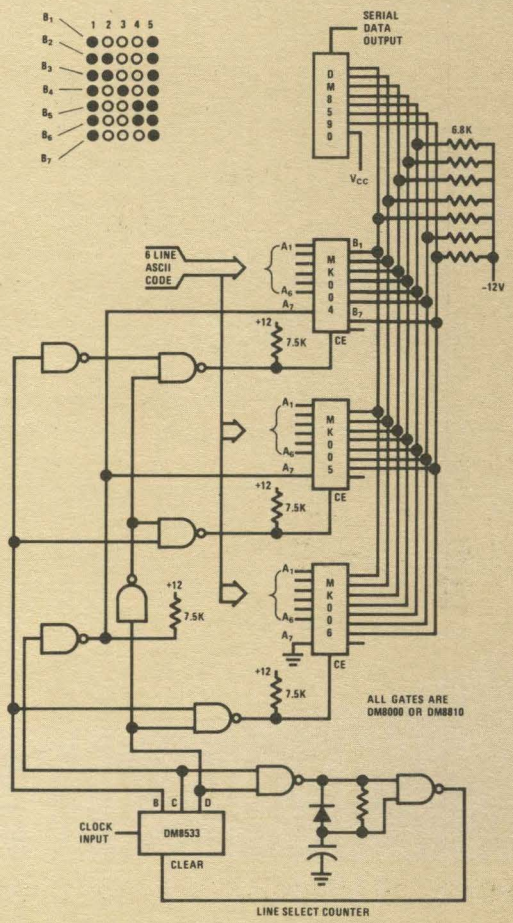

FIGURE 2. Character Generator for Tape Printers and Other Vertical-Scan Applications. (SK0002)

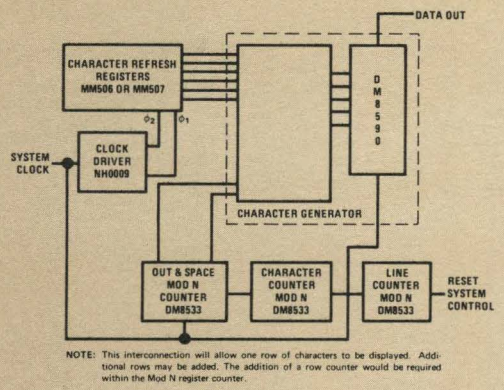

FIGURE 3. MOS/TTL System for Generation and Display Refresh.

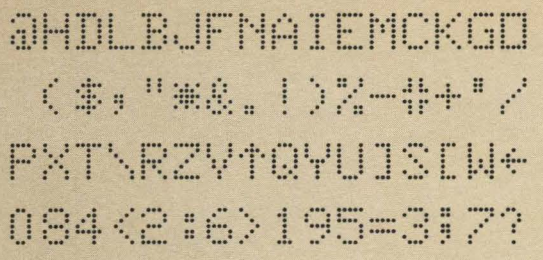

FIGURE 4. Raster-Scan 64-Character Display Font. Similar Standard Symbols Are Produced by the Vertical-Scan Memory Kit.

Some of the characters in the vertical-scan font look a little different, but the same symbols are generated and the displays are just as clear. Special symbol fonts can be made to order, on request.

Cathode-ray tubes can be controlled with the serial output of either character generator. Symbols are seen as bright dot patterns on the screen when the output is used to gate the CRT's electron beam. The raster-scan system of Figure 1 is ideal for low-cost television displays, while the vertical-scan system of Figure 2 is applicable to tape printers, billboards, and Broadway-type lamp displays, as well as CRT displays. The techniques should also be adaptable to electroluminescent panels and other advanced types of scanning displays.

Characters generated by the vertical scanning kit are displayed in five columns of seven bits per column. These are selected in the right order, under control of the DM8533 binary counter. The counter and gates are connected so that the first and third columns of the 5 x 7 patterns come from the top ROM (MK004 in Figure 2), the second and fourth columns from the center ROM, and the fifth column from the lower ROM. The counter toggles the system and also causes spacing bits (logic "0") to be loaded between characters on the CRT or other display. Its modulus establishes the number of spacing bits between the end of one character and the start of the next.

A DM8590 parallel-in/serial-out shift register arranges the parallel outputs into the serial gating-control stream. This TTL register is fast enough to permit the memories to operate in less than 1 μsec.

To generate raster-scan characters requires the selection of seven 5-bit lines. Therefore, the DM8533 in Figure 1 is used to count off the lines as well as the spacing interval between characters. After counting six intervals of N bits (five dots plus a spacing interval), the counter clears and counts six intervals again. The first four bits of the top four lines in each 7 x 5 display pattern are selected from the top ROM (MK001 in Figure 1), the first four bits of the bottom three lines come from the center ROM, and the last column of seven dots is generated by the lower ROM.

One method of implementing a complete system is blocked out in Figure 3. All functions are controlled by the system clock so that proper alignment of the symbols on the display is assured. The dot and space counter provides addressing control to the character generator, the character counter keeps track of the number of symbols displayed on each line in the display, and the line counter monitors the number of lines being displayed.

Other display functions can also be provided inexpensively with MOS memories. The MM520, for instance, can be the basis for a graphical display generator. If you like, we'll send data on our bipolar-compatible ROMs and shift registers, along with further information on MOS/TTL coupling techniques and the kits and devices used in these display systems.

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8-69 PRINTED IN U.S.A.