Video output function of MZ-2500

The MZ-2500 is equipped with a complicated and powerful video output function for an 8-bit personal computer.

High resolution mode / standard resolution mode

First, about switching between high resolution mode (24kHz) and standard resolution mode (15kHz). This is determined by hardware depending on whether the CRT switch in the kangaroo pocket is "H" or "L". If the CRT switch is "H", the pixel clock of 21.47725MHz is input to the CRT controller, and if it is "L", the pixel clock of 14.31818MHz is input to the CRT controller. The state of the CRT switch is input to GPIO-B Bit 6 of OPN.

Bit3 of the internal register 0Fh of the CRT controller has a setting item called "Number of display lines", which is set to match the state of the CRT switch. Even if the reverse setting is intentionally made, the screen will be disturbed and there is no particular utility value.

The screen output timing is fixed in each resolution mode, and there is no setting to adjust the timing.

Superposition of text screen and graphic screen

The MZ-2500 has a graphic screen that can display 16 colors consisting of 4 horizontal bitmap planes and a text screen that can display 8 colors of CGROM (ANK / Kanji) or PCG. The text screen is displayed on top of the graphic screen. The graphic screen is usually displayed in the transparent part of the text screen by overlaying, but it is also possible to set to display the background color instead.

If you want the graphic screen to appear above the text screen, use the palette display priority (see below).

Text screen resolution and graphic screen resolution

The resolution of the text screen and the resolution of the graphic screen can basically be set independently. However, since the color mode of the text screen (8 color mode ⇔ 64 color mode) and the color mode of the graphic screen (16 color mode ⇔ 256 color mode) must match, the graphic screen is changed to 320 x 200 256 color mode. If set, the color representation of the text screen may be restricted (described later).

Text screen resolution and color

It is possible to set 80 or 40 columns horizontally and 25 or 20 columns vertically. There is no setting of 12 vertical lines on the hardware, and software such as BASIC manages it so that it looks like 12 vertical lines in the vertical 25 line mode.

In high resolution mode (24kHz), you can change the vertical resolution of one character of text. With Bit0 of I / O F7h, you can select whether to read 8 lines twice and display them as 16 lines or display them as 16 lines. In 8-line mode, one character is composed of an 8-byte pattern, and in 16-line mode, it is composed of 16 bytes. This setting affects both CGROM / PCG. Therefore, the number of PCG definitions is halved in 16-line mode.

It has a two-screen text screen in 40-digit mode. (Text VRAM display address xor 400h) is the address of the second screen. You can select whether to display only one of the screens in 8 colors, to display 8 colors by superimposing the 2 screens, or to combine the colors of the 2 screens and display 64 colors.
The colors that can be developed in the 8-color mode are the so-called digital 8 colors.
In the 64-color mode, the color of the first screen is RGB Bit2, the color of the second screen is RGB Bit1, and the RGB Bit0 is always 0, and 64 out of 512 colors are output. Since the least significant bit of RGB is fixed to 0, the maximum brightness color cannot be output on the text screen in 64-color mode.

In CGROM and monochrome PCG, the character part is displayed in the specified color (including black), and the background part is treated as a transparent color. Color PCG always treats black as a transparent color. Note that the text screen does not have a palette function, so it is not possible to overlay opaque black on a graphic screen with a color PCG.
In 8-color 2-screen mode and 64-color mode, the pixels on the graphic screen are displayed only when the pixels on both the first and second sides are transparent.

Reverse (inverted) and blink (blinking at about 1 Hz) can be specified independently as character display attributes. Attributes are processed in the order of blink → reverse → color specification. (Example: Reverse blinking red characters switches between "transparent characters on an opaque red background" ⇔ "only opaque red background")

In 20-line mode, 2 lines (standard resolution mode) or 4 lines (high resolution mode) of white space are added below each character cell. Display attributes are also applied to the margins.

When the graphic screen is set to 320 x 200 256 color mode and the text screen is set to other than 64 color mode with the register 00h of the CRT controller, only the MSB plane in 64 color mode is valid.-The LSB plane is always treated as 0. And a color with low brightness is displayed. Since the display is normal except for the low brightness, it is possible to superimpose 640 x 400 8-color mode Kanji text on the 320 x 200 256-color mode graphic screen.

Graphic screen resolution and color

640 x 200 and 320 x 200 resolutions can be set. In high resolution mode (24kHz), 640x400 and 320x400 resolutions can also be set. In the horizontal 320 dot mode, it has a two-screen graphic screen, and (display address xor 2000h) is the address of the second screen. You can select whether to display 16 colors on only one of the screens, to display 16 colors by superimposing the two screens, or to combine the colors of the two screens and display 256 colors.

The colors that can be developed in the 16-color mode are IGRB 0 and 9 to 15 are so-called digital 8 colors, 1 to 7 are 7 colors with a brightness of 4/7, and 8 is white with a brightness of 3/7.

In 256-color mode, the RGB plane of the first screen is RGB Bit2, the RGB plane of the second screen is RGB Bit1, and RGB Bit0 refers to the setting of the internal register 0Ah of the CRT controller, and outputs 256 colors out of 512 colors. Is done. RGB Bit0 can be selected from the following.

- Graphic screen I plane on the first screen
- Graphic screen I plane on the second screen
- 0 fixed
- 1 fixed

You may think that if you fix Bit0 of RGB to 1, you cannot develop a perfect black color, but you can develop a color by setting the background color described later.

Palette code 0 is treated as a transparent color in the two-screen overlay in 16-color mode.

·palette

Palettes apply only to graphic screens.

Color code and display priority can be set for each of the 16 color palette codes. In 256-color mode, the palette is applied only to the first side. In 16-color 2-screen mode, the palette is applied to both the first and second sides.

For the palette code for which priority is set, the pixels on the text screen that overlap the corresponding pixels are forcibly hidden. As a result, only the specified palette code appears to be displayed in front of the text screen.

• Background color

It is possible to set the background color by selecting one color from 16 colors in 16-color mode and 512 colors in 256-color mode.

In 16-color mode, pixels with a color code of 0 (black) after applying the palette to the graphic screen are displayed in the background color.

In the 256-color mode, pixels whose color code is 0 after applying the palette to the first surface of the graphic screen and whose color code is 0 on the second surface are displayed in the background color.

In practice, it may not be set to anything other than black.

Text screen scrolling

The specified display address is displayed as the upper left. This allows scrolling in character units. The display address wraps between 000h and 7FFh.

By setting the display start line together, scrolling is possible in line units. (In the mode of 16 lines per character, scrolling is done in units of 2 lines)

Even in a mode with two text screens, the scroll settings are the same, so the two screens cannot be scrolled separately.

Graphic screen scrolling

The specified display start address is displayed as the upper left. This makes it possible to scroll in units of 8 dots horizontally and 1 line vertically.

The display address seen from the graphic controller is 0000h to 7FFFh, and the first half is assigned to standard VRAM and the second half is assigned to extended VRAM, but it is a linear space without distinction in handling. In 16-color 1-screen mode, scrolling that spans standard VRAM and extended VRAM is also possible. However, in the case where the second screen exists such as 256 color mode, the address of the second screen is (display address xor 2000h), so as soon as you scroll, you will enter the second screen. This can be avoided by using the split scroll function.

Even in a mode with two graphic screens, the scroll settings are the same, so the two screens cannot be scrolled separately.

- **Horizontal smooth scroll**

Only the first side of the graphic screen can insert 0-7 white pixels on the left edge. Horizontal smooth scrolling is possible by masking the leftmost digit.

- **Split scroll**

There is a function to "change the display address when the display line reaches the specified line" and a function to "return the display address to 0 when the display address reaches the specified address". This can be used for split scrolling.

Setting the blanking range

Both the text screen and graphic screen can be set to narrow the display range up, down, left, and right.
Increasing the vertical blanking period will increase the VRAM accessible period, but increasing the horizontal blanking period will not increase the accessible period.

Expansion pallet board

The extended palette board MZ-1M10 is valid only in 16-color mode. The palette works for the color code after compositing the text screen and graphic screen. 15 out of 4096 colors can be set for each of the color codes 1 to 15. Color code 0 is fixed to black.

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