

S. D. SYSTEMS
USER'S MANUAL
FOR
VDB-8024

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SECTION I
GENERAL INFORMATION

1-1 INTRODUCTION

VDB-8024 is a video display board which provides a high quality means for interfacing a monitor and keyboard to the S-100 bus. The display is interfaced through the S-100 bus using a single output port and provides an input port through which a keyboard can be interfaced to the S-100 bus. The output generated by the board is both composite video and separate TTL levels for horizontal sync, vertical sync and video input. This provides an easy interface to most standard monitors. The video display board, with the addition of a keyboard and a monitor, functions as a complete terminal.

1-2 GENERAL DESCRIPTION

The VDB utilizes a Z80 microprocessor to perform the control functions of a video terminal. These functions include LF, CR, full cursor control, home, clear, scroll and back space. In addition to the basic function several special additional features are provided. One of these features provides for specified fields of characters to be enhanced. This field can be enhanced in any of the following ways: Underline, Reverse, Blink, Protect or combinations. Another feature

of this board is the programmable character generator. This is a 7 x 8 dot character matrix with 2 bits of descenders to provide upper and lower case characters in a 7 x 10 dot field. 128 characters are typically available while 256 characters can be made available using a 2K x 8 PROM. These characters are displayed in a field of 80 characters in length and 24 lines per page. The VDB processor runs only during H & V sync to eliminate any disturbance of the display due to the processor running during the raster scan. There are several software controllable functions. These include a speed control similar to a baud rate control and also a scroll up or scroll down. In addition, a set of 32 special characters are available.

SECTION II
FUNCTIONAL DESCRIPTION

2-1 INTRODUCTION

The VDB hardware performs all control and timing functions as well as the special enhancement functions. This section will describe that hardware. Section III will describe the software control characters which must be output to the VDB to accomplish the special functions.

2-2 CRT 5027

The CRT 5027 video timer and controller is used to perform character count, character line count and row count. The outputs of these counters are then fed into the RAM or Character Generator (CGEN) to provide the proper scanning and display of each character in its proper place. This chip also provides for proper cursor control, horizontal sync, vertical sync and blinking signals.

2-3 Z80 MICROPROCESSOR

The Z80 executes the software which controls all functions of the system. This includes inputting data, storing data in memory, initializing the CRT 5027, controlling the special functions, cursor control and scrolling. These functions will be discussed in detail in the software section.

2-4 DATA OUT BUS

The 8 bit Data Out is the S-100 path for transferring data from the computer to the output port on the VDB board. This is the port through which all characters and control words are transferred to the display.

2-5 DATA IN BUS

The 8 bit Data In Bus is the S-100 path for transferring data from the input ports (keyboard data) to the computer (CPU).

2-6 A0-A7

The A0-A7 low order eight address lines are used by the computer (CPU) to address the input/output ports on the board.

2-7 I/O CONTROL LINES AND READ/WRITE CONTROL

The I/O Control lines consist of PWR, PDBIN, SOUT, SINP. These lines are used to control the input and output operations from/to the I/O ports on the board.

2-8 ADDRESS DECODER

The Address Decoder is used to address the ports on the VDB. These ports are initially addressed with port 0 for status and port 1 for data.

2-9 DATA IN LATCH

The Data In Latch isolates the keyboard from the S-100 Data In Bus. When data is ready, the keyboard strobe sets a latch and bit 1 of status port 0 goes high to indicate the input is valid. The input data is then read from port 1.

2-10 DATA OUT LATCH

The Data Out Latch isolates the Bi-Directional Data Bus used on the VDB from the S-100 Data Out Bus. When a word is written into output port 1, bit 2 of status port 0 goes low to indicate that the output port is busy. This also interrupts the VDB processor which will then read the latch and set the status bit to indicate the port is ready.

2-11 BI-DIRECTIONAL DATA BUS

The Bi-Directional Data Bus is the main path for communication between components on the VDB. This includes the Z80, input ports, output port, PROM, RAM, CRT 5027, special function latch and character generator latch.

2-12 KEYBOARD

Any ASCII encoded keyboard which has 7 data bits and a strobe line can be used. The 7 bits of data are stored in the Input Data Latch by the strobe line.

2-13 PROM

The PROM memory stores the program to be executed by the Z80.

2-14 RAM

The RAM stores the data which is scanned by the CRT 5027 and display upon the screen. The highest portion of the RAM which is not displayable is used as a stack by the Z80 during subroutine calls.

2-15 MUX

This determines whether the Z80 or the CRT 5027 will address the RAM. During the active scans the CRT 5027 will address the RAM and during V & H sync the Z80 will address the RAM. This will result in a clean display with no interference to the screen when characters are output to the VDB.

2-16 OSCILLATOR & DOT COUNTER

This is used to generate the dot shift rate and the dot counter carry. The dot counter carry is used by the CRT 5027 to increment the character counter and is used to load the data into the shift register.

2-17 CGEN

The Character Generator (CGEN) is a 1K PROM which is organized in a 7 x 8 dot matrix. The character generator is addressed by the CRT 5027 and the output of the RAM. The RAM points to the proper character within the PROM and the CRT 5027 points to the correct row of that character. A 2K PROM can be used for the CGEN to provide an extended set of characters.

2-18 SPECIAL FUNCTION LATCH

This 8 bit latch provides a means for software control of the special function. These functions include underline field, block field, reserve field as well as several others.

2-19 COMBINATIONAL LOGIC

The combinational logic is the hardware which performs the special functions. This generates the inverse, blanking, and blinking signals needed to control the output.

2-20 CHARACTER ROW COUNTER

This counter determines which row of a character will be addressed by the CGEN and latched into the shift register. It is also used to determine the proper blanking for lower case letters and for underline.

2-21 SHIFT REGISTER

The output of the CGEN is latched into this shift register and shifted out to produce the proper dot sequence. This is the feed to the combinational logic which will could either blank or invert the signal.

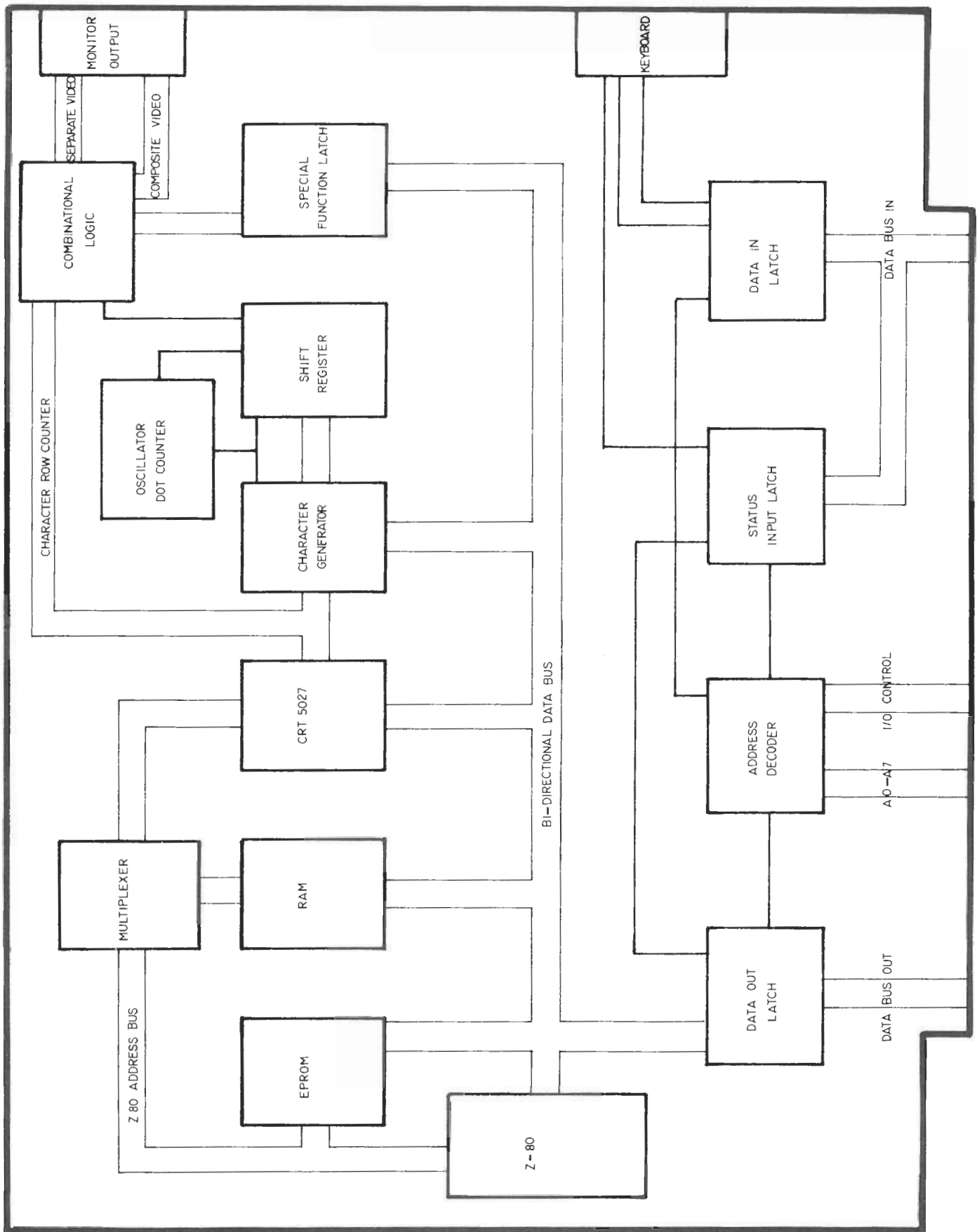
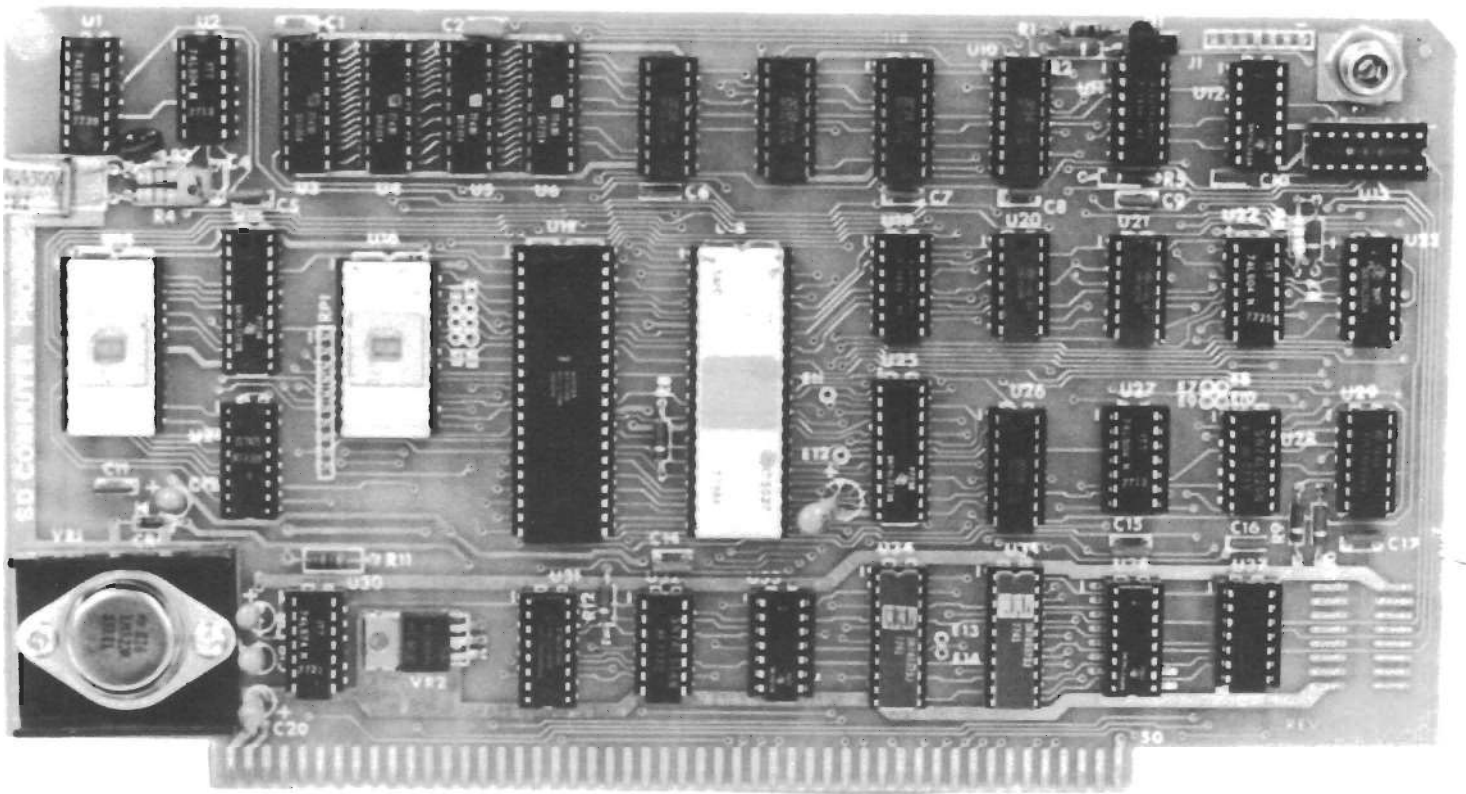


FIGURE 2-1

VDB - 8024 Video Display Board



SD Systems

SECTION III
CONTROL CHARACTERS

3-1 INTRODUCTION

The Z80 is used to perform two main functions: keep track of data or cursor position and to perform some control function as a result of a control character. From a user's viewpoint, the control characters are very important to understand to be able to fully utilize the power of the VDB. This section will describe the function of the control words used by the VDB.

3-2 SCROLLING

Scrolling is a method of displaying data which allows the most recently entered data to remain upon the screen while the old data is removed. This is accomplished by moving every line up one line and entering the next line at the bottom of the page. The top line on the page is then eliminated from the display. This method of scrolling in which every line is moved up is called Scrolling Up. There is another method of scrolling in which the data is moved down instead of up. This allows the last line to be entered on the top of the page instead of the bottom and the bottom line is eliminated. This method will be referred to as Scrolling Down or Reverse Scrolling.

In the VDB 8024, both methods of scrolling are available for usage. They are controlled by Control A and Control B for Scrolling Up and Scrolling Down. When a Control A is output to the display the VDB will enter a Scroll Up mode. It will remain in this mode until a Control B is output at which time it will enter a Scroll Down mode. The default mode is Scrolling Up.

3-3 EXTRA CHARACTER SET

The extra character set consists of 32 characters which provide the user with many special symbols such as greek letters, upper script and lower script.

In order to display these characters a Control C must be output to the device followed by a letter corresponding to the special letter needed. A summary of the special letters and their corresponding letters are shown in Table 3-1. The Control C must be entered before every special character needed because it only affects the character which is output immediately following the Control C.

3-4 CONTROL BITS

There are two control bits which are available on the VDB to be used for hardware control. These bits are controlled using four control characters. Bit #1 is turned on by outputting a Control D to the VDB and is turned off by outputting a Control E. Bit #2 is turned on or off by outputting a Control F or Control G. These are user defined hardware control functions.


| SPECIAL CHARACTER | CHARACTER FOLLOWING CONTROL C |
|-------------------|----------------------------------------------------------------------------------------|
| α | @, \ |
| β | A, a |
| γ | B, b |
| δ | C, c |
| ϵ | D, d |
| θ | E, e |
| ι | F, f |
| λ | G, g |
| μ | H, h |
| ν | I, i |
| π | J, j |
| Σ | K, k |
| Φ | L, l |
| Ψ | M, m |
| ω | N, n |
| Ω | O, o |
| \circ | P, p |
| 1 | Q, q |
| 2 | R, r |
| 3 | S, s |
| 0 | T, t |
| 2 | U, u |
| + | V, v |
| ÷ | W, w |
| ≈ | X, x |
| √ | Y, y |
| ∫ | Z, z |
| | [, { |
| ← | \, ! |
| → |], } |
| ↑ | ^, ~ |
| ↓ | -,  |

TABLE 3-1

The VDB is set up such that a control bit can be used in conjunction with an expanded character set. In this case a character generator must be specially programmed with two sets of characters. (See Section on Programming Character Generator). Then the control bit is used to select one of the two character sets. If Bit #1 was used to control this option then a Control D would cause character Set 1 to be used and a Control E would then go to character Set 2.

3-5 CURSOR CONTROL

The cursor control characters provide the user with a means of moving the cursor in any of four directions. The back space or Control H character causes the cursor to go to the left one space until it gets to the left most margin. This is not a destructive backspace. The line feed command advances the cursor one line until it gets to the last line at which time it will initial a scroll function. The up line or Control K command is used to move the cursor up until it reaches the top of the page at which point it will stop. The forward space, unlike the space, is a nondestructive forward space and is not a displayable character. This allows the user to space over existing data without destructing it. The last cursor control is the tab command. This will move the cursor to the right until it gets to the next even multiple of eight character spaces. This is similar to tabs being set every eight spaces on a typewriter. The cursor may be moved to any row and column using the sequence ESC=YX, where ESC is 1B_H, = is 3DH, Y is the row +20H and X is the column +20H.

3-6 SPEED CONTROL

The VDB has an asynchronous type of execution and the speed varies with the control words output to the VDB. This means there is no baud rate that can be associated with each speed. Therefore, the speeds are divided between fast, medium and slow. These speeds have been compared to a synchronous display and are in the range of 19200, 2400 and 300 baud. These are only approximate baud rates and are given only to relate the speed of the display to some standard.

These three speeds are programmable using three control words. The slow speed is set by a Control M, medium speed by a Control N and fast by a Control O.

3-7 ENHANCEMENT FIELD

The enhancement field involves a method of making a group of characters stand out and catch the attention of the user. The enhancement field is initiated by outputting a control character to the VDB which tells the display that the following characters are to be enhanced. All characters following will be enhanced until a Quit command, Control Q, is output to the display. The Control Q will stop the enhancement field and characters entered after the Quit command will not be enhanced.

There are several types of enhancement fields that can be entered using control characters. The reverse field is started by outputting a Control R to the display. The reverse field causes the characters in the enhanced field to be inverted so that they are black letters on a white background. The blinking field is started by using a Control T character. The blinking field will cause the characters to blink on and off with a 75% duty rate. The underline will cause a character to be underlined. This is started by outputting a Control U character to the display. The no enhancement command, Control W, will cause no field to be entered. The use of this command is discussed later in conjunction with the Protect Field.

There are two other types of enhancement which are available to the user. These involve combination of other enhancements. The blinking underline and the blinking reverse are started using controls V and Control S. All of the enhancement fields are started by entering the appropriate control letter and they are ended by outputting a Control Q or Quit command. Only one enhancement mode is available per page. If a second type of enhancement mode is entered, then all enhancement fields will change to the mode most recently entered.

3-8 PROTECT FIELD

The protect mode command will cause any enhancement field entered to be protected. This results a field that cannot be overwritten by the user. The no enhancement field command (Control W) is available so that the user has the ability to protect unenhanced characters as well as enhanced characters. The unprotected field will unprotect the display and the display can then be overwritten. The protect mode is initiated using a Control X and is unprotected using a Control Y.

X^c, R^c, Q^c

PROTECT
IN REVERSE

| <u>CONTROL CHARACTER</u> | <u>FUNCTION</u> | <u>ASCII CODE</u> | |
|--------------------------|----------------------|-------------------|----|
| CTR-A | Scroll | 01 | |
| CTR-B | Reverse Scroll | 02 | |
| CTR-C | Extra Character | 03 | |
| CTR-D | Set Control Bit #1 | 04 | |
| CTR-E | Reset Control Bit #1 | 05 | |
| CTR-F | Set Control Bit #2 | 06 | |
| CTR-G | Reset Control Bit #2 | 07 | |
| CTR-H | Back Space | 08 | ← |
| CTR-I | Tab | 09 | 8→ |
| CTR-J | Line Feed | 0A | ↓ |
| CTR-K | Up Line | 0B | ↑ |
| CTR-L | Forward Space | 0C | → |
| CTR-M | Carriage Return | 0D | |
| CTR-N | Slow | 0E | |
| CTR-O | Medium | 0F | |
| CTR-P | Fast | 10 | |
| CTR-Q | Quit | 11 | |
| CTR-R | Reverse | 12 | |
| CTR-S | Blinking Reverse | 13 | |
| CTR-T | Blinking | 14 | |
| CTR-U | Underline | 15 | |
| CTR-V | Blinking Underline | 16 | |
| CTR-W | No Enhancement | 17 | |
| CTR-X | Protect Mode | 18 | |
| CTR-Y | Unprotected Mode | 19 | |
| CTR-Z | Clear | 1A | |
| ESC=XY | Addressable Cursor | 1B | |
| CTR- | Home | 1E | |

SUMMARY OF CONTROL CHARACTERS

TABLE 3-2

| $b_3 b_2 b_1 b_0$ | $b_6 \ 0 \ \emptyset_H$ $b_5 \ 0$ $b_4 \ 0$ | $0 \ 1_H$ | $0 \ 2_H$ | $0 \ 3_H$ | $1 \ 4_H$ | $1 \ 5_H$ | $1 \ 6_H$ | $1 \ 7_H$ |
|-----------------------|---------------------------------------------------|--------------------|-----------|-----------|-----------|-----------|-----------|-----------|
| 0 0 0 0 \emptyset_H | NUL | FAST | SPACE | 0 | @ | P | ` | P |
| 0 0 0 1 1_H | SCROLL | QUIT | ! | 1 | A | Q | a | q |
| 0 0 1 0 2_H | REVERSE | REVERSE | " | 2 | B | R | b | r |
| 0 0 1 1 3_H | EXTRA CHARACTER | BLINKING REVERSE | # | 3 | C | S | c | s |
| 0 1 0 0 4_H | SET CONTROL BIT #1 | BLINKING | \$ | 4 | D | T | d | t |
| 0 1 0 1 5_H | RESET CONTROL BIT #1 | UNDERLINE | % | 5 | E | U | e | u |
| 0 1 1 0 6_H | SET CONTROL BIT #2 | BLINKING UNDERLINE | \$ & | 6 | F | V | f | v |
| 0 1 1 1 7_H | RESET CONTROL BIT #2 | NO ENHANCEMENT | ' | 7 | G | W | g | w |
| 1 0 0 0 8_H | BACK SPACE | PROTECT MODE | (| 8 | H | X | h | x |
| 1 0 0 1 9_H | TAB | UNPROTECTED MODE |) | 9 | I | Y | i | y |
| 1 0 1 0 A_H | LINE FEED | CLEAR | * | : | J | Z | j | z |
| 1 0 1 1 B_H | UP LINE | ESC=YX | + | ; | K | [| k | { |
| 1 1 0 0 C_H | FORWARD SPACE | α | , | < | L | \ | l | ! |
| 1 1 0 1 D_H | CARRIAGE RETURN | \rightarrow | - | = | M |] | m | } |
| 1 1 1 0 E_H | SLOW | HOME | . | > | N | ^ | n | ~ |
| 1 1 1 1 F_H | MEDIUM | \downarrow (^-) | / | ? | O | - | o | DEL |

ASCII ENCODED CHARACTERS

TABLE 3-3

SECTION IV
PROGRAMMABLE CHARACTER GENERATOR

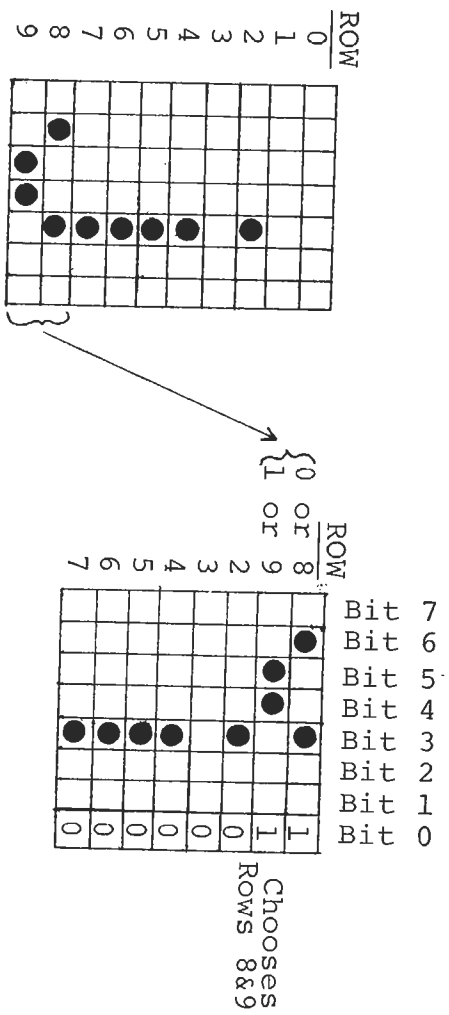
The character generator (CGEN) used in the VDB is programmable and the character fonts can be changed by replacing the CGEN. This section will discuss how to program a PROM to be used as a new CGEN. First the organization of the character within the PROM memory will be discussed.

Each character is made by a matrix of 7 dots by 8 dots. (Figure 4-1) Each row of the matrix is a single byte in memory with eight bytes forming a complete character. A 1K x 8 PROM is used and can hold up to 128 characters. A 2K x 8 can also be used to provide 256 characters.

The low order 3 address lines into the PROM are used to address a certain row of each character. The next 7 lines address the character. Each character is programmed on eight bit boundary starting with the top row of the character matrix. Care must be taken to insure that the PROM address bits 3 through 9 correspond to the ASCII code for the character to be displayed.

Lower case letters with descenders must be handled in a special way. A character is programmed within a 7 x 8 dot matrix with bit 0 of each byte not used. This bit is used to tell the hardware whether to display the first or second byte of the character on line 0 or 1 or on line 8 or 9. This will result in a 8 x 8 matrix in memory with bit 0 indicating when descenders should be displayed.

The letter j will be used as an example to illustrate how the CGEN is programmed. Figure 4-1 A shows the letter j in a 7 x 10 dot matrix as it will be displayed. In order to program the CGEN properly lines 8 and 9 must be superimposed on lines 0 and 1 as in Figure 4-1 B. Bit 0 of byte 0 and 1 must be set to a 1 in order to indicate the first two lines are to be displayed on lines 8 and 9. This forms a 8 x 8 matrix which must be programmed in the CGEN. Figure 4-1 C shows the HEX values that represent the letter j in memory.



CHARACTER GENERATOR ORGANIZATION

FIGURE 4-1

SECTION V
CONSTRUCTION

5-1 INTRODUCTION

The Video Display Board Kit is intended for those people who have had some prior experience with kit building and digital electronics. If you do not fall into this category it is highly recommended that you find an experienced person to help you in assembly and check out the board.

Appendix B shows the parts list for the Video Display Board. Double check all parts against this parts list.

NOTE: Assembly diagram and schematic diagram can be found in the Appendices.

5-2 ASSEMBLY PROCEDURE

1. Install the IC Sockets as follows:
 - A. 14 pin - U2,U11,U12,U19-U23,U27-U30,U32,U33,U37
 - B. 16 pin - U1,U7-U10,U13,U24,U26,U31,U36
 - C. 18 pin - U3-U6
 - D. 20 pin - U15,U25,U34,U35
 - E. 24 pin - U14,U16
 - F. 40 pin - U17,U18

R15

2. Install the resistors as follows:

- A. 100 Ohm 1/4W 5% (Brown,Black,Brown) - R1
- B. 220 Ohm 1/2W 5% (Red,Red,Brown) - R11
- C. 390 Ohm 1/4W 5% (Grey,Red,Brown) - R3, R4
- D. 1.5K Ohm 1/4W 5% (Brown,Green,Red) - R6
- E. 2.2K Ohm 1/4W 5% (Red,Red,Red) - R2,R5,R7-R10,R12
- F. 22K Ohm 1/4W 5% (Red,Red,Orange) - R8

more resistors

3. Install the capacitors as follows:

- A. 10pf - C3
- B. 200pf - C21
- C. 100pf - C4
- D. .1uf - C1,C2,C5-C10,C14-C17
- E. 10uf - C12,C13,C18-C20,C11

4. Install diodes with banded end as shown on PC board.

- CR1 1N751-5V
- CR2 1N914/1N4-148
- CR3, CR4 1N270

5. Install the voltage regulator with heat sink using the 6-32 hardware supplied.

- A. VR1 +5V 7805/LM340T-5
- B. VR2 +12V 7812/LM340K-12

6. Install transistor Q1-NPN 2N2222 or 2N3904.

7. Install the XTAL-14.43 MHz.

8. Double check all solder connections for cold solder joints, unsoldered connections and shorted connections.

5-3 VOLTAGE CHECK

1. Install the board in the computer and measure the output of +5V regulator VR1, -5V and +12V of CR1 and VR2 respectively.

- A. VR1 = +5V (Bottom Pin)
- B. CR1 = -5V (Anode)
- C. VR2 = +12V (Cathode)

2. Measure the power supply voltages in the Video Timer and Controller chip (any of the IC socket can be used.)

- A. Pin 6 U16 = -5V U16 - pin 21
- B. Pin 14 U16 = +5V U16 - pin 2A
- C. Pin 13 ~~V16~~ = +12V U16 - pin 19

NOTE: Do not proceed with board check out until all power supply voltages are correct. The TTL and MOS Logic can be permanently damaged if improper voltages are applied.

3. Install the IC's in their sockets observing the Pin 1 designation on each socket marked on the PC board.

| | | |
|-------|-----------------|---------------------|
| ✓ A. | U11, U19 | 74LS00 |
| ✓✓ B. | U2, U22, U27 | 74LS04 |
| ✓ C. | U29 | 74LS10 |
| ✓ D. | U32 | 74LS14 |
| ✓ E. | U28 | 74LS20 |
| ✓✓ F. | U20, U21, U33 | 7425 |
| ✓ G. | U30, U37 | 74LS74 |
| ✓ H. | U23 | 74LS86 |
| ✓ I. | U12 | 74LS93 |
| ✓ J. | U26 | 74LS139 |
| ✓ K. | U31 | 74LS155 |
| ✓✓ L. | U7, U8, U9, U10 | 74LS157 |
| ✓ M. | U1 | 74LS163 |
| ✓ N. | U24 | 74LS165 |
| ✓ O. | U15, U25 | 74LS273 |
| ✓ P. | U36 | 74LS368 |
| ✓ Q. | U34 | 74LS373 |
| ✓ R. | U35 | 74LS374 |
| ✓✓ S. | U3, U4, U5, U6 | 2114 |
| ✓ T. | U14, U16 | 2708 CGEN, 2708 VDB |
| ✓ U. | U17 | Z80 |
| ✓ V. | U18 | CRT 5027 |

4. Double check all IC's for proper orientation and location.

SECTION VI
SOFTWARE AND INTERFACE

6-1 INTRODUCTION

This section will discuss the software needed to interface a CPU with the VDB. Also, the on-board software will be described such that it could be modified for special applications.

6-2 INTERFACE SOFTWARE

The VDB interfaces to the CPU using port 00_H for status and 01_H for data. The keyboard status is input on the second bit (bit 1) of port 00_H and the display status is input on the third bit (bit 2) of port 00_H.

The following sequence of instructions would need to be executed to poll the keyboard and input when data is available.

```
INPUT  IN      A,(00H)           ;READ KEYBOARD STATUS
        AND     02H
        JP      Z, INPUT         ;LOOP IF NOT READY
        IN      A, (01H)         ;INPUT KEYBOARD DATA
```

The following sequence of instructions would need to be executed to poll the output port and output a character from C-Register when the display is ready.

```
OUTPUT IN      A,(00H)           ;INPUT DISPLAY STATUS
        AND     04H
        JP      Z, OUTPUT        ;LOOP IF NOT READY
        LD      A, C
        OUT     (01H), A         ;OUTPUT TO DISPLAY
```

6-3 PROCESSOR CONTROL SOFTWARE

The software that controls the display is stored in a PROM. This software recognizes the control word and executes a subroutine as a result of that control character. Thus, if a Line Feed Control character were output to the display, the software would compare the input to various characters and when it was found to be an OAH it would jump to the Line Feed subroutine.

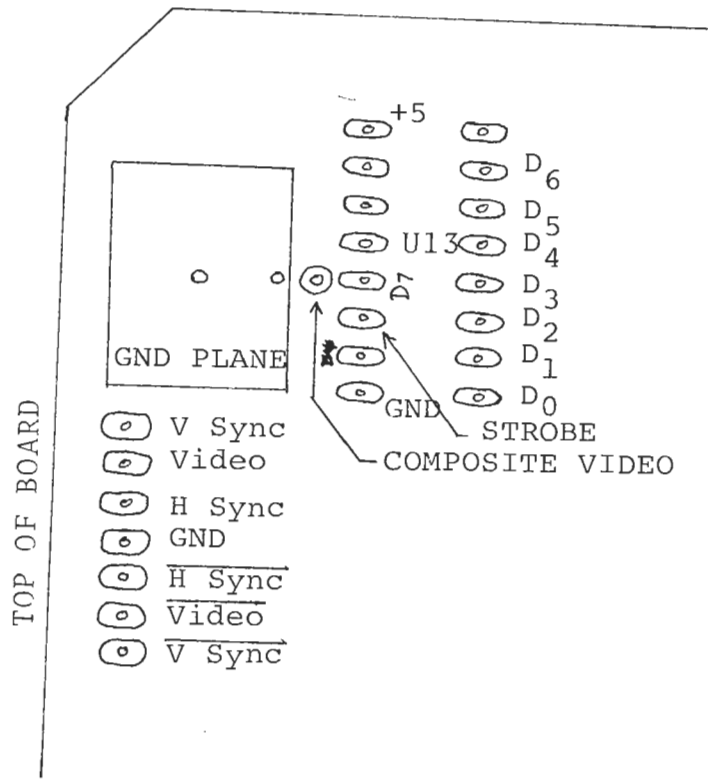
If a special function were needed it is possible to reprogram the PROM to accomplish the special function. Before reprogramming is attempted a complete understanding of how the board functions would be necessary to insure what is attempted would be possible.

6-4 KEYBOARD INPUT

The keyboard is interfaced through a DIP socket and can be connected with a ribbon cable and a 16 pin header. The pin out of the header U13 is shown in Figure 6-1. This header provides +5 Volts, GND, Strobe and D_0 through D_6 .

6-5 MONITOR OUTPUT

The monitor output is either separate TTL level outputs or composite video output. The TTL levels are output on pins of header J2. Both positive true and negative true signals are brought out. The output positions are shown in Figure 6-1 and include vertical sync, horizontal sync, and video.



VDB INTERFACE SIGNALS

FIGURE 6-1

The composite video is brought out to J3 and can be interfaced in several different ways. Coaxial cable should be used to go from the board to a monitor. A space is provided for 2 pin berg headers to be used if needed.

SECTION VII
JUMPER OPTION SELECTION

7-1 INTRODUCTION

The VDB has been designed to provide the user with several selectable options. These options are initially hard wired on the board so the user does not need to install any jumpers unless he wishes to change an option.

7-2 CHARACTER GENERATOR

The character generator has jumpers on several voltage inputs to allow the use of either 2708, 2758 or 2716 PROMS. The board is initially wired for 2708. To change from 2708 to 2758 or 2716 the etch between E3 and E4 and the etch between E5 and E6 must be cut and jumpers installed between E1 and E3 and also between E2 and E10. Table 7-1 summarizes these connections.

NOTE: BOTH PROMS must be 2708 or 2758/2716.

| E PROM | JUMPER | ETCH CUT |
|--------|---------------|-----------------|
| 2708 | E3-E9, E5-E6 | None |
| 2758 | E3-E1, E5-E2 | E3-E9 |
| 2716 | E3-E1, E5-E11 | E3-E4, E5-E6 |

TABLE 7-1

7-3 CURSOR TYPE CONTROL

Jumpers are available to select several different styles of cursors. These include reverse, underline, blinking underline, blinking reverse. Table 7-2 shows the jumper connection for each of these cursor types.

| CURSOR TYPE | JUMPER |
|--------------------|---------------|
| Reverse | None |
| Underline | E7-E8 |
| Blinking Reverse | E9-E10 |
| Blinking Underline | E7-E8, E9-E10 |

TABLE 7-2

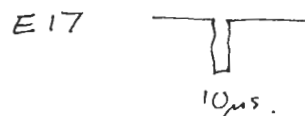
NOTE: The P.C. Board comes with jumpers E7 to E8 and E9 to E10 installed and the etch must be cut if a different cursor type is needed.

7-4 SPECIAL CONTROL BITS

The special control bits can be used for any control purpose. For example: The first bit can be used for control of a 2716 to determine which half of the PROM the CGEN will be taken from. This is used to select between two different character sets such as a regular upper and lower case set and a set of APL characters. This would be accomplished by connecting jumper E11 to E7. The second bit can be used for other purposes such as a brightness control input to a monitor. This is output on jumper E12.

7-5 INTERRUPT MODE

When the VDB is used with the SBC-100 the vectored interrupts on pins 5 through 8 of the S-100 bus, can be used for priority interrupts. The keyboard can be used to interrupt the SBC-100 by jumpering E17 to one of E13 through E16 depending upon the priority needed.



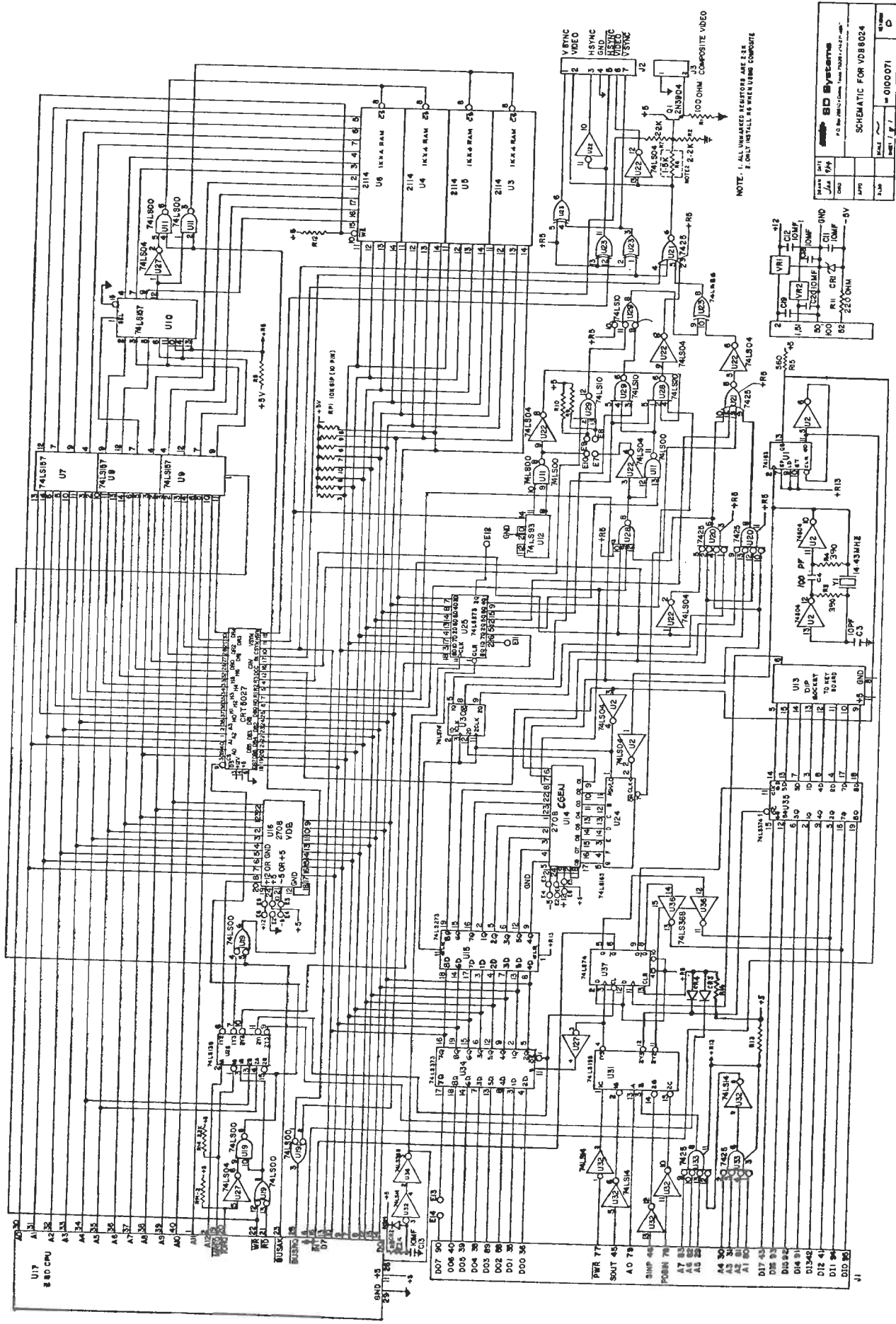
TP.

| | | |
|----------|-------------|--------------|
| 1-2 | -5V | } EPROM TYPE |
| 3-4 | +5V | |
| 5-6 | +12V | |
| 7-8 | } Cursor | |
| 9-10 | | |
| 11,12 | - output | |
| 13,14 | DC7 | |
| 15,16,17 | interrupts. | |

APPENDIX A

VDB 8024

SCHEMATIC DIAGRAM



NOTE: 1. ALL UNMARKED RESISTORS ARE 22K.
 2. ONLY INSTILL IN USED UMB COMPORTE

| | |
|------------------------|--------|
| Part No. | 74LS04 |
| Rev. | 1/84 |
| Date | 1/84 |
| Author | |
| Checked | |
| Approved | |
| Scale | 1/1 |
| Sheet | 1 of 1 |
| SCHEMATIC FOR VDB 8024 | |

APPENDIX B

VIDEO DISPLAY BOARD

PARTS LIST

SD Systems

P.O. Box 28810 • Dallas, Texas 75228 214-271-4667

BILL OF MATERIALS

| Title: | | | PL No. | Rev. | |
|---------------------|-----|-----------|----------------------------|--------------|-----------|
| VIDEO DISPLAY BOARD | | | 0100070 | D | |
| Date Released: | | Approved: | | Sheet 1 Of 3 | |
| 8-15-78 | | | | | |
| Item no | Qty | SD-P/N | Description | Unit Cost | Extension |
| 1 | 2 | 7010160 | 74LS00, U11, U19 | | |
| 2 | 2 | 7010164 | 74LS04, U22, U27 | | |
| 3 | 1 | 7010336 | 74S04, U2 | | |
| 4 | 1 | 7010168 | 74LS10, U29 | | |
| 5 | 1 | 7010172 | 74LS14, U32 | | |
| 6 | 1 | 7010174 | 74LS20, U28 | | |
| 7 | 3 | 7010022 | 7425, U20, U21, U33 | | |
| 8 | 2 | 7010195 | 74LS74, U30, U37 | | |
| 9 | 1 | 7010201 | 74LS86, U23 | | |
| 10 | 1 | 7010205 | 74LS93, U12 | | |
| 11 | 1 | 7010220 | 74LS139, U26 | | |
| 12 | 1 | 7010226 | 74LS155, U31 | | |
| 13 | 4 | 7010228 | 74LS157, U7, U8, U9, U10 | | |
| 14 | 1 | 7010099 | 74163, U1 | | |
| 15 | 1 | 7010235 | 74LS165, U24 | | |
| 16 | 2 | 7010276 | 74LS273, U15, U25 | | |
| 17 | 1 | 7010303 | 74LS368, U36 | | |
| 18 | 1 | 7010304 | 74LS373, U34 | | |
| 19 | 1 | 7010305 | 74LS374, U35 | | |
| 20 | 4 | 7010321 | 2114, U3, U4, U5, U6 | | |
| 21 | | | | | |
| 22 | 1 | 7010334 | 3880-4 (Z80A), U17 | | |
| 23 | 1 | 7010355 | CRT 5027, U18 | | |
| 24 | 1 | 7000010 | PC Board ARTWRK. # 0100072 | | |

SD Systems

P.O. Box 28810 • Dallas, Texas 75228 214-271-4667

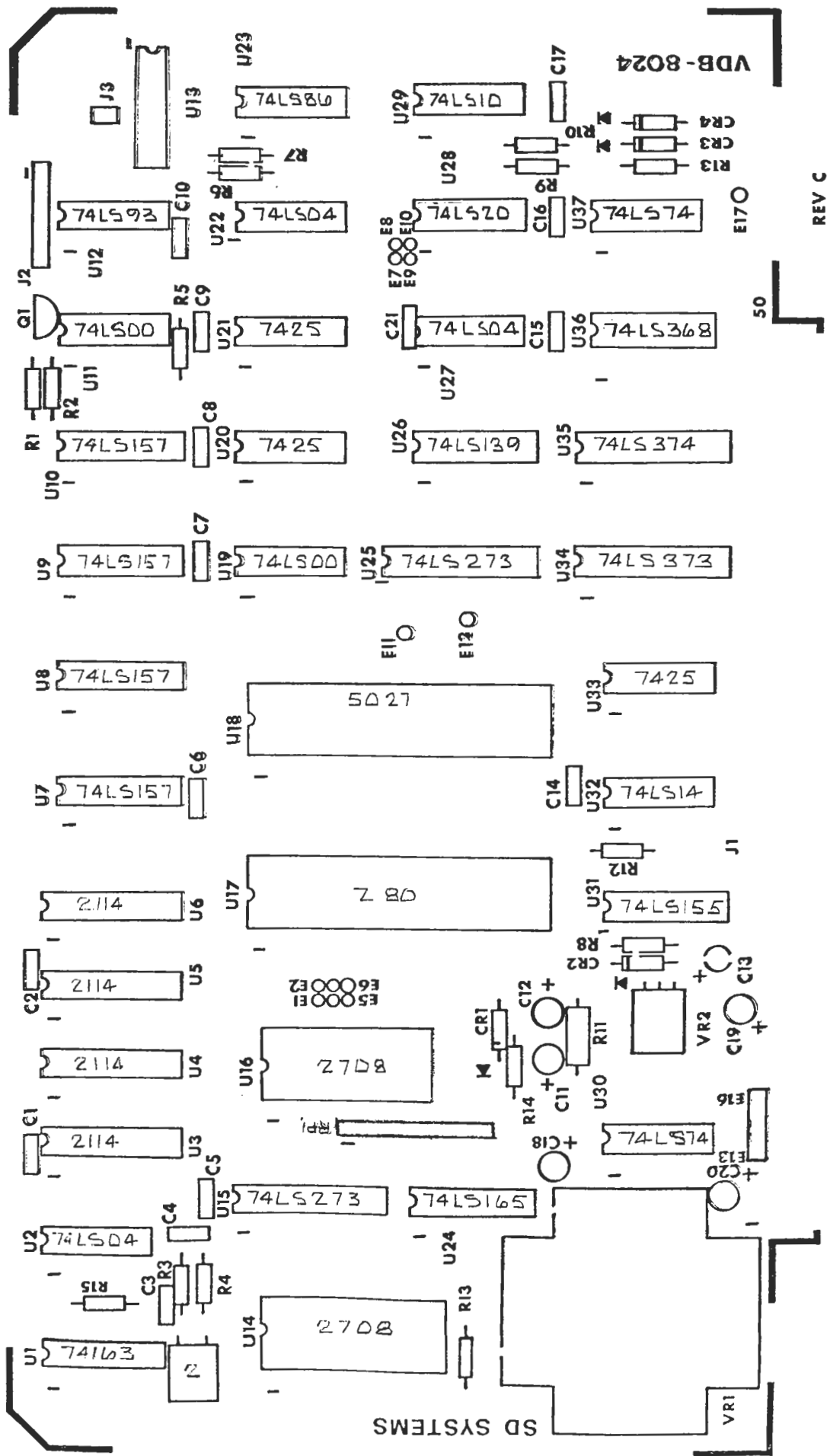
BILL OF MATERIALS

| Title: | | PL No. | | Rev. | |
|---------------------|-----|-----------|-------------------------------------------|--------------|-----------|
| VIDEO DISPLAY BOARD | | 0100070 | | D | |
| Date Released: | | Approved: | | Sheet 2 Of 3 | |
| 8-15-78 | | | | | |
| Item No. | Qty | SD-P/N | Description | Unit Cost | Extension |
| 25 | 1 | 7080005 | 14.43098 MH Crystal | | |
| 26 | 9 | 7020081 | 2.2K 1/4W, R2,R5,R7, R9, R10, R12-R14,R16 | | |
| 27 | 1 | 7020077 | 1.5K 1/4 Watt, R6 | | |
| 28 | 1 | 7020049 | 100 Ohm 1/4 Watt, R1 | | |
| 29 | 1 | 7020177 | 220 Ohm, 1/2 Watt, R11 | | |
| 30 | 1 | 7020067 | 560 Ohm 1/4 Watt, R15 | | |
| 31 | 12 | 7030007 | .1 uf, C1,C2,C5-C10,C14-C17 | | |
| 32 | 4 | 7030009 | 10 uf, C12,C13,C18,C19,C20,C11 | | |
| | 1 | 7030001 | 10 pf, C3 | | |
| 34 | 1 | 7030004 | 100 pf MICA C4 | | |
| 35 | 1 | 7030005 | 200 pf, C21 | | |
| 36 | 1 | 7160002 | LM323K 5V-3A Regulator | | |
| 37 | 1 | 7160003 | 7812/LM340T-12.0, 12V-1A Regulator | | |
| 38 | 1 | 7040003 | 1N-751, 5V Zener, CR1 | | |
| 39 | 1 | 7130026 | Heat Sink, 6051, Thermalloy | | |
| 40 | 3 | 7130006 | Screw, 6-32 x 3/8 PPH | | |
| 41 | 3 | 7130007 | Nut, 6-32 | | |
| 42 | 1 | 7040010 | 2N3904, NPN Transistor | | |
| 43 | 1 | 7170012 | 4-Pin Berg Connector | | |
| 44 | 2 | 7060009 | 40-Pin Socket | | |
| 45 | 2 | 7060007 | 24-Pin Socket | | |
| | 4 | 7060005 | 20-Pin Socket | | |
| 47 | 4 | 7060004 | 18-Pin Socket | | |
| 48 | 10 | 7060003 | 16-Pin Socket | | |

APPENDIX C

VDB 8024

PARTS PLACEMENT DIAGRAM



VDB-8024

REV C

SD SYSTEMS

APPENDIX D

VDB 8024

ONBOARD SOFTWARE

```

0002          NAME      VDB
0003 ;
0004 ;
0005 ;          VIDEO DISPLAY BOARD CONTROL SOFTWARE
0006 ;          VERSION 1.6      2/14/79
0007 ;
0008 ;          VERSION 1.6 ADDED THE CURSOR HOME CONTROL
0009 ;          FUNCTION
0010 ;
0011 ; POWER UP INITIALIZATION
0012 ;
0013 ;
>0000          0014          ORG 00
'0000 310020    0015          LD SP,2000H
'0003 DB20      0016          IN      A,(20H) ; CLEAR INTERRUPT FLOP
'0005 DB30      0017          IN A,(30H) ; CLEAR KEYBOARD RDY FLOP
'0007 D9        0018          EXX
'0008 2E00      0019          LD      L,0
'000A D9        0020          EXX
'000B CDFF00'   0021          CALL INIT
'000E CDCF01'   0022          CALL CLEAR
'0011 CDFE02'   0023          CALL FAST
'0014 CD2C03'   0024          CALL      STDN
'0017 210010    0025          LD HL,1000H ; DISPLAY MEMORY STARTING ADDRESS
'001A ED56      0026          IM 1
'001C 37        0027          SCF
'001D FB        0028          EI
'001E 76        0029          HALT
0030 ;
0031 ;
0032 ; START OF INTERUPT DRIVEN PROGRAM
0033 ;
0034 ;
>0038          0035          ORG 38H
'0038 D0        0036          RET NC ; RETURN ON NO CARRY
'0039 FDE1      0037          POP IY
'003B D9        0038          EXX
'003C CB7D      0039          BIT      7,L
'003E D9        0040          EXX
'003F DB20      0041          IN A,(20H) ; INPUT CHARACTER
'0041 CBBF      0042          RES      7,A
'0043 2802      0043          JR      Z,NEXT-$
'0045 F680      0044          OR      80H
'0047 CB77      0045 NEXT BIT      6,A ; TEST FOR CONTROL CHARACTER
'0049 C25100'   0046          JP NZ,TDIS
'004C CB6F      0047          BIT 5,A
'004E CA6600'   0048          JP Z,CTR
'0051 CDE302'   0049 TDIS CALL DELAY
'0054 CD0503'   0050          CALL PROTECT
0051 ;
0052 ;
0053 ; DISPLAY CHARACTER
0054 ;
0055 ;
'0057 77        0056 DISPLAY LD (HL),A ; MOVE CHARACTER TO DISPLAY R OR
'0058 14        0057 NODIS INC D
'0059 3E50      0058 CHECK LD A,80
'005B BA        0059          CP D ; CHECK FOR END OF LINE

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```
'005C CA2E01' 0060 JP Z,LFCR
'005F 23 0061 INC HL
'0060 7A 0062 LD A,D
'0061 D38C 0063 OUT (8CH),A ; MOVE CURSOR TO NEXT SPACE
'0063 37 0064 SCF
'0064 FB 0065 EI
'0065 76 0066 HALT
0067 ;
0068 ;
0069 ; BRANCH ON CONTROL CHARACTERS
0070 ;
0071 ;
'0066 FD213401' 0072 CTR LD IY,HLT
'006A FDE5 0073 PUSH IY ; PUSH RETURN ADDRESS
'006C CBBF 0074 RES 7,A
'006E FE0A 0075 CP 0AH ; LINE FEED
'0070 CA3701' 0076 JP Z,LF
'0073 FE0D 0077 CP 0DH ; CARRIAGE RETURN
'0075 CA6A01' 0078 JP Z,CR
'0078 FE01 0079 CP 01H ; SCROLL UP
'007A CA2C03' 0080 JP Z,STDN
'007D FE02 0081 CP 02H ; SCROLL DOWN
'007F CA2703' 0082 JP Z,STUP
'0082 FE03 0083 CP 03H ; SPECIAL CHARACTER
'0084 CAB002' 0084 JP Z,SPCH
'0087 FE04 0085 CP 04H ; SET CONTROL BIT #1
'0089 CAC702' 0086 JP Z,SC1
'008C FE05 0087 CP 05H ; RESET CONTROL BIT #1
'008E CACE02' 0088 JP Z,RC1
'0091 FE06 0089 CP 06H ; SET CONTROL BIT #2
'0093 CAD502' 0090 JP Z,SC2
'0096 FE07 0091 CP 07H ; RESET CONTROL BIT #2
'0098 CADC02' 0092 JP Z,RC2
'009B FE08 0093 CP 08H ; BACK SPACE
'009D CA7401' 0094 JP Z,CTRH
'00A0 FE09 0095 CP 09H ; TAB MODULO EIGHT
'00A2 CA6102' 0096 JP Z,TAB
'00A5 FE0B 0097 CP 0BH ; MOVE UP ONE LINE
'00A7 CAF701' 0098 JP Z,UPLINE
'00AA FE0C 0099 CP 0CH ; NONDESTRUCTIVE FORWARD SPACE
'00AC CA1402' 0100 JP Z,RIGHT
'00AF FE0E 0101 CP 0EH ; SLOW DISPLAY SPEED
'00B1 CAF002' 0102 JP Z,SLOW
'00B4 FE0F 0103 CP 0FH ; MEDIUM DISPLAY SPEED
'00B6 CAF702' 0104 JP Z,MED
'00B9 FE10 0105 CP 10H ; FAST DISPLAY SPEED
'00BB CAFE02' 0106 JP Z,FAST
'00BE FE11 0107 CP 11H ; QUIT STOPS REVERSE FIELD
'00C0 CA9802' 0108 JP Z,QUIT
'00C3 FE12 0109 CP 12H ; STARTS REVERSE FIELD
'00C5 CA7A02' 0110 JP Z,RVS
'00C8 FE13 0111 CP 13H ; STARTS REVERSE BLINKING FIELD
'00CA CA8402' 0112 JP Z,RVB
'00CD FE14 0113 CP 14H ; STARTS BLINKING FIELD
'00CF CA7002' 0114 JP Z,BLINK
'00D2 FE15 0115 CP 15H ; STARTS UNDERLINE FIELD
'00D4 CA8E02' 0116 JP Z,UND
'00D7 FE16 0117 CP 16H ; STARTS UNDERLINE BLINKING FIELI
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'00D9 CAA302' 0118 JP Z,UNB
'00DC FE17 0119 CP 17H ; STARTS NO ENHANCEMENT OR PROTEC
'00DE CA1203' 0120 JP Z,NFD
'00E1 FE18 0121 CP 18H ; ENTER PROTECT MODE
'00E3 CA1D03' 0122 JP Z,PFD
'00E6 FE19 0123 CP 19H ; EXIT PROTECT MODE
'00E8 CA2203' 0124 JP Z,UNPFD
'00EB FE1A 0125 CP 1AH ; CLEAR PAGE
'00ED CACF01' 0126 JP Z,CLEAR
'00F0 FE1B 0127 CP 1BH ; ESC=YX CURSOR PLACEMENT
'00F2 CA2A02' 0128 JP Z,ESC
'00F5 FE1E 0129 CP 1EH ; HOME
'00F7 CA1A02' 0130 JP Z,HOME
'00FA FDE1 0131 POP IY
'00FC C35700' 0132 JP DISPLAY
0133 ;
0134 ;
0135 ; INITIALIZE CRT 5027
0136 ;
0137 ;
'00FF D38A 0138 INIT OUT (8AH),A
'0101 3E65 0139 LD A,065H
'0103 D380 0140 OUT (80H),A
'0105 3E4B 0141 LD A,04BH
'0107 D381 0142 OUT (81H),A
'0109 3E4D 0143 LD A,04DH
'010B D382 0144 OUT (82H),A
'010D 3ED7 0145 LD A,0D7H
'010F D383 0146 OUT (83H),A
'0111 3E03 0147 LD A,003H ; 60HZ = 03H, 50HZ = 1DH
'0113 D384 0148 OUT (84H),A
'0115 3E0B 0149 LD A,0BH ; 60HZ = 0BH, 50HZ = 25H
'0117 D385 0150 OUT (85H),A
'0119 3E17 0151 LD A,23
'011B 47 0152 LD B,A
'011C D386 0153 OUT (86H),A
'011E 3E00 0154 LD A,00
'0120 D38C 0155 OUT (8CH),A
'0122 D38D 0156 OUT (8DH),A
'0124 D38E 0157 OUT (8EH),A
'0126 D38A 0158 OUT (8AH),A
'0128 D38E 0159 OUT (8EH),A
'012A 110000 0160 LD DE,0000
'012D C9 0161 RET
'012E CD3701' 0162 LFCR CALL LF
'0131 CD6A01' 0163 CALL CR
'0134 37 0164 HLT SCF ; RETURN POINT FROM CONTROLS
'0135 FB 0165 EI
'0136 76 0166 HALT
0167 ;
0168 ;
0169 ; LINE FEED
0170 ;
0171 ;
'0137 D9 0172 LFCR EXX
'0138 CB4D 0173 BIT 1,L ; TEST FOR SCROLL DIRECTION
'013A D9 0174 EXX
'013B CA4F01' 0175 JP Z,LFDN
```

```

'013E 7B          0176 LFUP    LD A,E
'013F 3D          0177          DEC A
'0140 FEFF       0178          CP 0FFH
'0142 C24701'    0179          JP NZ,LFCS
'0145 3E17       0180          LD A,23
'0147 B8         0181 LFCS    CP B
'0148 5F         0182          LD E,A
'0149 CC8B01'    0183          CALL Z,SCRDN
'014C C35C01'    0184          JP LFRT
'014F 7B         0185 LFDN    LD A,E
'0150 B8         0186          CP B
'0151 CCAD01'    0187          CALL Z,SCRUP
'0154 3C         0188          INC A
'0155 FE18       0189          CP 24
'0157 C25C01'    0190          JP NZ,LFRT
'015A 3E00       0191          LD A,00
                0192 ;
                0193 ;
                0194 ; IN SCROLL DOWN MODE LINE FEED MOVES CURSOR UP
                0195 ;
                0196 ;
'015C 5F         0197 LFRH    LD E,A          ; REG E CONTAINS LINE NUMBER
'015D D38D       0198          OUT (8DH),A
'015F 6A         0199          LD L,D
'0160 63         0200          LD H,E
'0161 CB15       0201          RL L
'0163 CB1C       0202          RR H
'0165 CB1D       0203          RR L
'0167 CBE4       0204          SET 4,H
'0169 C9         0205          RET
'016A 1600       0206 CR     LD D,00
'016C 7A         0207          LD A,D
'016D D38C       0208          OUT (8CH),A
'016F 3E80       0209          LD A,80H
'0171 A5         0210          AND L
'0172 6F         0211          LD L,A
'0173 C9         0212          RET
'0174 3E00       0213 CTRH    LD A,00
'0176 BA         0214          CP D
'0177 C8         0215          RET Z
'0178 15         0216          DEC D
'0179 2B         0217          DEC HL
'017A 7A         0218          LD A,D
'017B D38C       0219          OUT (8CH),A
'017D C9         0220          RET
'017E CD8401'    0221 SCRL    CALL SCROLL
'0181 C30302'    0222          JP PLACE
'0184 D9         0223 SCROLL  EXX
'0185 CB4D       0224          BIT 1,L
'0187 D9         0225          EXX
'0188 CAAD01'    0226          JP Z,SCRUP
                0227 ;
                0228 ;
                0229 ; SCROLL DOWN MODE
                0230 ;
                0231 ;
'018B 05         0232 SCRDN   DEC B
'018C 78         0233          LD A,B
  
```


| ADDR | COPYRIGHT CODE | 1978 STMT | SD SYSTEMS SOURCE | SD SYSTEMS STATEMENT |
|-------|----------------|-----------|-------------------|-------------------------------------|
| '018D | FEFF | 0234 | | CP 0FFH |
| '018F | C29401' | 0235 | | JP NZ,SCRD2 |
| '0192 | 0617 | 0236 | | LD B,23 |
| '0194 | 2E00 | 0237 | SCRD2 | LD L,00 |
| '0196 | 60 | 0238 | | LD H,B |
| '0197 | CB1C | 0239 | | RR H |
| '0199 | CB1D | 0240 | | RR L |
| '019B | CBE4 | 0241 | | SET 4,H |
| '019D | 0E20 | 0242 | | LD C,20H |
| '019F | 3E80 | 0243 | | LD A,80H |
| '01A1 | 85 | 0244 | | ADD A,L |
| '01A2 | 71 | 0245 | SCRDLP | LD (HL),C |
| '01A3 | 23 | 0246 | | INC HL |
| '01A4 | BD | 0247 | | CP L |
| '01A5 | C2A201' | 0248 | | JP NZ,SCRDLP |
| '01A8 | 78 | 0249 | | LD A,B |
| '01A9 | D386 | 0250 | | OUT (86H),A |
| '01AB | 7B | 0251 | | LD A,E |
| '01AC | C9 | 0252 | | RET |
| | | 0253 | | ; |
| | | 0254 | | ; |
| | | 0255 | | ; SCROLL UP MODE |
| | | 0256 | | ; |
| | | 0257 | | ; |
| '01AD | 04 | 0258 | SCRUP | INC B |
| '01AE | 78 | 0259 | | LD A,B |
| '01AF | FE18 | 0260 | | CP 24 |
| '01B1 | C2B601' | 0261 | | JP NZ,SCR2 |
| '01B4 | 0600 | 0262 | | LD B,00 |
| '01B6 | 2E00 | 0263 | SCR2 | LD L,00 |
| '01B8 | 60 | 0264 | | LD H,B |
| '01B9 | CB1C | 0265 | | RR H |
| '01BB | CB1D | 0266 | | RR L |
| '01BD | CBE4 | 0267 | | SET 4,H |
| '01BF | 0E20 | 0268 | | LD C,20H |
| '01C1 | 3E50 | 0269 | | LD A,80 |
| '01C3 | 85 | 0270 | | ADD A,L |
| '01C4 | 71 | 0271 | SCRLP | LD (HL),C |
| '01C5 | 23 | 0272 | | INC HL |
| '01C6 | BD | 0273 | | CP L |
| '01C7 | C2C401' | 0274 | | JP NZ,SCRLP |
| '01CA | 78 | 0275 | | LD A,B |
| '01CB | D386 | 0276 | | OUT (86H),A |
| '01CD | 7B | 0277 | | LD A,E |
| '01CE | C9 | 0278 | | RET |
| | | 0279 | | ; |
| | | 0280 | | ; |
| | | 0281 | | ; |
| | | 0282 | | ; FILL SCREEN WITH BLANK CHARACTERS |
| | | 0283 | | ; |
| | | 0284 | | ; |
| '01CF | 3E08 | 0285 | CLEAR | LD A,08H |
| '01D1 | D310 | 0286 | | OUT (10H),A |
| '01D3 | 210010 | 0287 | | LD HL,1000H |
| '01D6 | 0E20 | 0288 | | LD C,20H |
| '01D8 | 3E50 | 0289 | CLR1 | LD A,50H |
| '01DA | 71 | 0290 | CLR | LD (HL),C |
| '01DB | 23 | 0291 | | INC HL |

| VDB ADDR | COPYRIGTH CODE | 1978 STMT | SD SYSTEMS SOURCE | STATEMENT |
|----------|----------------|-----------|-------------------|------------------------------------------------------|
| '01DC | BD | 0292 | | CP L |
| '01DD | C2DA01' | 0293 | | JP NZ,CLR |
| '01E0 | 3ED0 | 0294 | | LD A,0D0H |
| '01E2 | 71 | 0295 | CLR2 | LD (HL),C |
| '01E3 | 23 | 0296 | | INC HL |
| '01E4 | BD | 0297 | | CP L |
| '01E5 | C2E201' | 0298 | | JP NZ,CLR2 |
| '01E8 | 3E1B | 0299 | | LD A,1BH |
| '01EA | BC | 0300 | | CP H |
| '01EB | C2D801' | 0301 | | JP NZ,CLR1 |
| '01EE | CD1A02' | 0302 | | CALL HOME |
| '01F1 | 3E20 | 0303 | | LD A,20H |
| '01F3 | D310 | 0304 | | OUT (10H),A |
| '01F5 | 08 | 0305 | | EX AF,AF' |
| '01F6 | C9 | 0306 | | RET |
| | | 0307 | | ; |
| | | 0308 | | ; |
| | | 0309 | | ; MOVE CURSOR UP ONE LINE |
| | | 0310 | | ; |
| | | 0311 | | ; |
| '01F7 | 7B | 0312 | UPLINE | LD A,E |
| '01F8 | FE00 | 0313 | | CP 00H |
| '01FA | C2FF01' | 0314 | | JP NZ,UPLP |
| '01FD | 3E18 | 0315 | | LD A,24 |
| '01FF | 3D | 0316 | UPLP | DEC A |
| '0200 | B8 | 0317 | | CP B |
| '0201 | C8 | 0318 | | RET Z |
| '0202 | 5F | 0319 | | LD E,A |
| | | 0320 | | ; |
| | | 0321 | | ; |
| | | 0322 | | ; PLACES CURSOR AT POSITION SPECIFIED IN REG D AND E |
| | | 0323 | | ; |
| | | 0324 | | ; |
| '0203 | 63 | 0325 | PLACE | LD H,E |
| '0204 | 6A | 0326 | | LD L,D |
| '0205 | CB15 | 0327 | | RL L |
| '0207 | CB1C | 0328 | | RR H |
| '0209 | CB1D | 0329 | | RR L |
| '020B | CBE4 | 0330 | | SET 4,H |
| '020D | 7A | 0331 | | LD A,D |
| '020E | D38C | 0332 | | OUT (8CH),A |
| '0210 | 7B | 0333 | | LD A,E |
| '0211 | D38D | 0334 | | OUT (8DH),A |
| '0213 | C9 | 0335 | | RET |
| '0214 | 14 | 0336 | RIGHT | INC D |
| '0215 | DDE1 | 0337 | | POP IX |
| '0217 | C35900' | 0338 | | JP CHECK |
| '021A | 1600 | 0339 | HOME | LD D,00 |
| '021C | 78 | 0340 | | LD A,B |
| '021D | 3C | 0341 | | INC A |
| '021E | FE18 | 0342 | | CP 24 |
| '0220 | C22502' | 0343 | | JP NZ,HOLP |
| '0223 | 3E00 | 0344 | | LD A,00 |
| '0225 | 5F | 0345 | HOLP | LD E,A |
| '0226 | CD0302' | 0346 | | CALL PLACE |
| '0229 | C9 | 0347 | | RET |
| | | 0348 | | ; |
| | | 0349 | | ; |

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0350 ; CURSOR PLACEMENT OF ESC=YX
0351 ;
0352 ;
'022A 37 0353 ESC SCF
'022B 3F 0354 CCF ; CLEAR CARRY FLAG WILL CAUSE
'022C FB 0355 EI ; RETURN AFTER INTERRUPT
'022D 76 0356 HALT
'022E DB20 0357 IN A,(20H) ; INPUT CHARACTER
'0230 CBBF 0358 RES 7,A
'0232 FE3D 0359 CP 3DH ; TEST FOR "="
'0234 C0 0360 RET NZ
'0235 37 0361 SCF
'0236 3F 0362 CCF
'0237 FB 0363 EI
'0238 76 0364 HALT
'0239 DB20 0365 IN A,(20H) ; INPUT Y VALUE
'023B CBBF 0366 RES 7,A
'023D D620 0367 SUB 20H
'023F F8 0368 RET M
'0240 FE18 0369 CP 24 ; TEST FOR VALUE > 24
'0242 F0 0370 RET P
'0243 80 0371 ADD A,B
'0244 3C 0372 INC A
'0245 FE18 0373 CP 24
'0247 FA4C02' 0374 JP M,ESLP
'024A D618 0375 SUB 24
'024C 4F 0376 ESLP LD C,A
'024D 37 0377 SCF
'024E 3F 0378 CCF
'024F FB 0379 EI
'0250 76 0380 HALT
'0251 DB20 0381 IN A,(20H) ; INPUT X VALUE
'0253 CBBF 0382 RES 7,A
'0255 D620 0383 SUB 20H
'0257 F8 0384 RET M
'0258 FE50 0385 CP 80 ; TEST FOR VALUE > 80
'025A F0 0386 RET P
'025B 59 0387 LD E,C
'025C 57 0388 LD D,A
'025D CD0302' 0389 CALL PLACE ; PLACE CURSOR AT NEW POSITION
'0260 C9 0390 RET
0391 ;
0392 ;
0393 ; TAB SET EVERY 8 SPACES
0394 ;
0395 ;
'0261 3EF8 0396 TAB LD A,0F8H
'0263 A2 0397 AND D
'0264 C608 0398 ADD A,08H
'0266 FE50 0399 CP 80
'0268 CA6F02' 0400 JP Z,TED
'026B 57 0401 LD D,A
'026C CD0302' 0402 CALL PLACE
'026F C9 0403 TED RET
0404 ;
0405 ;
0406 ; AF' REG CONTAINS SPECIAL CONTROL STATUS
0407 ; ENHANCEMENT FUNCTION CONTROLLED THROUGH PORT 10H

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0408 ;
0409 ;
0410 ; BIT 7 CONTROLS ENHANCEMENT FIELD
0411 ; BIT 6 CONTROLS SPECIAL BIT #1
0412 ; BIT 5 CONTROLS RUNNING TIME
0413 ; BIT 4 CONTROLS UNDERLINE
0414 ; BIT 3 CONTROLS BLANKING
0415 ; BIT 2 CONTROLS REVERSE
0416 ; BIT 1 CONTROLS BLINKING
0417 ; BIT 0 CONTROLS SPECIAL BIT #2
0418 ;
0419 ;
'0270 08 0420 BLINK EX AF,AF'
'0271 E669 0421 AND 69H
'0273 F622 0422 OR 22H
'0275 D310 0423 OUT (10H),A
'0277 08 0424 EX AF,AF'
'0278 1831 0425 JR ENHANC-$
'027A 08 0426 RVS EX AF,AF'
'027B E669 0427 AND 69H
'027D F624 0428 OR 24H
'027F D310 0429 OUT (10H),A
'0281 08 0430 EX AF,AF'
'0282 1827 0431 JR ENHANC-$
'0284 08 0432 RVB EX AF,AF'
'0285 E669 0433 AND 69H
'0287 F626 0434 OR 26H
'0289 D310 0435 OUT (10H),A
'028B 08 0436 EX AF,AF'
'028C 181D 0437 JR ENHANC-$
'028E 08 0438 UND EX AF,AF'
'028F E669 0439 AND 69H
'0291 F634 0440 OR 34H
'0293 D310 0441 OUT (10H),A
'0295 08 0442 EX AF,AF'
'0296 1813 0443 JR ENHANC-$
'0298 08 0444 QUIT EX AF,AF'
'0299 CBBF 0445 RES 7,A
'029B D310 0446 OUT (10H),A
'029D 08 0447 EX AF,AF'
'029E D9 0448 QUIT1 EXX
'029F CBBD 0449 RES 7,L
'02A1 D9 0450 EXX
'02A2 C9 0451 RET
'02A3 08 0452 UNB EX AF,AF'
'02A4 E669 0453 AND 69H
'02A6 F636 0454 OR 36H
'02A8 D310 0455 OUT (10H),A
'02AA 08 0456 EX AF,AF'
'02AB D9 0457 ENHANC EXX
'02AC CBFD 0458 SET 7,L
'02AE D9 0459 EXX
'02AF C9 0460 RET
0461 ;
0462 ;
0463 ; SPECIAL CHARACTER FUNCTION
0464 ;
0465 ;

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| ADDR | CODE | STMT | SOURCE STATEMENT |
|-------|---------|------|-----------------------------------------|
| '02B0 | 37 | 0466 | SPCH SCF |
| '02B1 | 3F | 0467 | CCF |
| '02B2 | FB | 0468 | EI |
| '02B3 | 76 | 0469 | HALT |
| '02B4 | DB20 | 0470 | IN A,(20H) ; INPUT SPECIAL CHARACTER |
| '02B6 | CBBF | 0471 | RES 7,A |
| '02B8 | D640 | 0472 | SUB 40H |
| '02BA | F8 | 0473 | RET M |
| '02BB | FDE1 | 0474 | POP IY |
| '02BD | FE20 | 0475 | CP 20H |
| '02BF | FA5100' | 0476 | JP M,TDIS |
| '02C2 | D620 | 0477 | SUB 20H |
| '02C4 | C35100' | 0478 | JP TDIS |
| | | 0479 | ; |
| | | 0480 | ; |
| | | 0481 | ; SETTING AND RESETTING OF CONTROL BITS |
| | | 0482 | ; |
| | | 0483 | ; |
| '02C7 | 08 | 0484 | SC1 EX AF,AF' |
| '02C8 | CBF7 | 0485 | SET 6,A |
| '02CA | D310 | 0486 | OUT (10H),A |
| '02CC | 08 | 0487 | EX AF,AF' |
| '02CD | C9 | 0488 | RET |
| '02CE | 08 | 0489 | RC1 EX AF,AF' |
| '02CF | CBB7 | 0490 | RES 6,A |
| '02D1 | D310 | 0491 | OUT (10H),A |
| '02D3 | 08 | 0492 | EX AF,AF' |
| '02D4 | C9 | 0493 | RET |
| '02D5 | 08 | 0494 | SC2 EX AF,AF' |
| '02D6 | CBC7 | 0495 | SET 0,A |
| '02D8 | D310 | 0496 | OUT (10H),A |
| '02DA | 08 | 0497 | EX AF,AF' |
| '02DB | C9 | 0498 | RET |
| '02DC | 08 | 0499 | RC2 EX AF,AF' |
| '02DD | CB87 | 0500 | RES 0,A |
| '02DF | D310 | 0501 | OUT (10H),A |
| '02E1 | 08 | 0502 | EX AF,AF' |
| '02E2 | C9 | 0503 | RET |
| | | 0504 | ; |
| | | 0505 | ; |
| | | 0506 | ; SOFTWARE DELAY LOOP |
| | | 0507 | ; |
| | | 0508 | ; |
| '02E3 | D9 | 0509 | DELAY EXX |
| '02E4 | D5 | 0510 | PUSH DE |
| '02E5 | 15 | 0511 | DLP DEC D |
| '02E6 | C2E502' | 0512 | JP NZ,DLP |
| '02E9 | 1D | 0513 | DEC E |
| '02EA | C2E502' | 0514 | JP NZ,DLP |
| '02ED | D1 | 0515 | POP DE |
| '02EE | D9 | 0516 | EXX |
| '02EF | C9 | 0517 | RET |
| | | 0518 | ; |
| | | 0519 | ; |
| | | 0520 | ; SET DISPLAY SPEED |
| | | 0521 | ; |
| | | 0522 | ; |
| '02F0 | D9 | 0523 | SLOW EXX |

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'02F1 16FF      0524      LD D,0FFH      ; REG D' AND E' CONTAIN DELAY
'02F3 1E01      0525      LD E,01H
'02F5 D9          0526      EXX
'02F6 C9          0527      RET
'02F7 D9          0528 MED     EXX
'02F8 165F      0529      LD D,05FH
'02FA 1E01      0530      LD E,01H
'02FC D9          0531      EXX
'02FD C9          0532      RET
'02FE D9          0533 FAST    EXX
'02FF 1601      0534      LD D,01H
'0301 1E01      0535      LD E,01H
'0303 D9          0536      EXX
'0304 C9          0537      RET
          0538 ;
          0539 ;
          0540 ; PROTECTED FIELD MODE
          0541 ;
          0542 ;
'0305 D9          0543 PROTECT EXX
'0306 CB45      0544      BIT 0,L      ; BIT 0 OF REG L' SETS PROTECT M
'0308 D9          0545      EXX
'0309 C8          0546      RET Z
'030A CB7E      0547      BIT 7,(HL)   ; BIT 7 OF MEMORY IS PROTECT BIT
'030C C8          0548      RET Z
'030D FDE1      0549      POP IY
'030F C35800'   0550      JP NODIS
'0312 08          0551 NFD     EX AF,AF'
'0313 E669      0552      AND 69H
'0315 CBFF      0553      SET 7,A
'0317 D310      0554      OUT (10H),A
'0319 08          0555      EX AF,AF'
'031A C39E02'   0556      JP          QUIT1
'031D D9          0557 PFD     EXX
'031E CBC5      0558      SET 0,L
'0320 D9          0559      EXX
'0321 C9          0560      RET
'0322 D9          0561 UNPFD  EXX
'0323 CB85      0562      RES 0,L
'0325 D9          0563      EXX
'0326 C9          0564      RET
          0565 ;
          0566 ;
          0567 ; SET SCROLL MODE
          0568 ;
          0569 ;
'0327 D9          0570 STUP    EXX
'0328 CBCD      0571      SET 1,L
'032A D9          0572      EXX
'032B C9          0573      RET
'032C D9          0574 STDN   EXX
'032D CB8D      0575      RES 1,L
'032F D9          0576      EXX
'0330 C9          0577      RET
```

APPENDIX E

VDB 8024

CHARACTER GENERATOR DATA

| ZAS ADDR | CODE | STMT | SOURCE | STATEMENT |
|-------------|----------------------|------|--------|---------------------------------------|
| | | 0001 | ; | |
| | | 0002 | ; | |
| | | 0003 | ; | CHARACTER GENERATOR SOFTWARE |
| | | 0004 | ; | VERSION 1.0 09/01/78/ KCG |
| | | 0005 | ; | |
| | | 0006 | ; | |
| >0000 | | 0007 | | ORG 00H |
| '0000 | 00000000 76888876 | 0008 | | DEFB 00,00,00,00,76H,88H,88H,76H |
| '0008 | 81384444 78444478 | 0009 | | DEFB 81H,38H,44H,44H,78H,44H,44H,78H |
| '0010 | 00E21418 28282810 | 0010 | | DEFB 00,0E2H,14H,18H,28H,28H,28H,10Hx |
| '0018 | 003C4020 30488478 | 0011 | | DEFB 00,3CH,40H,20H,30H,48H,84H,78H |
| '0020 | 0000003C 40FC403C | 0012 | | DEFB 00,00,00,3CH,40H,0FCH,40H,3CH |
| '0028 | 00384482 FE824438 | 0013 | | DEFB 00,38H,44H,82H,0FEH,82H,44H,38H |
| '0030 | 00000000 20202810 | 0014 | | DEFB 00,00,00,00,20H,20H,28H,10H |
| '0038 | 00804020 10284482 | 0015 | | DEFB 00,80H,40H,20H,10H,28H,44H,82H |
| '0040 | 81000000 2222225C | 0016 | | DEFB 081H,00,00,00,22H,22H,22H,5CH |
| '0048 | 00000000 E2222438 | 0017 | | DEFB 00,00,00,00,0E2H,22H,24H,38H |
| '0050 | 00000000 7EA42424 | 0018 | | DEFB 00,00,00,00,7EH,0A4H,24H,24H |
| '0058 | 00FC4020 102040FC | 0019 | | DEFB 00,0FCH,40H,20H,10H,20H,40H,0FCH |
| '0060 | 39381038 54543810 | 0020 | | DEFB 39H,38H,10H,38H,54H,54H,38H,10H |
| '0068 | 39381092 92543810 | 0021 | | DEFB 39H,38H,10H,92H,92H,54H,38H,10H |
| '0070 | 00000000 4482926C | 0022 | | DEFB 00,00,00,00,44H,82H,92H,6CH |
| '0078 | 00000078 848448CC | 0023 | | DEFB 00,00,00,78H,84H,84H,48H,0CCH |
| '0080 | 00000000 38444438 | 0024 | | DEFB 00,00,00,00,38H,44H,44H,38H |
| '0088 | 00000000 10301038 | 0025 | | DEFB 00,00,00,00,10H,30H,10H,38H |
| '0090 | 00000000 3844087C | 0026 | | DEFB 00,00,00,00,38H,44H,08H,7CH |
| '0098 | 00000000 78104830 | 0027 | | DEFB 00,00,00,00,78H,10H,48H,30H |
| '00A0 | 00384444 38000000 | 0028 | | DEFB 00,38H,44H,44H,38H,00,00,00 |
| '00A8 | 00384408 7C000000 | 0029 | | DEFB 00,38H,44H,08H,7CH,00,00,00 |
| '00B0 | 0000107C 10007C00 | 0030 | | DEFB 00,00,10H,7CH,10H,00,7CH,00 |
| '00B8 | 00001000 FE001000 | 0031 | | DEFB 00,00,10H,00,0FEH,00,10H,00 |
| '00C0 | 00006092 0C60920C | 0032 | | DEFB 00,00,60H,92H,0CH,60H,92H,0CH |
| '00C8 | 001C1010 | 0033 | | DEFB 00,1CH,10H,10H,10H,50H,30H,10H |

| ADDR | CODE | STMT | SOURCE STATEMENT |
|-------|----------------------------------|------|----------------------------------------|
| '00D0 | 10503010 00081410 10105020 | 0034 | DEFB 00,08H,14H,10H,10H,10H,50H,20H |
| '00D8 | 11001010 10101010 | 0035 | DEFB 11H,00,10H,10H,10H,10H,10H,10H |
| '00E0 | 00000820 FE200800 | 0036 | DEFB 00,00,08H,20H,0FEH,20H,08H,00 |
| '00E8 | 00002008 FE082000 | 0037 | DEFB 00,00,20H,08H,0FEH,08H,20H,00 |
| '00F0 | 00103854 10101010 | 0038 | DEFB 00,10H,38H,54H,10H,10H,10H,10H |
| '00F8 | 00101010 10543810 | 0039 | DEFB 00,10H,10H,10H,10H,54H,38H,10H |
| '0100 | 00000000 00000000 | 0040 | DEFB 00,00,00,00,00,00,00,00 |
| '0108 | 00101010 10100010 | 0041 | DEFB 00,10H,10H,10H,10H,10H,00H,10H |
| '0110 | 00444444 00000000 | 0042 | DEFB 00,44H,44H,44H,00H,00H,00H,00H |
| '0118 | 0028FE28 FE280000 | 0043 | DEFB 00H,28H,0FEH,28H,0FEH,28H,00H,00H |
| '0120 | 00107E90 7C12FC10 | 0044 | DEFB 00H,10H,7EH,90H,7CH,12H,0FCH,10H |
| '0128 | 0042A448 10244A84 | 0045 | DEFB 00H,42H,0A4H,48H,10H,24H,4AH,84H |
| '0130 | 00609060 908A847A | 0046 | DEFB 00H,60H,90H,60H,90H,8AH,84H,7AH |
| '0138 | 00101010 00000000 | 0047 | DEFB 00H,10H,10H,10H,00H,00H,00H,00H |
| '0140 | 00102040 40402010 | 0048 | DEFB 00H,10H,20H,40H,40H,40H,20H,10H |
| '0148 | 00100804 04040810 | 0049 | DEFB 00H,10H,08H,04H,04H,04H,08H,10H |
| '0150 | 004428FE 28440000 | 0050 | DEFB 00H,44H,28H,0FEH,28H,44H,00H,00H |
| '0158 | 00001010 7C101000 | 0051 | DEFB 00H,00H,10H,10H,7CH,10H,10H,00H |
| '0160 | 09110000 00001818 | 0052 | DEFB 09H,11H,00H,00H,00H,00H,18H,18H |
| '0168 | 00000000 7C000000 | 0053 | DEFB 00H,00H,00H,00H,7CH,00H,00H,00H |
| '0170 | 00000000 00000018 | 0054 | DEFB 00H,00H,00H,00H,00H,00H,00H,18H |
| '0178 | 00020408 10204080 | 0055 | DEFB 00H,02H,04H,08H,10H,20H,40H,80H |
| '0180 | 007C868A 92A2C27C | 0056 | DEFB 00H,7CH,86H,8AH,92H,0A2H,0C2H,7CH |
| '0188 | 00103010 10101038 | 0057 | DEFB 00H,10H,30H,10H,10H,10H,10H,38H |
| '0190 | 007C8202 3C4080FE | 0058 | DEFB 00H,7CH,82H,02H,3CH,40H,80H,0FEH |
| '0198 | 00FE0408 1C02827C | 0059 | DEFB 00H,0FEH,04H,08H,1CH,02H,82H,7CH |
| '01A0 | 000C1424 44FE0404 | 0060 | DEFB 00H,0CH,14H,24H,44H,0FEH,04H,04H |
| '01A8 | 00FE80FC 02028478 | 0061 | DEFB 00H,0FEH,80H,0FCH,02H,02H,84H,78H |
| '01B0 | 00182040 | 0062 | DEFB 00H,18H,20H,40H,0BCH,0C2H,82H,7CH |

| ADDR | CODE | STMT | SOURCE | STATEMENT |
|-------|----------------------|------|--------|-----------------------------------------|
| | BCC2827C | | | |
| '01B8 | 00FE8202 04081020 | 0063 | | DEFB 00H,0FEH,82H,02H,04H,08H,10H,20H |
| '01C0 | 007C8282 7C82827C | 0064 | | DEFB 00H,7CH,82H,82H,7CH,82H,82H,7CH |
| '01C8 | 007C8286 7A040830 | 0065 | | DEFB 00H,7CH,82H,86H,7AH,04H,08H,30H |
| '01D0 | 00001818 00181800 | 0066 | | DEFB 00H,00H,18H,18H,00H,18H,18H,00H |
| '01D8 | 09111818 00001818 | 0067 | | DEFB 09H,11H,18H,18H,00H,00H,18H,18H |
| '01E0 | 00020820 80200802 | 0068 | | DEFB 00H,02H,08H,20H,80H,20H,08H,02H |
| '01E8 | 00007C00 7C000000 | 0069 | | DEFB 00H,00H,7CH,00H,7CH,00H,00H,00H |
| '01F0 | 00802008 02082080 | 0070 | | DEFB 00H,80H,20H,08H,02H,08H,20H,80H |
| '01F8 | 117C8202 06101000 | 0071 | | DEFB 11H,7CH,82H,02H,06H,10H,10H,00H |
| '0200 | 003C428A 968C403E | 0072 | | DEFB 00H,3CH,42H,8AH,96H,8CH,40H,3EH |
| '0208 | 00384482 82FE8282 | 0073 | | DEFB 00H,38H,44H,82H,82H,0FEH,82H,82H |
| '0210 | 00F88484 FC8282FC | 0074 | | DEFB 00H,0F8H,84H,84H,0FCH,82H,82H,0FCH |
| '0218 | 003C4280 8080423C | 0075 | | DEFB 00H,3CH,42H,80H,80H,80H,42H,3CH, |
| '0220 | 00F88482 828284F8 | 0076 | | DEFB 00H,0F8H,84H,82H,82H,82H,84H,0F8H |
| '0228 | 00FE8080 F08080FE | 0077 | | DEFB 00H,0FEH,80H,80H,0F0H,80H,80H,0FEH |
| '0230 | 00FE8080 F0808080 | 0078 | | DEFB 00H,0FEH,80H,80H,0F0H,80H,80H,80H |
| '0238 | 003C4280 808E463A | 0079 | | DEFB 00H,3CH,42H,80H,80H,8EH,46H,3AH |
| '0240 | 00828282 FE828282 | 0080 | | DEFB 00H,82H,82H,82H,0FEH,82H,82H,82H |
| '0248 | 00381010 10101038 | 0081 | | DEFB 00H,38H,10H,10H,10H,10H,10H,38H |
| '0250 | 000E0404 04048478 | 0082 | | DEFB 00H,0EH,04H,04H,04H,04H,84H,78H |
| '0258 | 00828488 B0C88482 | 0083 | | DEFB 00H,82H,84H,88H,0B0H,0C8H,84H,82H |
| '0260 | 00808080 808080FE | 0084 | | DEFB 00H,80H,80H,80H,80H,80H,80H,0FEH |
| '0268 | 0082C6AA 92828282 | 0085 | | DEFB 00H,82H,0C6H,0AAH,92H,82H,82H,82H |
| '0270 | 0082C2A2 928A8682 | 0086 | | DEFB 00H,82H,0C2H,0A2H,92H,8AH,86H,82H |
| '0278 | 007C8282 8282827C | 0087 | | DEFB 00H,7CH,82H,82H,82H,82H,82H,7CH |
| '0280 | 00FC8282 FC808080 | 0088 | | DEFB 00H,0FCH,82H,82H,0FCH,80H,80H,80H |
| '0288 | 007C8282 828A847A | 0089 | | DEFB 00H,7CH,82H,82H,82H,8AH,84H,7AH |
| '0290 | 00FC8282 FC888482 | 0090 | | DEFB 00H,0FCH,82H,82H,0FCH,88H,84H,82H |
| '0298 | 007C8280 | 0091 | | DEFB 00H,7CH,82H,80H,7CH,02H,82H,7CH |

| ADDR | CODE | STMT | SOURCE STATEMENT |
|-------|----------------------------------|------|------------------------------------------|
| '02A0 | 7C02827C 00FE9210 10101010 | 0092 | DEFB 00H,0FEH,92H,10H,10H,10H,10H,10H |
| '02A8 | 00828282 8282867A | 0093 | DEFB 00H,82H,82H,82H,82H,82H,86H,7AH |
| '02B0 | 00828282 82442810 | 0094 | DEFB 00H,82H,82H,82H,82H,44H,28H,10H |
| '02B8 | 00828282 9292926C | 0095 | DEFB 00H,82H,82H,82H,92H,92H,92H,6CH |
| '02C0 | 00824428 10284482 | 0096 | DEFB 00H,82H,44H,28H,10H,28H,44H,82H |
| '02C8 | 00824428 10101010 | 0097 | DEFB 00H,82H,44H,28H,10H,10H,10H,10H |
| '02D0 | 00FE8408 102042FE | 0098 | DEFB 00H,0FEH,84H,08H,10H,20H,42H,0FEH |
| '02D8 | 00382020 20202038 | 0099 | DEFB 00H,38H,20H,20H,20H,20H,20H,38H |
| '02E0 | 00804020 10080402 | 0100 | DEFB 00H,80H,40H,20H,10H,08H,04H,02H |
| '02E8 | 00380808 08080838 | 0101 | DEFB 00H,38H,08H,08H,08H,08H,08H,38H |
| '02F0 | 00102844 82000000 | 0102 | DEFB 00H,10H,28H,44H,82H,00H,00H,00H |
| '02F8 | 00000000 FE000000 | 0103 | DEFB 00H,00H,00H,00H,0FEH,00H,00H,00H |
| '0300 | 00201008 00000000 | 0104 | DEFB 00H,20H,10H,08H,00H,00H,00H,00H |
| '0308 | 00000078 047C847A | 0105 | DEFB 00H,00H,00H,78H,04H,7CH,84H,7AH |
| '0310 | 008080B8 C484C4B8 | 0106 | DEFB 00H,80H,80H,0B8H,0C4H,84H,0C4H,0B8H |
| '0318 | 0000007C 8080807C | 0107 | DEFB 00H,00H,00H,7CH,80H,80H,80H,7CH |
| '0320 | 00040474 8C848C74 | 0108 | DEFB 00H,04H,04H,74H,8CH,84H,8CH,74H |
| '0328 | 00000078 84FC807C | 0109 | DEFB 00H,00H,00H,78H,84H,0FCH,80H,7CH |
| '0330 | 00182420 70202020 | 0110 | DEFB 00H,18H,24H,20H,70H,20H,20H,20H |
| '0338 | 05790074 8C848C74 | 0111 | DEFB 05H,79H,00H,74H,8CH,84H,8CH,74H |
| '0340 | 008080B8 C4848484 | 0112 | DEFB 00H,80H,80H,0B8H,0C4H,84H,84H,84H |
| '0348 | 00001000 10101010 | 0113 | DEFB 00H,00H,10H,00H,10H,10H,10H,10H |
| '0350 | 49310800 08080808 | 0114 | DEFB 49H,31H,08H,00H,08H,08H,08H,08H |
| '0358 | 00808084 88B0C884 | 0115 | DEFB 00H,80H,80H,84H,88H,0B0H,0C8H,84H |
| '0360 | 00101010 10101010 | 0116 | DEFB 00H,10H,10H,10H,10H,10H,10H,10H |
| '0368 | 000000EC 92929292 | 0117 | DEFB 00H,00H,00H,0ECH,092H,92H,92H,92H |
| '0370 | 000000B8 C4848484 | 0118 | DEFB 00H,00H,00H,0B8H,0C4H,84H,84H,84H |
| '0378 | 00000078 84848478 | 0119 | DEFB 00H,00H,00H,78H,84H,84H,84H,78H |
| '0380 | 818100B8 | 0120 | DEFB 81H,81H,00H,0B8H,0C4H,84H,0C4H,0B8H |

| ADDR | CODE | STMT | SOURCE | STATEMENT |
|-------|----------------------------------|------|--------|------------------------------------------|
| '0388 | C484C4B8 05070074 8C848C74 | 0121 | | DEFB 05H,07H,00H,74H,8CH,84H,8CH,74H |
| '0390 | 000000B8 C4808080 | 0122 | | DEFB 00H,00H,00H,0B8H,0C4H,80H,80H,80H |
| '0398 | 0000007C 807804F8 | 0123 | | DEFB 00H,00H,00H,7CH,80H,78H,04H,0F8H |
| '03A0 | 0000107C 10101010 | 0124 | | DEFB 00H,00H,10H,7CH,10H,10H,10H,10H |
| '03A8 | 00000084 84848C74 | 0125 | | DEFB 00H,00H,00H,84H,84H,84H,8CH,74H |
| '03B0 | 00000082 82442810 | 0126 | | DEFB 00H,00H,00H,82H,82H,44H,28H,10H |
| '03B8 | 00000082 8292926C | 0127 | | DEFB 00H,00H,00H,82H,82H,92H,92H,6CH |
| '03C0 | 00000084 48304884 | 0128 | | DEFB 00H,00H,00H,84H,48H,30H,48H,84H |
| '03C8 | 05790084 84848C74 | 0129 | | DEFB 05H,79H,00H,84H,84H,84H,8CH,74H |
| '03D0 | 000000FC 083040FC | 0130 | | DEFB 00H,00H,00H,0FCH,08H,30H,40H,0FCH |
| '03D8 | 00182020 40202018 | 0131 | | DEFB 00H,18H,20H,20H,40H,20H,20H,18H |
| '03E0 | 00101000 00001010 | 0132 | | DEFB 00H,10H,10H,00H,00H,00H,10H,10H |
| '03E8 | 00300808 04080830 | 0133 | | DEFB 00H,30H,08H,08H,04H,08H,08H,30H |
| '03F0 | 00000022 54880000 | 0134 | | DEFB 00H,00H,00H,22H,54H,88H,00H,00H |
| '03F8 | 00AA54AA 54AA54AA | 0135 | | DEFB 00H,0AAH,54H,0AAH,54H,0AAH,54H,0AAH |
| | | 0136 | | END |

ERRORS=0000