

If you want your program to display data by storing it directly into the display memory, you must first transform the display coordinates into the appropriate memory addresses, as shown in the section "Video Display Pages" in Chapter 2. The descriptions that follow will help you understand how this address transformation is done and why it is necessary. They will not (alas!) eliminate that necessity.

The address transformation that folds three rows of forty display bytes into 128 contiguous memory locations is the same for all display modes, so it is described first. The differences among the different display modes are then described in the section "Video Display Modes."

Display address mapping

Consider the simplest display on the Apple IIe, the 40-column text mode. To address 40 columns requires 6 bits, and to address 24 rows requires another 5 bits, for a total of 11 address bits. Addressing the display this way would involve 2048 (2^{11}) bytes of memory to display a mere 960 characters. The 80-column text mode would require 4096 bytes to display 1920 characters. The leftover chunks of memory that were not displayed could be used for storing other data, but not easily, because they would not be contiguous.

Instead of using the horizontal and vertical counts to address memory directly, the circuitry inside the IOU transforms them into the new address signals described below. The transformed display address must meet the following criteria:

- ☐ map the 960 bytes of 40-column text into only 1024 bytes
- ☐ scan the low-order address to refresh the dynamic RAMs
- ☐ continue to refresh the RAMs during video blanking

The requirements of the RAM refreshing are discussed earlier in this chapter in the section "Dynamic-RAM Refreshment."

The transformation involves only horizontal counts H3, H4, and H5, and vertical counts V3 and V4. Vertical count bits VA, VB, and VC address the lines making up the characters, and are not involved in the address transformation. The remaining low-order count bits, H0, H1, H2, V0, V1, and V2 are used directly, and are not involved in the transformation.