

line at the top and bottom of the display, and cut the number of mode 2 scrolling lines to 15. Then when you scroll, the mode 0 lines are unaffected and only the mode 2 lines are changed.

On ATARI computers, maintaining the display requires a significant fraction of the computer's time. Full scrolling displays require even more time, and in some cases the time required is more than available. It is important to keep the number of visible scroll display lines as small as possible. Modes 2 and 13 give the best results since each display line gives 16 screen lines, letting you cover large screen areas with the minimum number of display lines. Modes 0, 1, 2, and 12 also work fairly well; however, if you try to fill the entire screen (i.e., no top or bottom border) with one of these modes you may have problems. If the display requires more computer time than is available the screen will not be stable and/or you will get garbage on the screen.

Limited scrolling'

Remember, that the custom graphics modes are wider than the standard ones. In fact, the left and right parts of each line are normally off the screen. You can set up a display line so that it can be shifted to the right by an amount you specify, but the amount is rather limited. For example, in mode 1 you can shift right only by the width of about two characters. This allows you to see the two characters which are normally off the left screen edge.

For certain types of patterns in a line, you can make the pattern seem to move to the right by gradually increasing the amount of the line's right shift. When you reach the maximum, go to a zero shift and then start increasing the right shift again. To make the line seem to move left, first go to the maximum right shift and then gradually reduce the right shift. When you reach zero, go back to the maximum right shift and then start decreasing again. Remember, this works only for certain patterns, such as perhaps a checkerboard.

You can also set up a group of display lines so that they can be shifted up vertically by an amount you specify, but the amount is not large. The maximum shift is one less than the number of screen lines in the display line. For example, mode 1 uses 8 screen lines per display line; thus the maximum shift for this mode is 7. If you set the vertical shift to 0, only the top screen line of the bottom display line will be visible and the other lines will be in an unshifted position. If you set the vertical shift at 1, all of the lines of the group will be shifted up by one screen line. The top screen line of the first (top) scroll display line will disappear and the top two screen lines of the bottom scroll line will become visible. If you set the vertical shift at 7, the group will be shifted up by seven screen lines. The top seven screen lines of the first scroll display line will disappear, and all of the scroll bottom line will be visible. You can sometimes use the vertical shift to make certain patterns seem to move up or down.

To set up a group of display lines for limited horizontal scrolling, enter the graphics mode number, a space, an H, and RETURN. For example, when the program asks for the mode number for a given display, you could type 1, a space, an H, and RETURN. When it asks how many lines, you could type 6. This sets up six mode 1 display lines. If you use the SCROLL@ command (see below) to set a right shift of 1, all six of these lines will be shifted