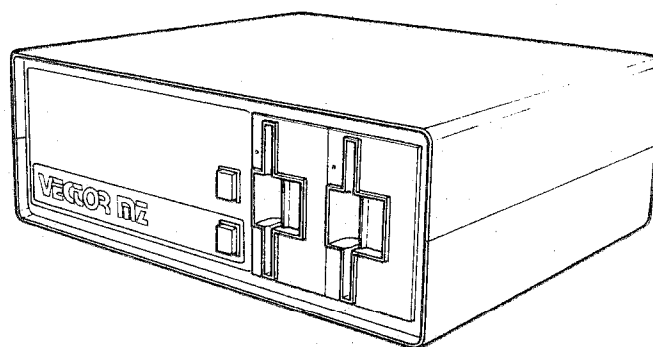
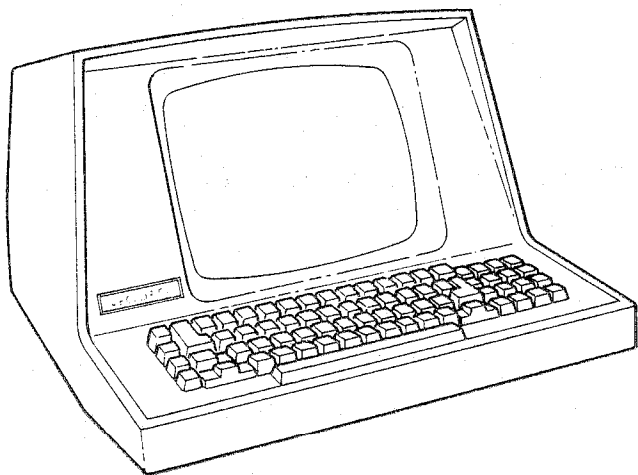


# FLASHWRITER II

## USER'S MANUAL



 VECTOR GRAPHIC INC.



FLASHWRITER II BOARD

Manual Revision 3  
March 29, 1979

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Vector Graphic Flashwriter II Board

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Repair Agreement void if the enclosed card is not returned to VECTOR GRAPHIC, INC. within ten (10) days of end consumer purchase.



# Vector Graphic Flashwriter II Board

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## I. INTRODUCTION

### 1.1 Description of the Board

The Flashwriter II Video Board is Vector Graphic's advanced 80 x 24 memory mapped video board. By "80 x 24" we mean that the board displays characters on the screen in 24 rows of 80 characters each. Each character is made up of an 8 x 10 matrix of dots.

The Flashwriter II can be installed in ANY S-100 8080 or Z-80 computer, including existing Vector Graphic computers, in order to convert the existing memory mapped display to 80 x 24, or to make use of memory mapped video for the first time if a serial terminal had been used. It can be used with almost any standard computer video monitor, since it can produce either separate or combined video and sync signals. However, the monitor must have a band width of at least 12 MHz. The board is definitely applicable to the Vector Graphic Mindless Terminal, which requires separate signals. (Note: in this manual, the word "monitor" refers to a video display unit, and the word "Monitor" with an upper-case M refers to a kind of computer program which handles basic housekeeping functions for the computer.)

The Flashwriter II makes use of the most up-to-date ideas in circuit design such as flicker-free updating of the screen, separate sync outputs for video monitors requiring it, on-board user-programmable PROMs storing the character set, on-board socket for a video-driver and/or Monitor, Jump-on-Reset capability, to be used if the on-board video-driver socket is used, the availability of inverted or non-inverted vertical sync signals, the availability of combined or separate video and sync signals, and the capability for reverse video. To make the board adaptable to many different systems, you are free by using jumpers to specify the memory addresses used by the on-board video memory RAM and the on-board video driver.

Further, a parallel keyboard input port is incorporated on the board, with the port numbers changeable by jumper anywhere from 00 and 01 (status and data) up to 0E and 0F. Although the board is shipped jumpered so that it strobes the keyboard data into the input latch on the rising edge of the key-depression strobe, a jumper can be installed to strobe the data on the falling edge, as required by some keyboards. The board can also be jumpered to generate an interrupt when a key is depressed, instead of waiting to be polled.

A particularly useful feature of the board is the ability to accept a user-created character set, which can be either a 128 or 256 character set. If a 256 character set is desired, then the user must sacrifice the use of reverse video. The board is shipped with a 128 character set, on a PROM. This set consists of the 96 standard ASCII characters and 16 special graphics characters which can be used to build graphics images or large characters.

Instructions are provided for creating your own character set and encoding it on 2708 or 2716 EPROMs (the latter for a 256 character set), if desired.

Instructions are given in this manual for writing programs to use the board. In addition, the user can purchase, if not already included in his computer system, the Vector Graphic Extended Systems Monitor with video driver, Version 3 EV-II. Before making this decision, section 3.2.1 should be read. Use of this Monitor will eliminate some or all of the assembly language programming necessary to use the board. The EVIOS program, a sophisticated video driver used with the Flashwriter I board, cannot be used with the Flashwriter II board, but Version 3 of the Monitor makes it largely unnecessary. For user's familiar with Flashwriter I, this is partly due to the fact that Flashwriter II does not have a separate memory block containing character attributes. In Flashwriter II, there are no special vertical and horizontal lines outside of those in the graphics characters, there is no reduced intensity, and the graphics characters are produced in response to ASCII codes 00 to 1F and 80 to 9F.

The Flashwriter II board is a major addition to the Vector Graphic product line. Vector Graphic has now applied its well known excellence in video display quality and product flexibility to the creation of an advanced 80 x 24 video display board.

## 1.2 Description of the Manual

This manual provides a discussion of the theory of operation of the Flashwriter II, and a User's Guide describing 1) when and how to modify the board's electronics and PROM's, 2) how to program for the board, how to adjust the TV monitor, and how to connect the board to keyboard and video. Since the board is not sold as a kit, assembly information and parts list are not included.

## II. THEORY OF OPERATION

A block diagram of the video display module is shown on page 4-5. Each of the blocks is comprised of several integrated circuits as shown on the schematic diagram on page 4-7.

### 2.1 Keyboard Port

Starting with the keyboard port, U46 is an 8 bit latch which internally stores the data from the keyboard coming through J1 when the STB (pin 11) input goes low. A jumper option allows the correct strobe polarity to be selected. U46 contains a service request flip flop which is set by the same strobe edge that latches the data, causing  $\overline{INT}$  to go low (pin 23). This signal can optionally be connected to  $\overline{PINT}$  on the bus (pin 73) for interrupt driven keyboard input, or can be tested by accessing the status port. Two adjacent ports are always occupied by the status and data with the status being the lower one. The port address is decoded by U39 and the associated sections of U27 and U38. A jumper allows the selection of port addresses from 0 and 1 to E and F. (Each pair of ports refers to status and data, respectively.) Signals INPS and INPD enable tristate bus drivers U45 and U21 to gate the  $\overline{INT}$  signal and data onto the bus at the appropriate time. Both inverted and non-inverted status are available, for keyboard drivers using different conventions. The vertical blanking signal is also available, from the status port, for use as a 60Hz clock signal, or for synchronizing data transfers with the vertical retrace.

### 2.2 Horizontal Sync Circuitry

The timing for the characters, horizontal blanking and horizontal sync pulse is provided by U15, U29, U3 and U1. A crystal oscillator at 14.318 MHz provides the clock for all the signals. This is the frequency at which the individual dots making up the characters are displayed. U15 divides this clock by 8 to generate a character clock output every time a new character is to be displayed. This signal is further divided by U29 and U3 to generate a horizontal period of 63.69 micro-seconds. The outputs H0-H6 are binary outputs representing the 80 character positions per line. H7 goes high at the end of the displayed line of characters, and is used as the horizontal blanking signal. At the count of 207, decoded by U2 pin 8, the counter string is preset to the value of 94 and starts counting over again. This signal also triggers U1, a dual one-shot to generate a horizontal sync pulse. The delay of this pulse can be varied by the horizontal position potentiometer to allow centering the display on the TV screen.

### 2.3 Vertical Sync Circuitry

The vertical sync counters U6, U4 and U5 are clocked by the horizontal sync pulse from U1 pin 5 to produce a count from 0 to 261. Each row of characters occupies 10 scan lines. U6 is a decade counter, so it generates a terminal count (TC) every 10 lines. The displayed characters occupy 240 lines, and U19 pin 12 goes low at the count of 240 to blank the display. A vertical sync pulse is generated by a section of U5 and U20 pin 1 which is 2 lines long, from 240 to 242. This is slightly shorter than a standard TV sync signal, and produces a minimum disturbance to the horizontal sync of the TV. The video output remains blanked until the counters are preset to 0 at the count of 261 for a total of 262 scan lines.

### 2.4 Memory Address Multiplexer

The on board memory is multiplexed between the CPU and the sync circuitry. This is done using tristate drivers U40, U41, U28 and the tristate outputs of U16. Thus when the CPU addresses memory, the address bus signals drive the memory address inputs, and while the characters are displayed on the screen, the address inputs are generated by the sync circuitry. One complication is that since 80 is not a binary power, there is not a convenient separation of horizontal and vertical address inputs. 80 is divisible by 16, so the least significant 4 bits from U29 are applied directly to the memory address inputs. The remaining 3 horizontal counter outputs H4-H6 and the vertical sync signals V0-V4 are mapped into 7 bits using a 256 x 8 ROM U16. This effectively maps the displayed characters in a linear fashion into the 2K of address space occupied by the memory. Since  $80 \times 24 = 1920$ , there are 128 locations in RAM that are not displayed on the screen.

If the memory is addressed by the CPU, it will not be able to generate the proper output to be displayed on the screen. This would cause undesirable glitches, or flashes of light on the screen as the display was being written into. To prevent this, access is inhibited by the CPU except during the horizontal retrace interval. U12 provides the necessary arbitration and pulls PRDY (pin 72) low to put the CPU in a wait state until it can access the memory. Two sections of U12 provide delays to ensure that control is transferred properly. U12 pin 13 provides a delay to ensure that the CPU has finished its current memory access cycle, and U12 provides a similar delay to ensure that the memory access time is satisfied before the CPU proceeds. The data bus is buffered by U44 and U33.

### 2.5 Memory Latch

The combined access time of the memory and the character generator ROM exceeds the character period of 558 ns. Thus the data is "pipelined" using U34 and U35 to latch the memory data. This

provides 558 ns access time for both the RAM and character generator. The output of U34, U35 is delayed by one character clock period from the sync counter outputs, while the data strobed into the dot shift register U8 is delayed two character clocks. To compensate for this delay, it is necessary to delay the horizontal blanking signal also. This is done using sections of U35, and the output of pin 12 is H Blank DLD, the delayed horizontal blanking signal.

## 2.6 Character Generator and Shift Register

The dot patterns for each character are generated by U22 and U23. The 8 bit output from these user programmable EPROMs is supplied in parallel to U8 which shifts the dots out at the high dot clock (14.318 MHz) rate. The addressing of U22, 23 is arranged so that there are several options as far as the ROMs are concerned. U22 generates the top 8 lines of each character cell. If only upper case characters are used with no descenders, this is the only ROM required. For the descenders of lower case characters and graphic symbols, a second ROM is required (U23) which generates the bottom two lines of each character cell. If in addition, a full 256 characters are used, U22 is replaced with a TMS 2716. For the 128 character ASCII character set, the most significant memory bit is not required. This is normally jumpered to U7 pin 12 to control the reverse video. If the 256 character set is used, this bit is connected to U22 pin 20 to select the upper half of the ROM. More information on this subject is provided in the User's Guide, Section III of this manual.

## 2.7 Video Combiner

The horizontal and vertical sync signals are available at J2 pin 4,5 for monitors such as the Ball Brothers TV 120 used in the Vector Graphic Mindless Terminal which require separate sync and video. U19 pin 8 is the combined video and blanking signal which is available at J2 pin 3 with the proper polarity for the Mindless Terminal. The sync signals and video are combined in the circuitry associated with U10, and are available at J2 pin 1. The horizontal and vertical sync are first combined in U7 and then summed with the video using the open collector outputs of U10 and the resistive network. The resistor values have been chosen to give the proper sync and video amplitudes and to provide a 75 ohm source impedance to drive a terminated video cable. Very good video rise and fall times are obtained with this circuit. In order to compensate for the limited bandwidth of most TV monitors, some high frequency preemphasis is provided by the 470 pf capacitor shunting the 100 ohm output resistor. If the video display is not satisfactory, it may be improved by changing this value.

## 2.8 Monitor ROM Circuit

A socket is provided for a 2708/2716 ROM to be used as a monitor and/or video driver. U26 selects both the address for the video memory RAM and also the ROM with jumper options every 2K in the upper 16K of memory. A Jump on Reset flip flop consisting of U9 sections has two functions: 1) to disable RAM after the system is powered up or reset; 2) to enable the on-board Monitor ROM at address 0. If the first three instructions of the ROM are JMP XX03, where XX00 is the normal ROM address, then when the system is powered on or the reset key is depressed, these instructions will be executed, causing the CPU to continue executing with the 4th byte of the ROM. After the jump takes place, the circuitry automatically resets the flip flop and restores normal operation of the RAM. Circuitry is also provided to generate MWRITE, a signal produced in some computers by the front panel. This is not required in Vector Graphic equipment as it is generated by the Z-80 CPU board.

### III. USER'S GUIDE

#### 3.1 Modifications to the Standard Configuration

The sub-sections within section 3.1 discuss each of the possible modifications which can be made to the standard Flashwriter II Board, both to its electronics and to the PROM's which support the board. In each sub-section, you will find a description of how the board is used if no modification is made, a description of why you might make the modification, and the method for carrying it out. This section should be reviewed, if only to determine what indeed constitutes the standard configuration of the board. In order to find the location of chips, jumper areas, and pads within each area, refer to the diagram on page 4-6.

##### 3.1.1 Creating a New Character Set

The Flashwriter II Board is shipped with a standard 96 character ASCII character set plus 32 special "graphics" characters. You will find a diagram of this character set on page 4-1. The graphics characters can be used through appropriate programming to create a large variety of graphic designs on the screen. These 128 characters are those that the board displays on the video screen when the corresponding codes are stored in the on-board RAM. The code for each character consists only of 7 bits, the lower 7 bits of each stored byte. The eighth bit when set converts the character into reverse video (black on white background.) Otherwise it is normal video. Reverse video versions of the graphics characters are found on page 4-2.

The characters are stored in two 2708 1K PROM's, U22 and U23. Each character consists of an 8 by 10 matrix of bits, as illustrated on page 4-1. PROM U22 stores the first 8 lines (lines 0 to 7) and U23 stores the last 2 lines (the descender portion). The lowest addresses on U22 contain the first lines of all 128 characters, then come the second lines of all 128 characters, and so on, up to the eighth line of all 128 characters. Then U23 completes the characters with the ninth and tenth lines.

If you wish to replace these characters, you need only create a new pair of PROM's, using the arrangement described above. For a nominal fee, Vector Graphic will do this for you. You must provide Vector Graphic with a drawing of each character, darkening the appropriate cells in an 8 by 10 matrix. Use the blank character form on page 4-3. Note that if you limit yourself to only upper-case characters, not using the bottom two lines in each character, you will not need the U23 PROM. To order custom character PROM's from Vector Graphic, please contact the company directly to make arrangements.

You can also create a full 256 character set. To do this, you use a

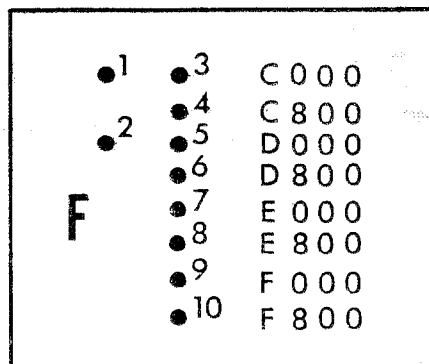
TMS 2716 2K x 8 PROM or equivalent for U22, and 2708 for U23. The data is organized in the same way as with a 128 character set, except that 256, instead of 128, consecutive addresses contain the first lines of all the characters, and so on for each line in the character matrices. With a 256 character set, you sacrifice the use of reverse video, because all 8 bits of each byte are used to designate the character. Vector Graphic will also create the PROM's for you for a 256 character set, for an appropriate fee. Use both of the blank character forms found on pages 4-3 and 4-4 when sending your character set to Vector Graphic, putting the first 128 characters on the first page, and the second 128 characters on the second page.

The board is shipped jumpered for a 128 character set. Jumpers must be changed as follows for a 256 character set.

	<u>128 character set</u>	<u>256 character set</u>
Area I	2 - 1	Cut 2 - 1
Area B	2 - 4 3 - 1	2 - 1 3 - 4 Cut 2 - 4 Cut 3 - 1
Area E	1 - 3 2 - 5	1 - 3 Cut 2 - 5 2 - 4

### 3.1.2 Changing the Address of the Video Memory

2K of RAM are provided on-board for storage of the current screen image. Since the screen contains only 1920 character locations, the last 128 bytes of this RAM is available for any other purpose. The board is shipped with this RAM addressed at D000. Since the Vector Graphic Extended Systems Monitor assumes this location, do not change it if you are using the video driver in this Monitor, unless you are willing to modify the Monitor on PROM. If you do want to change the address of video memory, a jumper must be changed in Area F. The jumper which determines the address of the RAM goes from pad 2 to one of the 8 pads below it. Each of the 8 pads corresponds to one address, as indicated in the diagram below. Cut the existing jumper and install a new one as required.





### 3.1.3 Putting a Monitor PROM on the Board

The Flashwriter II board is not shipped with a Monitor PROM on the board. However, socket U42 is available for either a 1K 2708 or a 2K 2716 PROM holding a Monitor and/or video driver. This program can be one of the Vector Graphic Monitors (see section 3.2.1) or one you have written yourself (see section 3.2.2.) (Note that in Vector Graphic computers the Monitor PROM resides on the 12K PROM/RAM board.) If you do install a Monitor PROM on the Flashwriter board in U42, it will function if the board is properly jumpered. Refer to sections 3.1.4, 3.1.5, and 3.1.6.

### 3.1.4 Address of the Monitor PROM on the Board

If you choose to use the socket provided on the board for a Monitor and/or Video Driver PROM, you must put a jumper in Area F to specify the address of this PROM. The jumper goes from pad 1 to one of the 8 pads below it. Each of the 8 pads corresponds to one address, as indicated in the diagram in section 3.1.2. Obviously, you cannot use the same block of memory that is used for the on-board RAM.

### 3.1.5 Specifying whether Monitor PROM on Board is 2708 or 2716

If you choose to use the socket provided on the board for a Monitor and/or video driver PROM, the chip used can be either a 1K or 2K chip, i.e. a 2708 or 2716 respectively. The board is shipped to accept a 1K PROM, as determined by the jumpers in Area D. In order to use a 2716 PROM, cut the jumpers from 1 - 4 and from 2 - 3 and replace with a jumper from 1 - 3 and a jumper from 4 to Area M. (There is only one pad in Area M.)

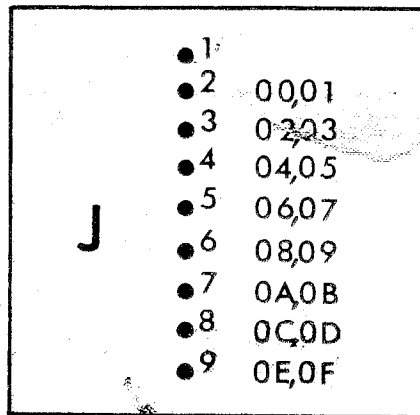
### 3.1.6 Enabling Jump on Reset

At this time, the Flashwriter II board is not shipped with a Monitor PROM, and therefore is not responsible for Jump-on-Reset. If you install a PROM on the board, you will want to enable Jump-on-Reset. If this is enabled, when the operator powers on the system or depresses the front panel reset switch, the CPU will automatically read the first 3 bytes of the Monitor PROM on the board. Thus, the first three bytes of the Monitor PROM must be a jump to some other address in memory. Usually this address is simply the next address on the same PROM, namely the beginning address of the PROM plus 3.

In order to enable Jump on Reset, install a jumper in Area C from 1 - 2, and in Area K from 1 - 2. If you are writing your own Monitor PROM, then the program which begins at the 4th byte of the PROM must be an appropriate response to the reset.

### 3.1.7 Changing the Keyboard Port Address

Normally the keyboard is accessed through ports 00 and 01 (status and data, respectively). You can change this to any consecutive pair of ports up to 0E and 0F. This is done by changing the jumper in Area J. Cut the existing jumper. Then, install a jumper from pad 1 to the pad corresponding to the desired port address, as illustrated below.



### 3.1.8 Changing the Polarity of Vertical Sync Signal

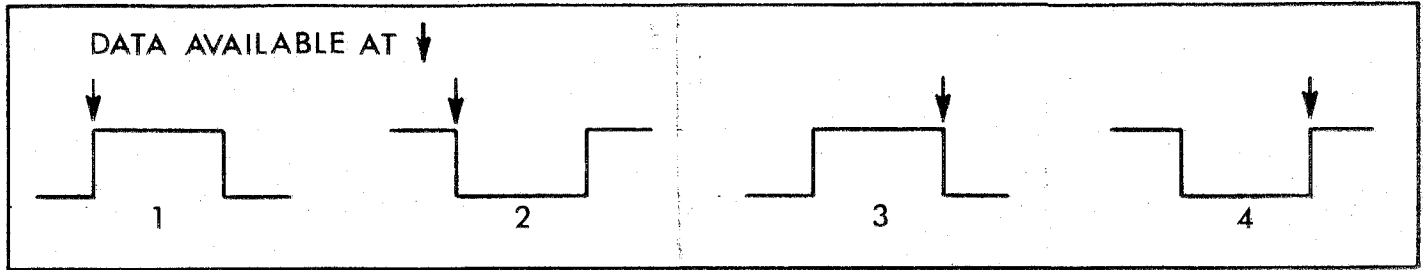
The board is shipped to output an inverted vertical sync signal, as required by the Vector Graphic Mindless Terminal. If you are using a video monitor which requires a non-inverted vertical sync signal, then cut the jumper in Area A from 1 - 2, and install a jumper from 1 - 3.

### 3.1.9 Obtaining MWRITE

The composite S-100 signal MWRITE is produced by the Vector Graphic Z-80 CPU board. In other computers, it is produced by the front panel. If your computer does not generate MWRITE, then you will need it in order to write to memory. The Flashwriter II board will generate it if you place a jumper in area G, from 1 - 2.

### 3.1.10 Changing the Polarity of the Keyboard Strobe

There are 4 common types of strobes generated by keyboards to indicate that a key has been depressed, as illustrated below:



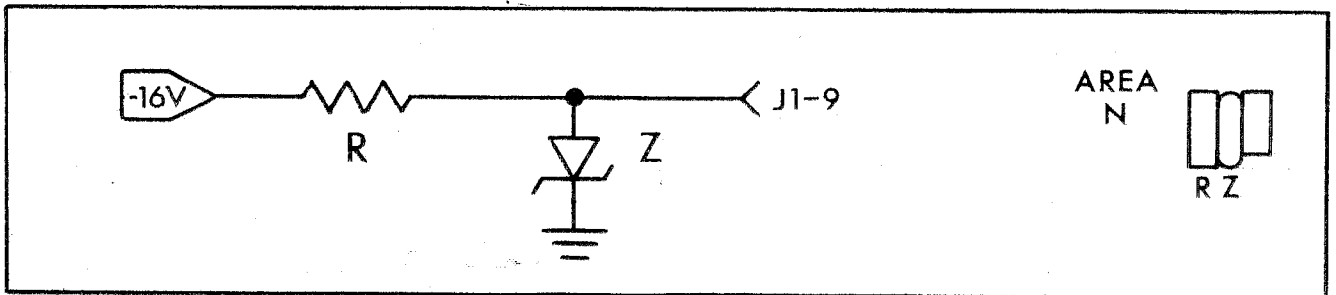
The first type is the one used by the keyboard on the Vector Graphic Mindless Terminal. Both it and the fourth type require that the key data be strobed into the Flashwriter keyboard latch on the rising edge of the strobe. The Flashwriter II board is shipped to strobe the data into the latch on the rising edge. On the other hand, if your keyboard generates the second or third type of strobe, cut the jumper in Area H.

**3.1.11 Using Interrupt Driven Software**

If you want the keyboard to generate an interrupt whenever a key is depressed, put a jumper in Area L from 1 - 2. If this jumper is not in place, then keyboard data can only be obtained by polling the status port. (See section 3.2).

**3.1.12 Supplying a Keyboard with a Negative Voltage Power Supply**

If you have a keyboard which requires a negative voltage power supply in addition to the +5V, and you are technically oriented, then there are pads in Area N of the board to install a zener regulated power supply. The circuit diagram on the left, below, will be completed if you insert the correct resistor and zener in Area N, as shown on the right, below.



The zener voltage will depend on the keyboard requirements if it is needed at all, and the resistor should be selected to bias the zener with at least 10 mA of current in addition to the current required by the keyboard. For example, with a keyboard requiring 10 mA of current at -6V, the zener could be a IN752A (5.6V) and the resistor could be  $10/.02 = 500$  ohms (470 nominal). The zener power dissipation would be 60 mw and the resistor dissipation would be 200

mw. Use a 1/2 watt resistor to allow for higher supply voltages.

### 3.1.13 Using a Spare Key on the Keyboard for Reset

If your keyboard has an extra key not connected to the keyboard encoder logic, it can be used to reset the system, as an alternate to the reset key on the front panel. This is not possible with the Vector Graphic Mindless Terminal. Simply connect the key so that when it is depressed it grounds pin 11 of J1, the keyboard socket. See section 3.4.3 for a diagram of J1.

This pin is connected to pin 75 on the bus (PRESET). When the line is grounded by depressing the key, the jump-on-reset circuit on this or another board will enable the Monitor PROM on the same board.

### 3.1.14 Accessing the 60 Hz Vertical Blanking Signal

Bit 5 of the input status port is low during vertical retrace.

## 3.2 Programming for the Flashwriter II Board

### 3.2.1 Vector Graphic Extended Systems Monitor 3 EV-II

By far the most convenient way to use the Flashwriter II board is through the use of the Vector Graphic Extended Systems Monitor, Version 3, Option EV-II or CV-II. This program comes on a PROM to be installed in position 8 on the Vector Graphic 12K PROM/RAM board. The Monitor is NOT automatically included with any order of the Flashwriter II board, and therefore must be ordered as a separate item. If you are upgrading a system from a Flashwriter I board, the Extended System Monitor used for that board will not work with Flashwriter II. You must order Monitor 3.

In contrast with earlier Vector Graphic Monitors, the video driver in Monitor Version 3 allows you to write anywhere on the screen, either by moving the cursor from the keyboard or entering X,Y coordinates from an assembly language or BASIC program. (BASIC must have POKE, as does M.BASIC provided with Vector Graphic Systems.) It also allows you to toggle reverse video from program or keyboard, and offers several less significant additional features. Both Monitor Version 3 and earlier versions contain keyboard input routines. Option EV-II interfaces to parallel keyboards, while Option CV-II interfaces to serial keyboards as on printing

terminals.

In addition to the video driver, and keyboard input routines, the Version 3 Monitor offers a wide range of useful utility programs, including ASCII Dump, Hex Dump, Jump to Micropolis Bootstrap Loader (D800), Compare Blocks of Memory, Jump to Extension PROM (C400 - the start of MZOS or a user written PROM), Find Two Bytes, Go To and Execute, Input from a Port, Jump to Loaded DOS (jumps to the warmstart location of MZOS or MDOS, whichever is running), Jump to 0000, Move Memory Block, Non-destructive Memory Test, Output to Port, Accessing Program Memory (for displaying and changing consecutive addresses), Compute Checksum, Jump to DC00, Search for Single Byte, Test Memory, Jump to 2A00, Wide Screen ASCII Dump, Exchange Memory Blocks, Keyboard Echo, and Zero or Fill Memory. These routines are accessed when the Monitor Executive routine is running, as indicated by the Monitor prompt \*.

Version 3 of the Monitor contains several methods of displaying characters. Although the documentation to the Monitor describes these, a review here is useful. The basic technique is to call the video driver (CALL C006) with the desired character in the A register. This is sometimes called "sending" a character to the driver. This is the method used by all Vector Graphic operating system software such as MDOS and MZOS to display characters. By itself, this can only be used to display normal alphanumeric characters, those with codes between 20 and 7F (Hex). (The driver converts the codes higher than 7F to the corresponding code from 00 to 7F, by changing the 8th bit from 1 to 0.) Then, only the codes between 20 and 7F are displayed. Any code between 00 and 1F is interpreted as a command rather than a character, or if not a valid command, then ignored.

How then are graphics characters displayed? To get around the above restrictions in order to print characters outside the range 20 to 7F, first put the character you want to print in the B register, then put Hex 05 in the A register, and then call the video driver at C006. If the character is from 80 to FF, then it will be displayed in reverse video if your board is jumpered for reverse video as shipped. If not jumpered for reverse video and you are using a 256 character set, then codes 80 to FF will produce whatever characters are specified in the character generator PROM (see section 3.1.1.) If the character is from 00 to 1F, the corresponding graphics character will be displayed, or whatever other character is stored in the character PROM if you have created your own character set.

There is another method which is specifically used to display reverse video characters (those from 8A to FF.) First, send the character Control-T (14 Hex) to the video driver, either from program or from the keyboard via a program such as the Monitor Executive. Following this, any character sent will be converted to the corresponding character from 80 to FF, or left in that range if already there. Thus it will be displayed as reverse video. To

cancel, send another Control-T.

### 3.2.2 Displaying Characters Without Using the Vector Graphic Monitor Video Driver

This section is of concern if you are bypassing the Vector Graphic Extended Systems Monitor video driver, or writing your own video driver.

To display a character somewhere on the screen, simply write the corresponding ASCII code into the appropriate RAM location, using the RAM on the Flashwriter II board. Unless you have changed the location of this RAM as described in section 3.1.2, it is the 2K block from D000 to D7FF. Since the screen is 80 x 24, the last 128 bytes of this block are not used. The first location of this RAM corresponds to the upper left-hand corner of the screen, and successive locations move across the screen from left to right, going to the left edge of the next line down at the end of each line.

If the board is used as shipped, the characters which will be produced by each ASCII code are shown on the diagrams on pages 4-1 and 4-2. This includes special graphics characters which you can use to build graphic images such as pictures or large letters. Note that the characters from 80 to 9F are reverse video versions of those from 00 to 1F. Similarly, if you display a character having a code from A0 to FF, it will be the reverse video version of normal alphanumeric characters from 20 to 7F. (This assumes that the board is jumpered for reverse video, as shipped.) As explained in 3.1.1, you may create your own characters to replace those supplied with the board.

If you are writing your own Monitor program, including a video driver, you can if you choose install this PROM on the Flashwriter Board. The socket is labelled U42 on the board. If you do this, you should refer to sections 3.1.3, 3.1.4, and 3.1.5 in order to make appropriate hardware modifications if necessary.

### 3.2.3 Producing Reverse Video

This section specifically covers reverse video, even though it has been discussed in preceding sections. Reverse video refers to displaying a character in black, on a white background. This section is only relevant if the Flashwriter Board is jumpered for reverse video, as shipped from Vector Graphic, rather than for a 256 character set. (See section 3.1.1.)

The easiest way to cause reverse video is to go the Monitor Executive routine (if you have the Vector Graphic Monitor Version 3) by depressing ESC on the keyboard. Then depress Control-T (CTRL and

T keys simultaneously). Any characters displayed after that will be in reverse video, until another Control-T is depressed.

Any character stored in the Video Memory RAM will be displayed as a reverse video character if the 8th bit of the character is a 1. This corresponds to Hex codes 80 to FF. If the 8th bit is 0, i.e. codes 00 to 7F, video will be normal. In other words, if you display a character with a code between 80 and FF, it will be the reverse video version of the corresponding character between 00 and 7F. The chart on page 4-1 shows characters corresponding to 00 to 7F (Hex). On page 4-2 a number of additional graphics characters are shown having codes from 80 to 9F (Hex). Notice that the graphics characters from 80 to 9F are reverse video versions of those from 00 to 1F. In the same way, if you store in video RAM the codes beyond 9F, that is A0 to FF, they will be displayed as the reverse video versions of the normal ASCII characters, having codes 20 to 7F.

There are three ways to store the reverse video characters in video memory. First, you can create the appropriate 8 bit code in a program and then store it in video RAM. For the second and third methods you must have the Vector Graphic Monitor Version 3.

As the second method, you can send the character Control-T (14 Hex) to the video driver. This is how the method given in the first paragraph of this section works. Control-T toggles reverse video, so that any characters sent after it, assuming they are in the displayable range, i.e. between 20 and 7F, will be displayed in reverse video (i.e. the driver will set the 8th bit.) The Control-T itself will not be displayed.

(Sending a character to the video driver means putting the code in the A register and calling C006. The Monitor Executive routine, and M.BASIC and MDOS do this automatically when displaying a character on the screen, so that all you have to do is cause the character to be displayed in any way available. For example, since the Monitor Executive echoes characters as they are entered, just depress Control-T on the keyboard after the Monitor prompt \* in order to toggle reverse video. In contrast, the MZOS executive will pass Control-T (and all other Control characters) only if it is the first character of a line. The CP/M executive will not pass it at all, so that you cannot send a control-T from the keyboard under the CP/M executive.

Third, you can send the character Control-E (05 Hex) to the video driver. Following this, you can put any character code in register B and call C006, and the code will be displayed. If it is in the range 80 to FF, then it will be reverse video because the 8th bit is set in these codes. Refer to the Monitor documentation for more discussion of Monitor commands.

### 3.2.4 Determining Whether a Character is in the Keyboard Buffer

This section is of concern if you are not using the keyboard input routine in the Vector Graphic Monitor. Bit 6 of the status port (usually port 00, unless the board is jumpered as described in section 3.1.6) is high and bit 0 is low when a character is available in the data port. You can test either one of these bits. When the test is successful, simply input the data from the data port (data port = status port + 1).

### 3.2.5 Accessing the Vertical Blanking Signal

For programmers interested in accessing the vertical blanking signal, bit 5 of the status port is low during vertical retrace and high at all other times.

## 3.3 Adjusting Your TV Monitor

If your monitor is the Mindless Terminal from Vector Graphic, then refer to the handbook for the Mindless Terminal instead of this section.

The FLASHWRITER is designed to utilize every line of the TV raster (picture). Therefore, some adjustment of the TV monitor is usually required to make all of the characters visible on the screen. Other adjustments may also be necessary. Most monitors have the following controls, either at the rear of the set, or as in the case of the Hitachi, inside the back panel. Often times an insulated screw driver is necessary to turn the controls.

1. HEIGHT - controls the amplitude of the vertical deflection.
2. VERTICAL LINEARITY - controls the line spacing usually at the top of the picture.
3. WIDTH - controls the amplitude of the horizontal deflection.
4. CENTERING - controls the positioning of the raster on the tube.
5. HORIZONTAL HOLD - sets the frequency of the horizontal oscillator.
6. VERTICAL HOLD - sets the frequency of the vertical oscillator.
7. BRIGHTNESS - sets the background picture brightness.
8. CONTRAST - sets the video amplifier gain.

Begin the adjustment of the set with the HEIGHT and VERTICAL linearity. Fill the screen with a pattern of characters. (If you are using the Vector Graphic Extended Systems Monitor, then enter Z



D000 D7FF 30 following the Monitor prompt. The missing character in the bottom line is normal - it is the cursor location.) Adjust the HEIGHT control, which is usually at the rear of the set, until all the characters fit on the screen with an adequate margin on top and bottom. Notice whether the top line of characters is exactly the same height as the bottom line. If it is not, adjust the VERTICAL LINEARITY control until it is. These controls tend to interact to some degree, so several adjustments back and forth may be necessary until a satisfactory adjustment is obtained. Do not be concerned if the display is not exactly centered from top to bottom. The HORIZONTAL HOLD should now be adjusted so that the control is in the center of the range over which the display is in sync, i.e., no characters are misshapen. For some types of displays, this may be over the whole range. At this point, the horizontal position control on the Flashwriter Board should be adjusted so that the rows of characters are centered on the screen horizontally. This control is the small black potentiometer on the upper left hand corner of the board.

Hopefully, at this point you have satisfactorily adjusted your display. If the characters extend off the sides of the display, it will be necessary to adjust the WIDTH control. Some newer sets do not have WIDTH controls. If you are electronically oriented, you can handle this as follows: You can install a choke in series with the horizontal deflection yoke. Local radio-TV stores may be able to supply a width choke if this is necessary, or it is possible to wind one on a small powdered iron form on a cut-and-try basis. Another possibility is to slightly increase the high voltage if the set has this adjustment.

After this, if the display is not exactly centered, it may be desirable to adjust the centering rings on the deflection yoke. On the rear of the deflection yoke are two metal rings with tabs protruding from them. These rings are magnetized, and by rotating them independently, the display can be shifted in any direction up to 1/2 inch or so.

The adjustment of the BRIGHTNESS and CONTRAST should be so that the background is just barely blacked out or slightly grey, while the characters are just bright enough. Too much contrast will result in excessive overshoot on the left edges of the characters, or "hot spots" in the characters.

### 3.4 Connecting the Board to the Video Display and the Keyboard

This section is only relevant if the board is purchased as a separate item, not already integrated into a computer at the factory.

The 6-pin molex connector, called J2, jutting from the top left corner of the board is used to connect the board to the video

display. The pins are numbered 1 to 6 from the left. Pin 1 is composite video, pin 2 is ground, pin 3 is TTL video, pin 4 is horizontal sync, and pin 5 is vertical sync. Accompanying the board in the same shipping container, you will find a small envelope containing one 6-socket molex connector, and 6 small pins that insert into it. Solder the wires of a cable of your choice onto as many pins as you need. Then, insert these pins into the sockets corresponding to the pins on J2 which you require, as described in sections 3.4.1 and 3.4.2.

As an alternate to using the enclosed 6-socket connector and assembling your own cable, Vector Graphic supplies two cables factory assembled, which you can use if one or the other meets your needs. They are described in sections 3.4.1 and 3.4.2.

#### 3.4.1 Connecting a Video Display Requiring Separate Sync and Video

Access pins 2, 3, 4, and 5 of J2.

The cable supplied with the Vector Graphic Mindless Terminal comes with an appropriate socket attached. If you have ordered the Vector Graphic Mindless Terminal, then this cable will be enclosed with it. Use of this cable is described in the Mindless Terminal manual. You may discard the socket and insertable pins accompanying the Flashwriter II board.

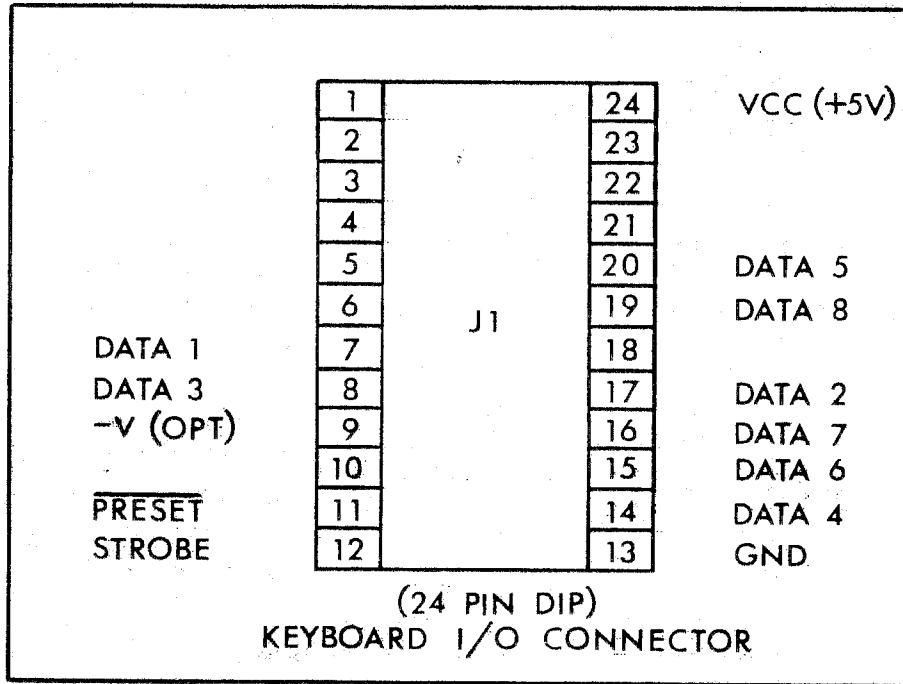
#### 3.4.2 Connecting a Video Display Requiring Combined Sync and Video

Access pins 1 and 2 of J2. If you are using a monitor having a coaxial cable, you will probably want to assemble a cable having a compatible socket at one end, and install it in the rear of your computer, with the other end connected to J2 of the Flashwriter Board.

You can order from Vector Graphic a cable equipped with a 2-socket molex connector at one end and a BNC (circular) socket at the other end which can be installed in the rear panel of a computer. When ordering, refer to it as the "VBC" cable. Vector Graphic computers have cutouts at the rear which are the right size for this socket.

**3.4.3 Connecting a Keyboard**

The keyboard is connected via a 24-pin dip plug to socket J1 on the right side of the board. The following diagram shows the pin assignments:



The cable shipped with the Vector Graphic Mindless Terminal has a properly wired 24-pin dip plug already attached. Simply plug it in. The use of pins 9 and 11 are discussed in sections 3.1.12 and 3.1.13.





BINARY	HEX 1	HEX 2	HEX 3	HEX 4	HEX 5	HEX 6	HEX 7	HEX 8	HEX 9	HEX A	HEX B	HEX C	HEX D	HEX E	HEX F
0000	00	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
0001	01	00000001	00000001	00000001	00000001	00000001	00000001	00000001	00000001	00000001	00000001	00000001	00000001	00000001	00000001
0010	02	00000010	00000010	00000010	00000010	00000010	00000010	00000010	00000010	00000010	00000010	00000010	00000010	00000010	00000010
0011	03	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011	00000011
0100	04	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100	00000100
0101	05	00000101	00000101	00000101	00000101	00000101	00000101	00000101	00000101	00000101	00000101	00000101	00000101	00000101	00000101
0110	06	00000110	00000110	00000110	00000110	00000110	00000110	00000110	00000110	00000110	00000110	00000110	00000110	00000110	00000110
0111	07	00000111	00000111	00000111	00000111	00000111	00000111	00000111	00000111	00000111	00000111	00000111	00000111	00000111	00000111
1000	08	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000	00001000
1001	09	00001001	00001001	00001001	00001001	00001001	00001001	00001001	00001001	00001001	00001001	00001001	00001001	00001001	00001001
1010	0A	00001010	00001010	00001010	00001010	00001010	00001010	00001010	00001010	00001010	00001010	00001010	00001010	00001010	00001010
1011	0B	00001011	00001011	00001011	00001011	00001011	00001011	00001011	00001011	00001011	00001011	00001011	00001011	00001011	00001011
1100	0C	00001100	00001100	00001100	00001100	00001100	00001100	00001100	00001100	00001100	00001100	00001100	00001100	00001100	00001100
1101	0D	00001101	00001101	00001101	00001101	00001101	00001101	00001101	00001101	00001101	00001101	00001101	00001101	00001101	00001101
1110	0E	00001110	00001110	00001110	00001110	00001110	00001110	00001110	00001110	00001110	00001110	00001110	00001110	00001110	00001110
1111	0F	00001111	00001111	00001111	00001111	00001111	00001111	00001111	00001111	00001111	00001111	00001111	00001111	00001111	00001111
00000000		00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
00000001		00000001	00000001	00000001	00000001	00000001	00000001	00000001	00000001	00000001	00000001	00000001	00000001	00000001	00000001

\*\* REVERSE VIDEO VERSIONS OF GRAPHIC CHARACTERS

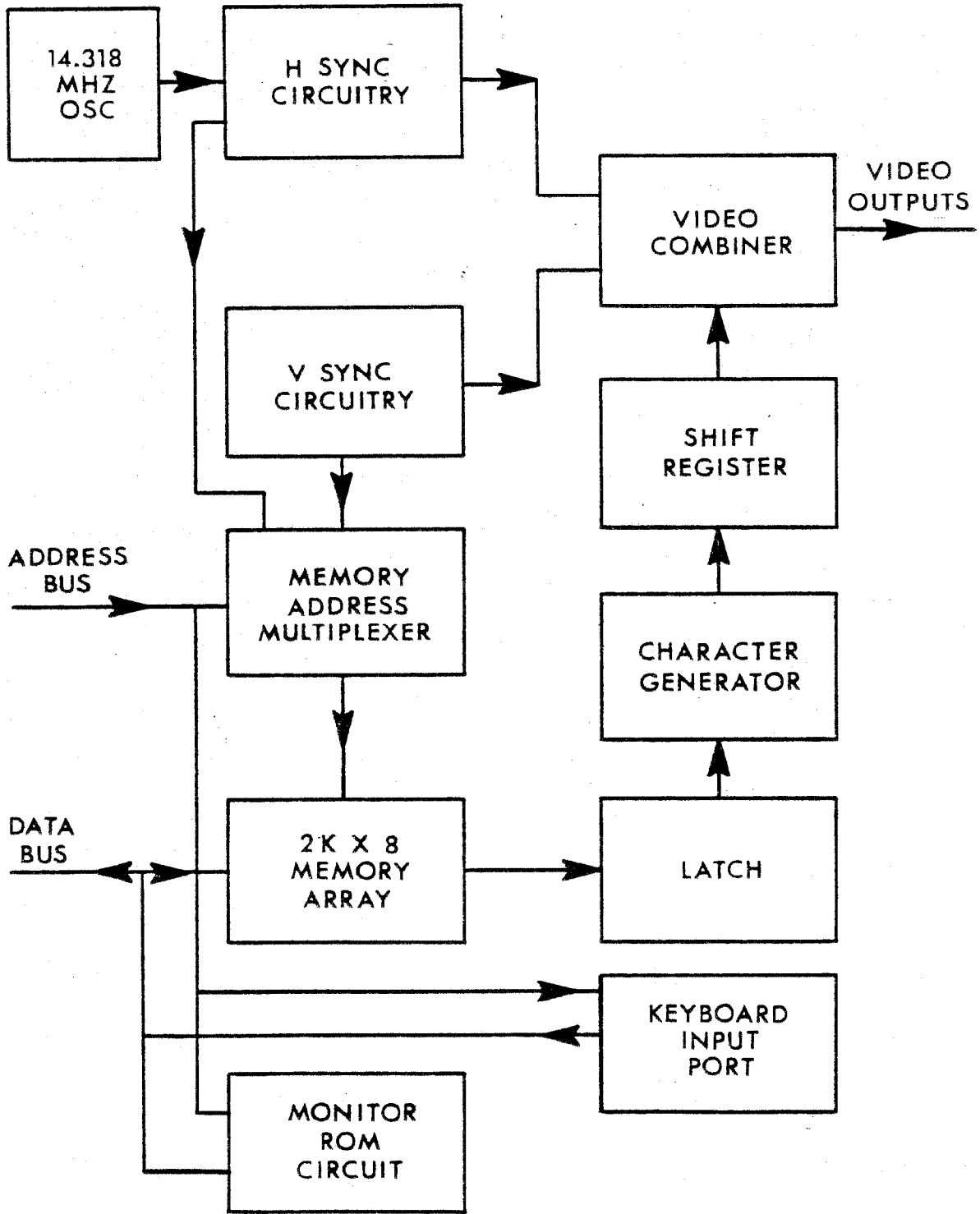
Vector Graphic Flashwriter II Board Revision 2/7/79



		8 <sup>TH</sup> BIT IS SET															
BINARY DIGITS	HEX 1 DIGITS	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
		D7...D0	D7...D0	D7...D0	D7...D0	D7...D0	D7...D0	D7...D0	D7...D0	D7...D0	D7...D0	D7...D0	D7...D0	D7...D0	D7...D0	D7...D0	D7...D0
1000 B	R0 R9	00000000	00000001	00000010	00000011	00000100	00000101	00000110	00000111	00001000	00001001	00001010	00001011	00001100	00001101	00001110	00001111
		00010000	00010001	00010010	00010011	00010100	00010101	00010110	00010111	00011000	00011001	00011010	00011011	00011100	00011101	00011110	00011111
1001 9	R0 R9	00010000	00010001	00010010	00010011	00010100	00010101	00010110	00010111	00011000	00011001	00011010	00011011	00011100	00011101	00011110	00011111
		00020000	00020001	00020010	00020011	00020100	00020101	00020110	00020111	00021000	00021001	00021010	00021011	00021100	00021101	00021110	00021111
1010 A	R0 R9	00020000	00020001	00020010	00020011	00020100	00020101	00020110	00020111	00021000	00021001	00021010	00021011	00021100	00021101	00021110	00021111
		00030000	00030001	00030010	00030011	00030100	00030101	00030110	00030111	00031000	00031001	00031010	00031011	00031100	00031101	00031110	00031111
1011 B	R0 R9	00030000	00030001	00030010	00030011	00030100	00030101	00030110	00030111	00031000	00031001	00031010	00031011	00031100	00031101	00031110	00031111
		00040000	00040001	00040010	00040011	00040100	00040101	00040110	00040111	00041000	00041001	00041010	00041011	00041100	00041101	00041110	00041111
1100 C	R0 R9	00040000	00040001	00040010	00040011	00040100	00040101	00040110	00040111	00041000	00041001	00041010	00041011	00041100	00041101	00041110	00041111
		00050000	00050001	00050010	00050011	00050100	00050101	00050110	00050111	00051000	00051001	00051010	00051011	00051100	00051101	00051110	00051111
1100 D	R0 R9	00050000	00050001	00050010	00050011	00050100	00050101	00050110	00050111	00051000	00051001	00051010	00051011	00051100	00051101	00051110	00051111
		00060000	00060001	00060010	00060011	00060100	00060101	00060110	00060111	00061000	00061001	00061010	00061011	00061100	00061101	00061110	00061111
1110 E	R0 R9	00060000	00060001	00060010	00060011	00060100	00060101	00060110	00060111	00061000	00061001	00061010	00061011	00061100	00061101	00061110	00061111
		00070000	00070001	00070010	00070011	00070100	00070101	00070110	00070111	00071000	00071001	00071010	00071011	00071100	00071101	00071110	00071111
1111 F	R0 R9	00070000	00070001	00070010	00070011	00070100	00070101	00070110	00070111	00071000	00071001	00071010	00071011	00071100	00071101	00071110	00071111
		00080000	00080001	00080010	00080011	00080100	00080101	00080110	00080111	00081000	00081001	00081010	00081011	00081100	00081101	00081110	00081111

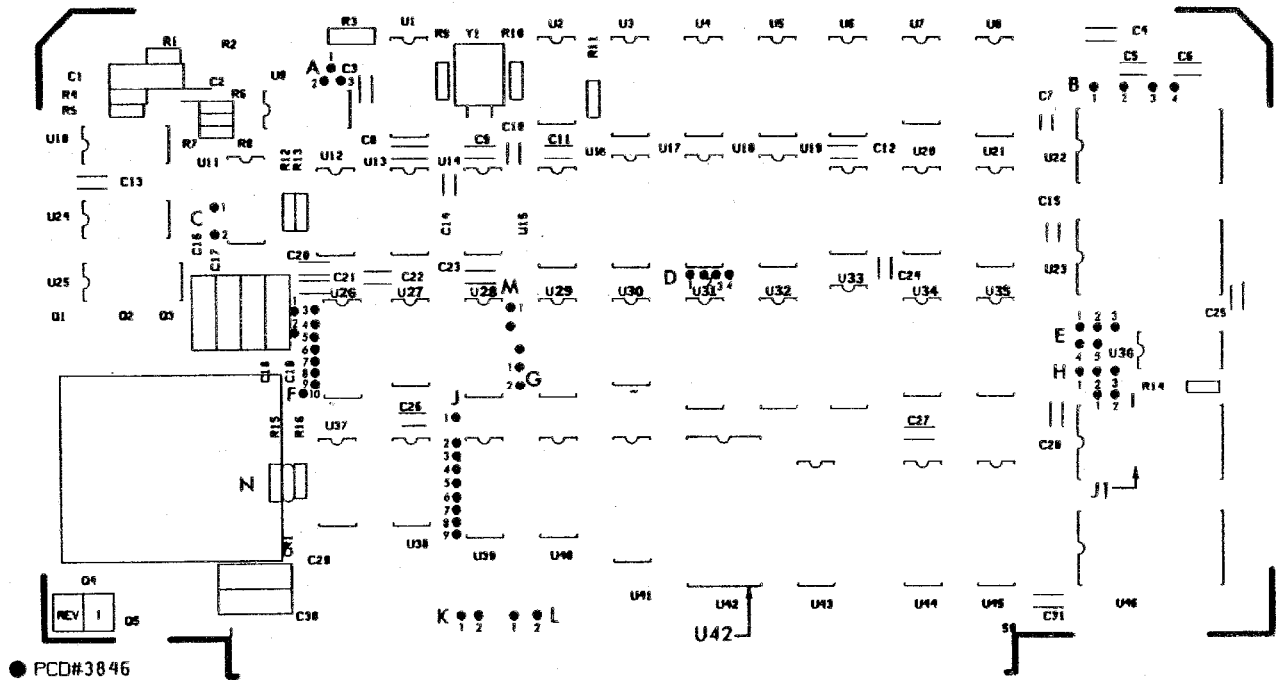
\*\* REVERSE VIDEO VERSIONS OF GRAPHICS CHARACTERS  
\*\* REVERSE VIDEO VERSIONS OF ASCII CHARACTERS





80 X 24 VIDEO DISPLAY MODULE BLOCK DIAGRAM

Vector Graphic Flashwriter II Board



SILK SCREEN  
 80X24 DISPLAY BOARD  
 VECTOR GRAPHIC

Revision 2 2/7/79