S. D. SYSTEMS

USER'S MANUAL

FOR

VDB-8024

INDEX

APPENDICES

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 hori-
zontal 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 com-
plete terminal.

1-2   GENERAL DESCRIPTION

The VDB utilizes a Z80 microprocessor to perform the control functions
of a video terminal. These functions inlcude LF, CR, full cursor con-
trol, 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 charact-
ers are typically available while 256 characters can be made avail-
able 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 dis-
play due to the processor running during the raster scan. There are
several software controllable functions. These include a speed con-
trol 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 dis-
play 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 pro-
vide 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.
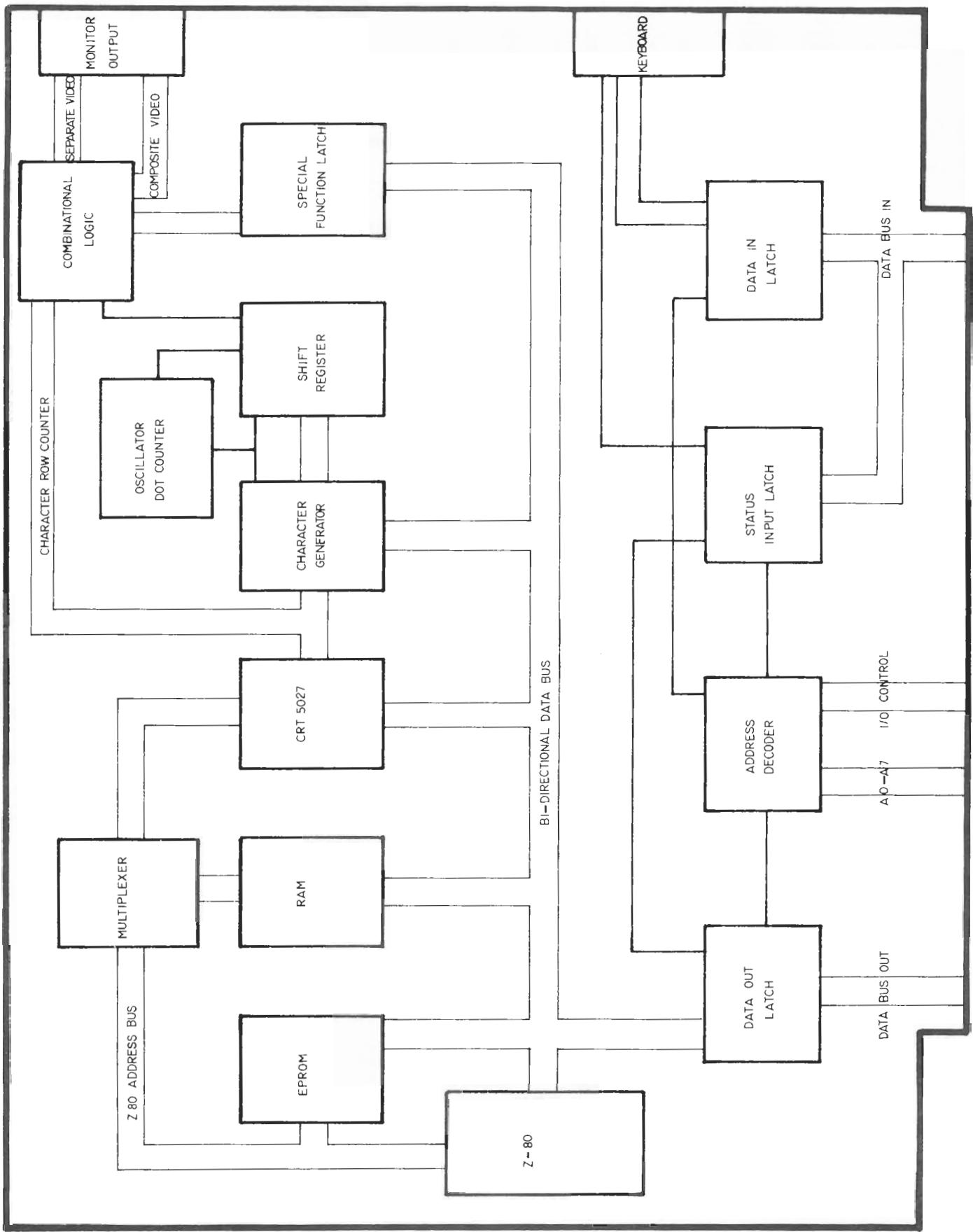
FIGURE 2-1

VDB - 8024 Video Display Board
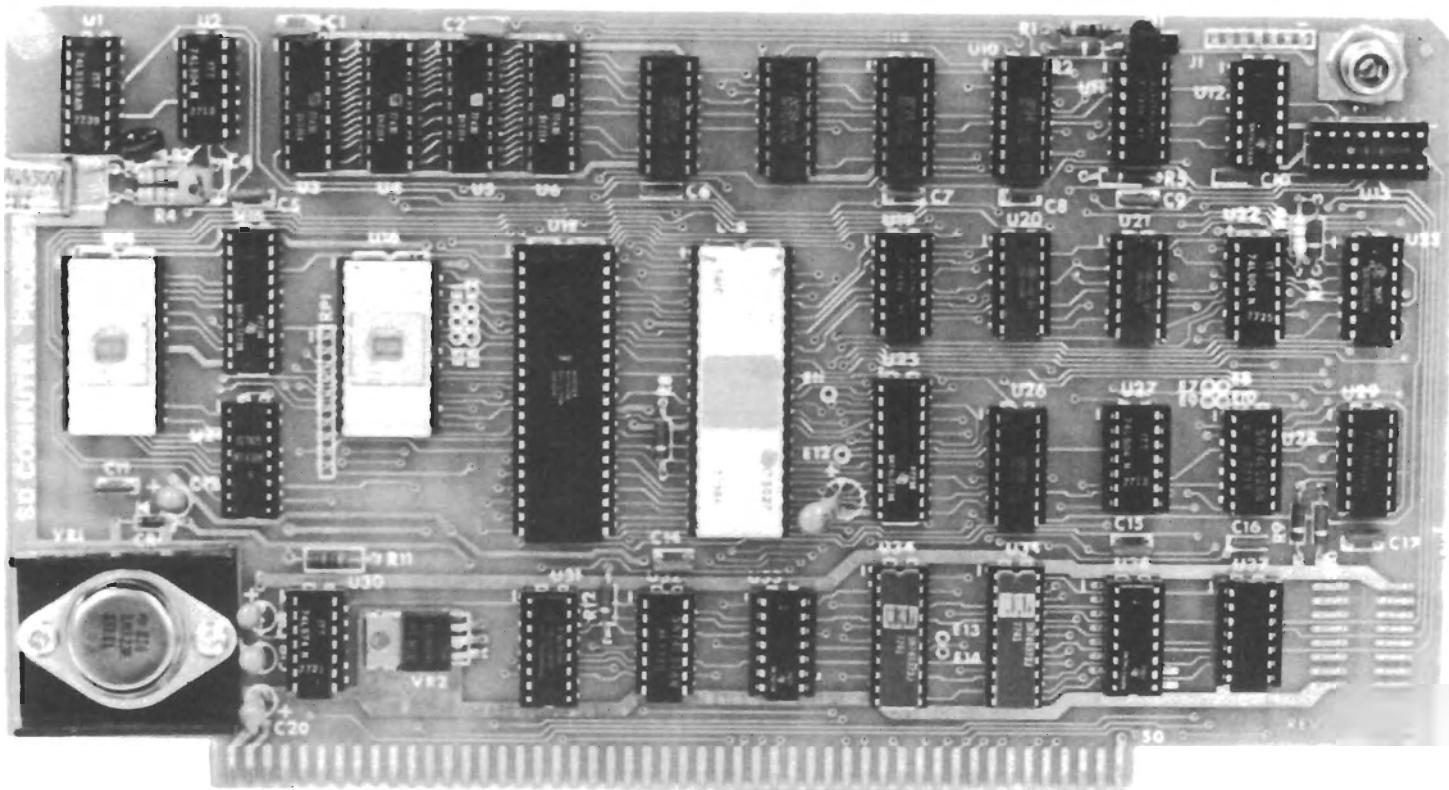
SD Systems

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 charac-
ters 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	@ , $\backslash$
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
$\overline{\Phi}$	M , m
ω	N , n
Ω	O , o
$\circ$	P , p
$\underline{1}$	Q , q
2	R , r
$\frac{3}{0}$	S , s
	T , t
2	U , u
$\pm$	V , v
$\div$	W , w
$\approx$	X , x
$\sqrt{}$	Y , y
$\int$	Z , z
$\mid$	[, {
$\leftarrow$	$\backslash$, |
$\rightarrow$	] , }
$\uparrow$	^ , ~
$\downarrow$	_ , ▒

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 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 avail-
able 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.

$X^c, R^c, \ldots, Q^c$

PROTECTE
IN REVERSE

CONTROL CHARACTER	FUNCTION	ASCII CODE	
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

$b_3b_2b_1b_0$	b_6 0 0_H b_5 0 b_4 0	0 1_H 0 1	0 2_H 1 0	0 3_H 1 1	1 4_H 0 0	1 5_H 0 1	1 6_H 1 0	1 7_H 1 1
0 0 0 0 0_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	BLINK-ING RE-VERSE	#	3	C	S	c	s
0 1 0 0 4_H	SET CONTROL BIT #1	BLINK-ING	$	4	D	T	d	t
0 1 0 1 5_H	RESET CON-TROL BIT #1	UNDER-LINE	%	5	E	U	e	u
0 1 1 0 6_H	SET CONTROL BIT #2	BLINKING UNDER-LINE	&	6	F	V	f	v
0 1 1 1 7_H	RESET CON-TROL BIT #2	NO EN-HANCE-MENT	'	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	UNPRO-TECTED 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	$\propto$	,	<	L	\	l	!
1 1 0 1 D_H	CARRIAGE RETURN	$\rightarrow$	-	=	M	]	m	}
1 1 1 0 E_H	SLOW	HOME	.	>	N	$\wedge$	n	~
1 1 1 1 F_H	MEDIUM	$\downarrow$ (^—)	/	?	O	—	0	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 indica-
ting 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.

Displayed Character

ROW
0
1
2
3
4
5
6
7
8
9

A

Character in Memory

ROW
0 or 8
1 or 9
2
3
4
5
6
7

Bit 7
Bit 6
Bit 5
Bit 4
Bit 3
Bit 2
Bit 1
Bit 0

1 Chooses
0 Rows 8&9

B

Hex Data in Memory

ROW	DATA
0	49
1	39
2	08
3	00
4	08
5	08
6	08
7	08

C
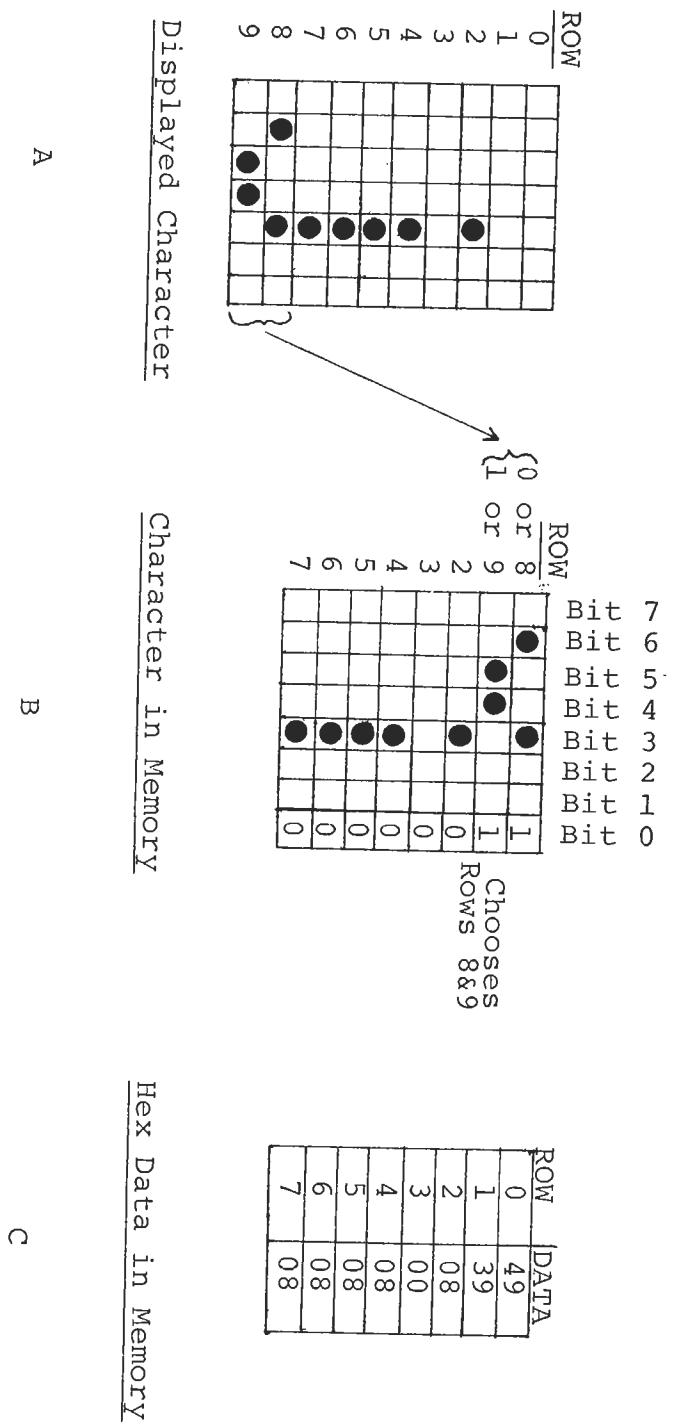
CHARACTER GENERATOR ORGANIZATION

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

R V5

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 respect-
     ively.

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 24
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.
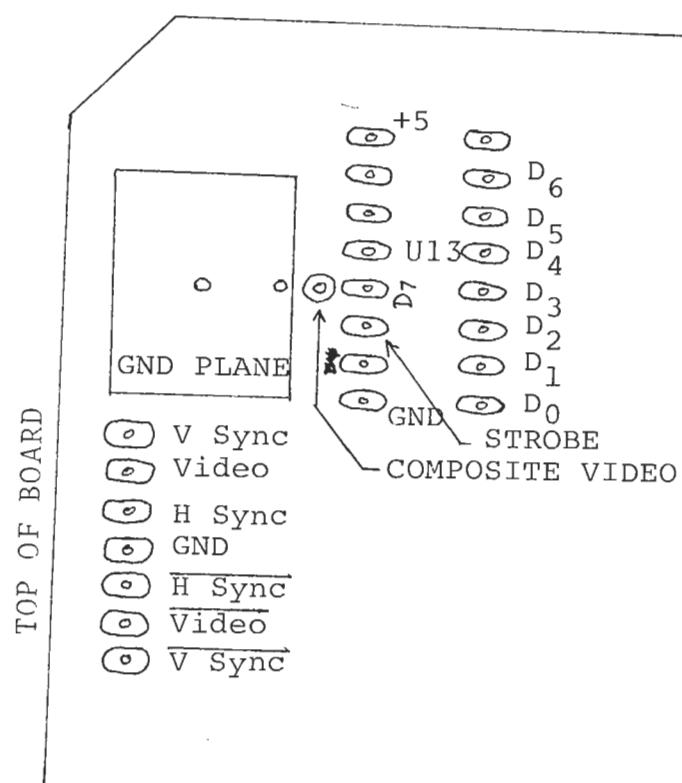
VDB INTERFACE SIGNALS

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.

E 17

10μs.

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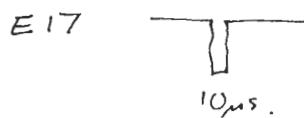
1-2	-5V	
3-4	+5V	EPROM TYPE
5-6	+12V	
7-8		Cursor
9-10		
11,12	– output	
13-14	DC7	
15,16,17	Interrupts.	

APPENDIX A

VDB 8024

SCHEMATIC DIAGRAM

SCHEMATIC FOR VDB8024
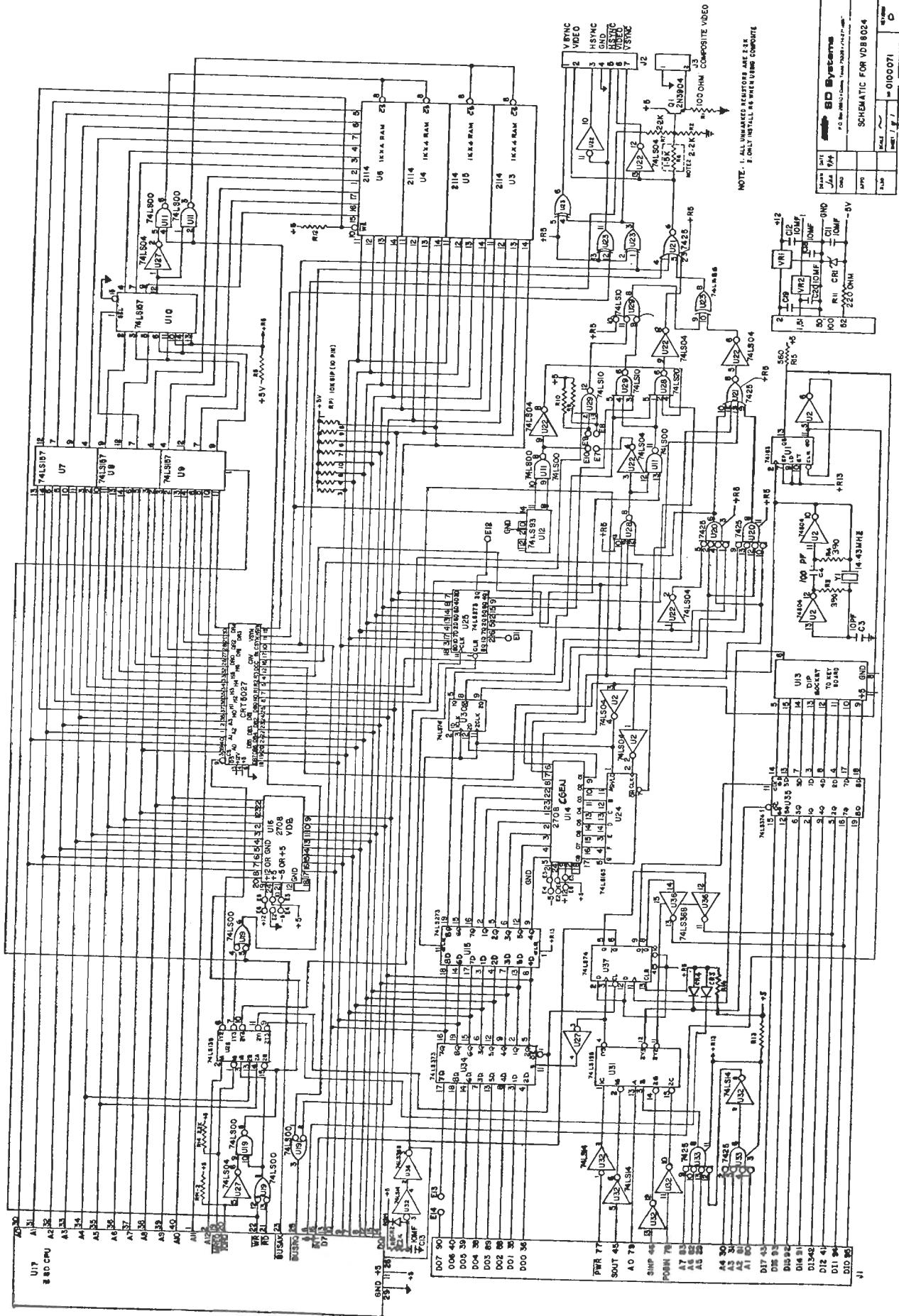
APPENDIX B

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 ARTWORK # 0100072		

Title: VIDEO DISPLAY BOARD				PL No. 0100070		Rev. D
Date Released: 8-15-78			Approved:		Sheet 2	Of 3

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	6	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		

SD Systems

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

BILL OF MATERIALS

Title:				PL No. 0100070		Rev. D
VIDEO DISPLAY BOARD						

Date Released: 8-15-78	Approved:		Sheet 3	Of 3

Item no	Qty	SD-P/N	Description	Unit Cost	Extension
49	15	7060002	14-Pin Socket		
50	1	7010347	Resistor SIP, 10K, 10 Pin, RP1		
51	1	7040001	Diode, 1N914, CR2		
52	1	7020105	Resistor, 22K, R8		
53	2	7040011	DIODE 1N270 CR3&4 GERMANIUM		
54	2	7020063	RESISTOR 390 oHMs 1/4W R3, R4		
55	1	7010360	VDB CONTROL SOFTWARE(2708)U16 (60HZ)OPTION		
	1	7010365	VDB CONTROL SOFTWARE(2708)U16 (50HZ) OPTION		
56	1	7010361	CGEN CHARACTER GENERATOR 2708 U14.		

APPENDIX C

VDB 8024

PARTS PLACEMENT DIAGRAM

VDB-8024

REV C

SD SYSTEMS

J3
U23 74LS86
U13
C17

U29 74LS10
R10
CR4
CR3
R13
CR2
R9

R7
R6
U22 74LS04
U12 74LS93
C10
J2
U28
U8 74LS20
C16 U37 74LS74
E8
E10
E7 E9 E9
E17
50

Q1
74LS00
R5 C9
U21 7425
C21 74LS04 C15 U36 74LS368
U11
R2
U27

R1
U10 74LS157
C8 U20 7425
U26 74LS139
U35 74LS374

C7
U9 74LS157
U19 74LS00
U25 74LS273
U34 74LS373

U8 74LS157
E11 E12
U18 5027
U33 7425

C6
U7 74LS157
C14 U32 74LS14

R12 J1
U17 Z80
U31 74LS155

U6 2114
R8
CR2
C13
C12
U5 2114
E4 E3
E6 E2
E5 E1
CR1
R11 VR2
C19
C2

U4 2114
U16 2708
CR3
R14 C11
U30

C1
U3 2114
RP1
R18 C18
E16
74LS74
E13
C5
C20

U15 74LS273
74LS165
VR1
C4
U2 74LS04
U24
R3 R4
R15 C3
U14 2708
R13
U1 74163
2

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 M  OR
'0058   14              0057 NODIS    INC D
'0059   3E50            0058 CHECK    LD A,80
'005B   BA              0059          CP D             ; CHECK FOR END OF LINE
```

```
'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 FIELD
```

```
'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 LF       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 LFRT      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
```

```
'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
```

```
'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 ;
```

```
                      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 INTERUPT
'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
```

```
                        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 ;
```

```
'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
```

```
'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

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

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

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

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

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

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