IBM

Personal Computer

IBM Enhanced Graphics Adapter

Contents

Description

The IBM Enhanced Graphics Adapter (EGA) is a graphics controller that supports both color and monochrome direct drive displays in a variety of modes. In addition to the direct drive port, a light pen interface is provided. Advanced features on the adapter include bit-mapped graphics in four planes and a RAM (Random Access Memory) loadable character generator. Design features in the hardware substantially reduce the software overhead for many graphics functions.

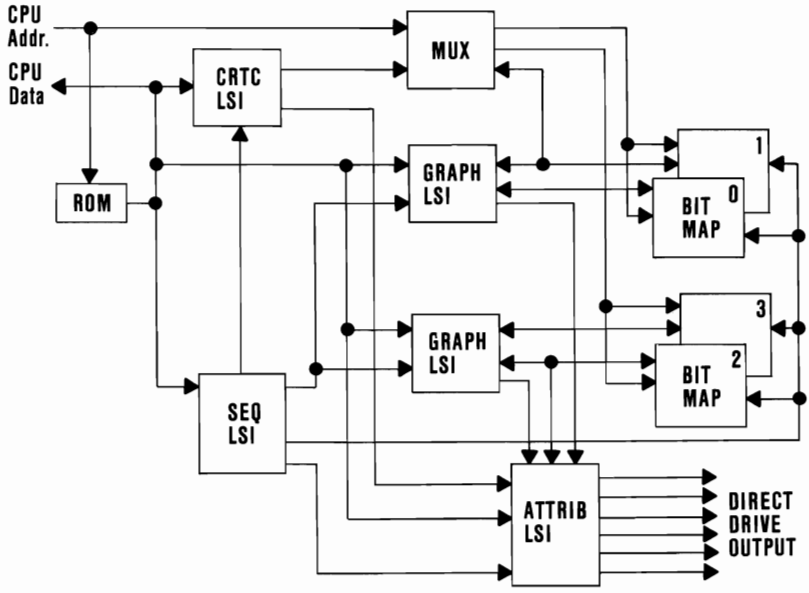
The Enhanced Graphics Adapter provides Basic Input Output System (BIOS) support for both alphanumeric (A/N) modes and all-points-addressable (APA) graphics modes, including all modes supported by the Monochrome Display Adapter and the Color/Graphics Monitor Adapter. Other modes provide APA 640x350 pel graphics support for the IBM Monochrome Display, full 16 color support in both 320x200 pel and 640x200 pel resolutions for the IBM Color Display, and both A/N and APA support with resolution of 640x350 for the IBM Enhanced Color Display. In alphanumeric modes, characters are formed from one of two ROM (Read Only Memory) character generators on the adapter. One character generator defines 7x9 characters in a 9x14 character box. For Enhanced Color Display support, the 9x14 character set is modified to provide an 8x14 character set. The second character generator defines 7x7 characters in an 8x8 character box. These generators contain dot patterns for 256 different characters. The character sets are identical to those provided by the IBM Monochrome Display Adapter and the IBM Color/Graphics Monitor Adapter.

The adapter contains 64K bytes of storage configured as four 16K byte bit planes. Memory expansion options are available to expand the adapter memory to 128K bytes or 256K bytes.

The adapter is packaged on a single 13-1/8 inch (333.50 mm) card. The direct drive port is a right-angle mounted connector at the rear of the adapter and extends through the rear panel of the system unit. Also on the card are five large scale integration (LSI) modules custom designed for this controller.

Located on the adapter is a feature connector that provides access to internal functions through a 32-pin berg connector. A separate 64-pin connector provides an interface for graphics memory expansion.

The following is a block diagram of the Enhanced Graphics Adapter:



Enhanced Graphics Adapter Block Diagram

Major Components

CRT Controller

The CRT (Cathode Ray Tube) Controller (CRTC) generates horizontal and vertical synchronous timings, addressing for the regenerative buffer, cursor and underline timings, and refresh addressing for the dynamic RAMs.

Sequencer

The Sequencer generates basic memory timings for the dynamic RAMs and the character clock for controlling regenerative memory fetches. It allows the processor to access memory during active display intervals by inserting dedicated processor memory cycles periodically between the display memory cycles. Map mask registers are available to protect entire memory maps from being changed.

Graphics Controller

The Graphics Controller directs the data from the memory to the attribute controller and the processor. In graphics modes, memory data is sent in serialized form to the attribute chip. In alpha modes the memory data is sent in parallel form, bypassing the graphics controller. The graphics controller formats the data for compatible modes and provides color comparators for use in color painting modes. Other hardware facilities allow the processor to write 32 bits in a single memory cycle, (8 bits per plane) for quick color presetting of the display areas, and additional logic allows the processor to write data to the display on non-byte boundaries.

Attribute Controller

The Attribute Controller provides a color palette of 16 colors, each of which may be specified separately. Six color outputs are

available for driving a display. Blinking and underlining are controlled by this chip. This chip takes data from the display memory and formats it for display on the CRT screen.

Display Buffer

The display buffer on the adapter consists of 64K bytes of dynamic read/write memory configured as four 16K byte video bit planes. Two options are available for expanding the graphics memory. The Graphics Memory Expansion Card plugs into the memory expansion connector on the adapter, and adds one bank of 16K to each of the four bit planes, increasing the graphics memory to 128K bytes. The expansion card also provides DIP sockets for further memory expansion. Populating the DIP sockets with the Graphics Memory Module Kit adds two additional 16K banks to each bit plane, bringing the graphics memory to its maximum of 256K bytes.

The address of the display buffer can be changed to remain compatible with other video cards and application software. Four locations are provided. The buffer can be configured at segment address hex A0000 for a length of 128K bytes, at hex A0000 for a length of 64K bytes, at hex B0000 for a length of 32K bytes, or at hex B8000 for a length of 32K bytes.

BIOS

A read-only memory (ROM) Basic Input Output System (BIOS) module on the adapter is linked to the system BIOS. This ROM BIOS contains character generators and control code and is mapped into the processor address at hex C0000 for a length of 16K bytes.

Support Logic

The logic on the card surrounding the LSI modules supports the modules and creates latch buses for the CRT controller, the

processor, and character generator. Two clock sources (14 MHz and 16 MHz) provide the dot rate. The clock is multiplexed under processor I/O control. Four I/O registers also resident on the card are not part of the LSI devices.

Modes of Operation

IBM Color Display

The following table describes the modes supported by BIOS on the IBM Color Display:

MODE #	TYPE	COLORS	ALPHA FORMAT	BUFFER START	BOX SIZE	MAX. PAGES	RESOLUTION
0	A/N	16	40x25	B8000	8x8	8	320x200
1	A/N	16	40x25	B8000	8x8	8	320x200
2	A/N	16	80x25	B8000	8x8	8	640x200
3	A/N	16	80x25	B8000	8x8	8	640x200
4	APA	4	40x25	B8000	8x8	1	320x200
5	APA	4	40x25	B8000	8x8	1	320x200
6	APA	2	80x25	B8000	8x8	1	640x200
D	APA	16	40x25	A0000	8x8	2/4/8	320x200
E	APA	16	80x25	A0000	8x8	1/2/4	640x200

Modes 0 through 6 emulate the support provided by the IBM Color/Graphics monitor Adapter.

Modes 0,2 and 5 are identical to modes 1,3 and 4 respectively at the adapter's direct drive interface.

The Maximum Pages fields for modes D and E indicate the number of pages supported when 64K, 128K or 256K bytes of graphics memory is installed, respectively.

IBM Monochrome Display

The following table describes the modes supported by BIOS on the IBM Monochrome Display.

MODE #	TYPE	COLORS	ALPHA FORMAT	BUFFER START	BOX SIZE	MAX. PAGES	RESOLUTION
7	A/N	4	80x25	B0000	9x14	8	720x350
F	APA	4	80x25	A0000	8x14	1/2	640x350

Mode 7 emulates the support provided by the IBM Monochrome Display Adapter.

IBM Enhanced Color Display

The Enhanced Graphics Adapter supports attachment of the IBM Enhanced Color Display. The IBM Enhanced Color Display is capable of running at the standard television frequency of 15.75 KHz as well as running 21.85 KHz. The table below summarizes the characteristics of the IBM Enhanced Color Display:

Parameter	TV Frequency	High Resolution
Horiz Scan Rate	15.75 KHz.	21.85 KHz.
Vertical Scan Rate	60 Hz.	60 Hz.
Video Bandwidth	14.318 MHz.	16.257 MHz.
Displayable Colors	16 Maximum	16 or 64
Character Size	7 by 7 Pels	7 by 9 Pels
Character Box Size	8 by 8 Pels	8 by 14 Pels
Maximum Resolution	640x200 Pels	640 by 350 Pels
Alphanumeric Modes	0,1,2,3	0,1,2,3
Graphics Modes	4,5,6,D,E	10

In the television frequency mode, the IBM Enhanced Color Display displays information identical in color and resolution to the IBM Color Display.

In the high resolution mode, the adapter provides enhanced alphanumeric character support. This enhanced alphanumeric support consists of transforming the 8 by 8 character box into an 8 by 14 character box, and providing 16 colors out of a palette of

64 possible display colors. Display colors are changed by altering the programming of the color palette registers in the Attribute Controller. In alphanumeric modes, any 16 of 64 colors are displayable. the screen resolution is 320x350 for modes 0 and 1, and 640x350 for modes 2 and 3.

The resolution displayed on the IBM Enhanced Color Display is selected by the switch settings on the Enhanced Graphics Adapter.

The Enhanced Color Display is compatible with all modes listed for the IBM Color Display. the following table describes additional modes supported by BIOS for the IBM Enhanced Color Display:

MODE #	TYPE	COLORS	ALPHA FORMAT	BUFFER START	BOX SIZE	MAX. PAGES	RESOLUTION
0*	A/N	16/64	40x25	B8000	8x14	8	320x350
1*	A/N	16/64	40x25	B8000	8x14	8	320x350
2*	A/N	16/64	80x25	B8000	8x14	8	640x350
3*	A/N	16/64	80x25	B8000	8x14	8	640x350
10*	APA	4/16 16/64	80x25	A0000	8x14	1/2	640x350

* Note that modes 0, 1, 2, and 3, are also listed for IBM Color Display support. BIOS provides enhanced support for these modes when an Enhanced Color Display is attached.

The values in the "COLORS" field indicate 16 colors of a 64 color palette or 4 colors of a sixteen color palette.

In mode 10, The dual values for the "COLORS" field and the "MAX. PAGES" field indicate the support provided when 64K or when greater than 64K of graphics memory is installed, respectively.

Basic Operations

Alphanumeric Modes

The data format for alphanumeric modes on the Enhanced Graphics Adapter is the same as the data format on the IBM Color/Graphics Monitor Adapter and the IBM Monochrome Display Adapter. As an added function, bit three of the attribute byte may be redefined by the Character Map Select register to act as a switch between character sets. This gives the programmer access to 512 characters at one time. This function is valid only when memory has been expanded to 128K bytes or more.

When an alphanumeric mode is selected, the BIOS transfers character patterns from the ROM to bit plane 2. The processor stores the character data in bit plane 0, and the attribute data in bit plane 1. The programmer can view bit planes 0 and 1 as a single buffer in alphanumeric modes. The CRTC generates sequential addresses, and fetches one character code byte and one attribute byte at a time. The character code and row scan count address bit plane 2, which contains the character generators. The appropriate dot patterns are then sent to the palette in the attribute chip, where color is assigned according to the attribute data.

Graphics Modes

320x200 Two and Four Color Graphics (Modes 4 and 5)

Addressing, mapping and data format are the same as the 320x200 pel mode of the Color/Graphics Monitor Adapter. The display buffer is configured at hex B8000. Bit image data is stored in bit planes 0 and 1.

640x200 Two Color Graphics (Mode 6)

Addressing, mapping and data format are the same as the 640x200 pel black and white mode of the Color/Graphics

Monitor Adapter. The display buffer is configured at hex B8000. Bit image data is stored in bit plane 0.

640x350 Monochrome Graphics (Mode F)

This mode supports graphics on the IBM Monochrome Display with the following attributes: black, video, blinking video, and intensified video. Resolution of 640x350 requires 56K bytes to support four attributes. By chaining maps 0 and 1, then maps 2 and 3 together, two 32K bit planes can be formed. This chaining is done only when necessary (less than 128K of graphics memory). The first map is the video bit plane, and the second map is the intensity bit plane. Both planes reside at hex address A0000.

Two bits, one from each bit plane, define one picture element (pel) on the screen. The bit definitions for the pels are given in the following table. The video bit plane is denoted by C0 and the Intensity Bit Plane is denoted by C2.

C2	C0	Pixel Color	Valid Attributes
0	0	Black	0
0	1	Video	3
1	0	Blinking Video	C
1	1	Intensified Video	F

The byte organization in memory is sequential. The first eight pels on the screen are defined by the contents of memory in location A000:0H, the second eight pels by location A000:1H, and so on. The first pel within any one byte is defined by bit 7 in the byte. The last pel within the byte is defined by bit 0 in the byte.

Monochrome graphics works in odd/even mode, which means that even CPU addresses go into even bit planes and odd CPU addresses go into odd bit planes. Since both bit planes reside at address A0000, the user must select which plane or planes he desires to update. This is accomplished by the map mask register of the sequencer. (See the table above for valid attributes).

16/64 Color Graphics Modes (Mode 10)

These modes support graphics in 16 colors on either a medium or high resolution monitor. The memory in these modes consists of using all four bit planes. Each bit plane represents a color as shown below. The bit planes are denoted as C0,C1,C2 and C3 respectively.

C0 = Blue Pels
C1 = Green Pels
C2 = Red Pels
C3 = Intensified Pels

Four bits (one from each plane) define one pel on the screen. The color combinations are illustrated in the following table:

I	R	G	B	Color
0	0	0	0	Black
0	0	0	1	Blue
0	0	1	0	Green
0	0	1	1	Cyan
0	1	0	0	Red
0	1	0	1	Magenta
0	1	1	0	Brown
0	1	1	1	White
1	0	0	0	Dark Gray
1	0	0	1	Light Blue
1	0	1	0	Light Green
1	0	1	1	Light Cyan
1	1	0	0	Light Red
1	1	0	1	Light Magenta
1	1	1	0	Yellow
1	1	1	1	Intensified White

The display buffer resides at address A0000. The map mask register of the sequencer is used to select any or all of the bit planes to be updated when a memory write to the display buffer is executed by the CPU.

Color Mapping

The Enhanced Graphics Adapter supports 640x350 Graphics for both the IBM Monochrome and the IBM Enhanced Color

Displays. Four color capability is supported on the EGA without the Graphics Memory Expansion Card (base 64 KB), and sixteen colors are supported when the Graphics Memory Expansion Card is installed on the adapter (128 KB or above). This section describes the differences in the colors displayed depending upon the graphics memory available. Note that colors 0H, 1H, 4H, and 7H map directly regardless of the graphics memory available.

Character Attribute	Monochrome	Mode 10H 64KB	Mode 10H >64KB
00H*	Black	Black	Black
01H*	Video	Blue	Blue
02H	Black	Black	Green
03H	Video	Blue	Cyan
04H*	Blinking	Red	Red
05H	Intensified	White	Magenta
06H	Blinking	Red	Brown
07H*	Intensified	White	White
08H	Black	Black	Dark Gray
09H	Video	Blue	Light Blue
0AH	Black	Black	Light Green
0BH	Video	Blue	Light Cyan
0CH	Blinking	Red	Light Red
0DH	Intensified	White	Light Magenta
0EH	Blinking	Red	Yellow
0FH	Intensified	White	Intensified White

* Graphics character attributes which map directly regardless of the graphics memory available.

Registers

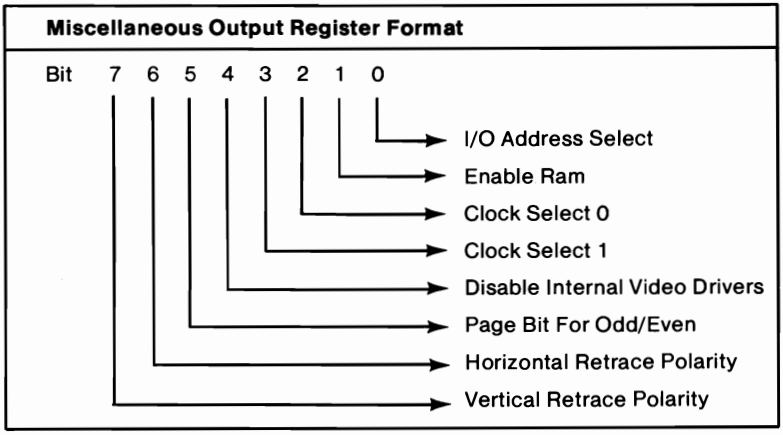
External Registers

This section contains descriptions of the registers of the Enhanced Graphics Adapter that are not contained in an LSI device.

Name	Port	Index
Miscellaneous Output Register	3C2	-
Feature Control Register	3?A	-
Input Status Register 0	3C2	-
Input Status Register 1	3?2	-
? = B in Monochrome Modes	? = D in Color Modes	

Miscellaneous Output Register

This is a write-only register. The processor output port address is hex 3C2. A hardware reset causes all bits to reset to zero.



Bit 0 3BX/3DX CRTC I/O Address—This bit maps the CRTC I/O addresses for IBM Monochrome or Color/Graphics Monitor Adapter emulation. A logical 0 sets CRTC addresses to 3BX and Input Status Register 1 's address to 3BA for Monochrome emulation. A logical 1 sets CRTC

addresses to 3DX and Input Status Register 1's address to 3DA for Color/Graphics Monitor Adapter emulation.

Bit 1 Enable RAM—A logical 0 disables RAM from the processor; a logical 1 enables RAM to respond at addresses designated by the Control Data Select value programmed into the Graphics Controllers.

Bit 2-Bit 3 Clock Select—These two bits select the clock source according to the following table:

Bits 3	2	
0	0	Selects 14 MHz clock from the processor I/O channel
0	1	Selects 16 MHz clock on-board oscillator
1	0	Selects external clock source from the feature connector.
1	1	Not used

Bit 4 Disable Internal Video Drivers—A logical 0 activates internal video drivers; a logical 1 disables internal video drivers. When the internal video drivers are disabled, the source of the direct drive color output becomes the feature connector direct drive outputs.

Bit 5 Page Bit For Odd/Even—Selects between two 64K pages of memory when in the Odd/Even modes (0,1,2,3,7). A logical 0 selects the low page of memory; a logical 1 selects the high page of memory.

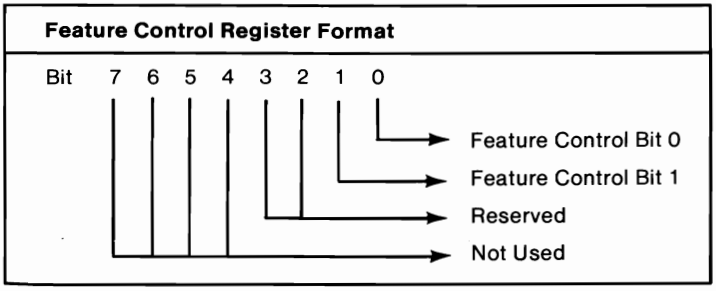
Bit 6 Horizontal Retrace Polarity—A logical 0 selects positive horizontal retrace; a logical 1 selects negative horizontal retrace.

Bit 7 Vertical Retrace Polarity—A logical 0 selects positive vertical retrace; a logical 1 selects

negative vertical retrace. The IBM Monochrome display requires a negative vertical retrace polarity.

Feature Control Register

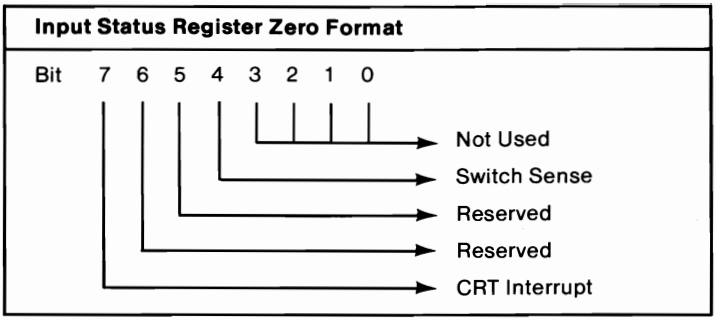
This is a write-only register. The processor output register is hex 3BA or 3DA.



Bits 0 and 1 Feature Control Bits—These bits are used to convey information to the feature connector. The output of these bits goes to the FEAT 0 (pin 19) and FEAT 1 (pin 17) of the feature connector.

Input Status Register Zero

This is a read-only register. The processor input port address is hex 3C2.



Bit 4 Switch Sense—When set to 1, this bit allows the processor to read the four configuration switches on the board. The setting of the CLKSEL field determines which switch is being read. The switch configuration can be determined by reading byte 40:88H in RAM.

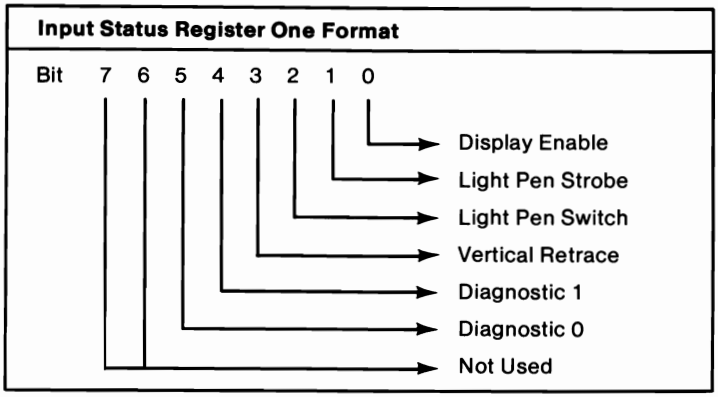
Bit 3: Switch 4 ; Logical 0 = switch closed
Bit 2: Switch 3 ; Logical 0 = switch closed
Bit 1: Switch 2 ; Logical 0 = switch closed
Bit 0: Switch 1 ; Logical 0 = switch closed

Bits 5 and 6 Feature Code—These bits are input from the Feat (0) and Feat (1) pins on the feature connector.

Bit 7 CRT Interrupt—A logical 1 indicates video is being displayed on the CRT screen; a logical 0 indicates that vertical retrace is occurring.

Input Status Register One

This is a read-only register. The processor port address is hex 3BA or hex 3DA.



Bit 0 Display Enable—Logical 0 indicates the CRT raster is in a horizontal or vertical retrace interval. This bit is the real time status of the display enable signal. Some programs use this status bit to restrict screen updates to inactive display intervals. The Enhanced Graphics Adapter does not require the CPU to update the screen buffer during inactive display intervals to avoid glitches in the display image.

Bit 1 Light Pen Strobe—A logical 0 indicates that the light pen trigger has not been set; a logical 1 indicates that the light pen trigger has been set.

Bit 2 Light Pen Switch—A logical 0 indicates that the light pen switch is closed; a logical 1 indicates that the light pen switch is open.

Bit 3 Vertical Retrace—A logical 0 indicates that video information is being displayed on the CRT screen; a logical 1 indicates the CRT is in a vertical retrace interval. This bit can be programmed to interrupt the processor on interrupt level 2 at the start of the vertical retrace. This is done through bits 4 and 5 of the Vertical Retrace End Register of the CRTC.

Bits 4 and 5 Diagnostic Usage—These bits are selectively connected to two of the six color outputs of the

Attribute Controller. The Color Plane Enable register controls the multiplexer for the video wiring. The following table illustrates the combinations available and the color output wiring.

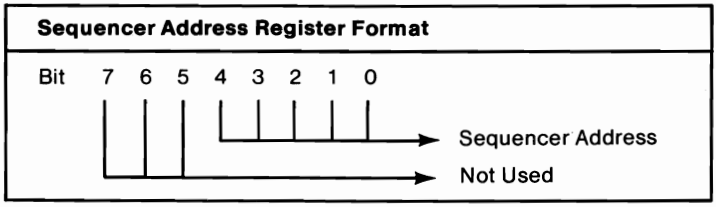
Color Plane Register		Input Status Register One	
Bit 5	**Bit 4**	**Bit 5**	**Bit 4**
0	0	Red	Blue
0	1	Secondary Blue	Green
1	0	Secondary Red	Secondary Green
1	1	Not Used	Not Used

Sequencer Registers

Name	Port	Index
Address	3C4	-
Reset	3C5	00
Clocking Mode	3C5	01
Map Mask	3C5	02
Character Map Select	3C5	03
Memory Mode	3C5	04

Sequencer Address Register

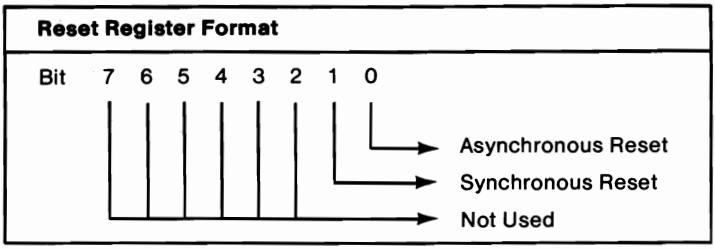
The Address Register is a pointer register located at address hex 3C4. This register is loaded with a binary value that points to the sequencer data register where data is to be written. This value is referred to as "Index" in the table above.



Bit 0-Bit 3 Sequencer Address Bits—A binary value pointing to the register where data is to be written.

Reset Register

This is a write-only register pointed to when the value in the address register is hex 00. The output port address for this register is hex 3C5.

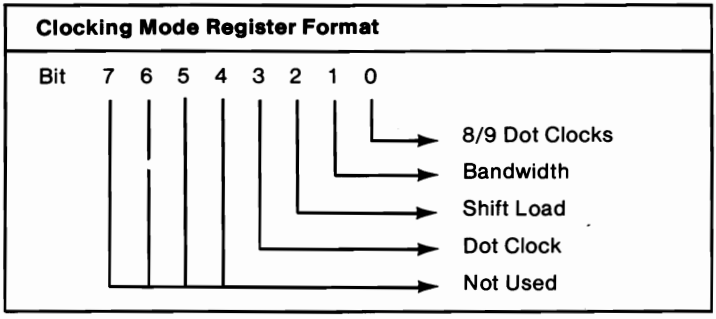


Bit 0 Asynchronous Reset—A logical 0 commands the sequencer to asynchronous clear and halt. All outputs are placed in the high impedance state when this bit is a 0. A logical 1 commands the sequencer to run unless bit 1 is set to zero. Resetting the sequencer with this bit can cause data loss in the dynamic RAMs.

Bit 1 Synchronous Reset—A logical 0 commands the sequencer to synchronous clear and halt. Bits 1 and 0 must both be ones to allow the sequencer to operate. Reset the sequencer with this bit before changing the Clocking Mode Register, if memory contents are to be preserved.

Clocking Mode Register

This is a write-only register pointed to when the value in the address register is hex 01. The output port address for this register is hex 3C5.



Bit 0 8/9 Dot Clocks—A logical 0 directs the sequencer to generate character clocks 9 dots wide; a logical 1 directs the sequencer to generate character clocks 8 dots wide. Monochrome alphanumeric mode (07H) is the only mode that uses character clocks 9 dots wide. All other modes must use 8 dots per character clock.

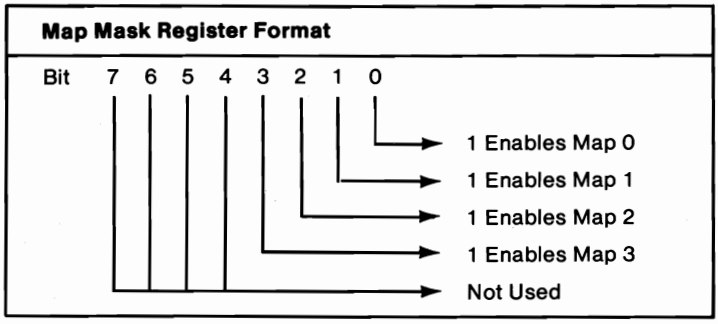
Bit 1 Bandwidth—A logical 0 makes CRT memory cycles occur on 4 out of 5 available memory cycles; a logical 1 makes CRT memory cycles occur on 2 out of 5 available memory cycles. Medium resolution modes require less data to be fetched from the display buffer during the horizontal scan time. This allows the CPU greater access time to the display buffer. All high resolution modes must provide the CRTC with 4 out of 5 memory cycles in order to refresh the display image.

Bit 2 Shift Load—When set to 0, the video serializers are reloaded every character clock; when set to 1, the video serializers are loaded every other character clock. This mode is useful when 16 bits are fetched per cycle and chained together in the shift registers.

Bit 3 Dot Clock—A logical 0 selects normal dot clocks derived from the sequencer master clock input. When this bit is set to 1, the master clock will be divided by 2 to generate the dot clock. All the other timings will be stretched since they are derived from the dot clock. Dot clock divided by two is used for 320x200 modes (0, 1, 4, 5) to provide a pixel rate of 7 MHz, (9 MHz for mode D).

Map Mask Register

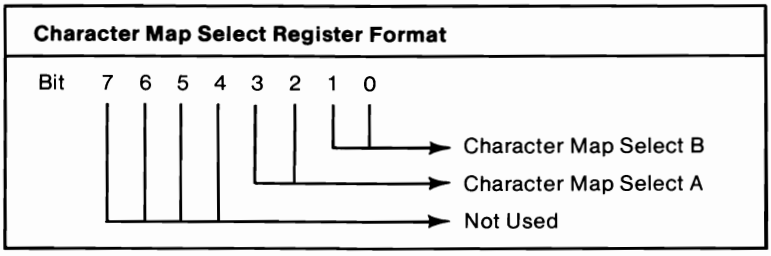
This is a write-only register pointed to when the value in the address register is hex 02. The output port address for this register is hex 3C5.



Bit 0-Bit 3 Map Mask—A logical 1 in bits 3 through 0 enables the processor to write to the corresponding maps 3 through 0. If this register is programmed with a value of 0FH, the CPU can perform a 32-bit write operation with only one memory cycle. This substantially reduces the overhead on the CPU during display update cycles in graphics modes. Data scrolling operations are also enhanced by setting this register to a value of 0FH and writing the display buffer address with the data stored in the CPU data latches. This is a read-modify-write operation. When odd/even modes are selected, maps 0 and 1 and maps 2 and 3 should have the same map mask value.

Character Map Select Register

This is a write-only register pointed to when the value in the address register is hex 03. The output port address for this register is 3C5.



Bit 0-Bit 1 Character Map Select B—Selects the map used to generate alpha characters when attribute bit 3 is a 0, according to the following table:

Bits 1	0	Map Selected	Table Location
Value			
0	0	0	1st 8K of Plane 2 Bank 0
0	1	1	2nd 8K of Plane 2 Bank 1
1	0	2	3rd 8K of Plane 2 Bank 2
1	1	3	4th 8K of Plane 2 Bank 3

Bit 2-Bit 3 Character Map Select A—Selects the map used to generate alpha characters when attribute bit 3 is a 1, according to the following table:

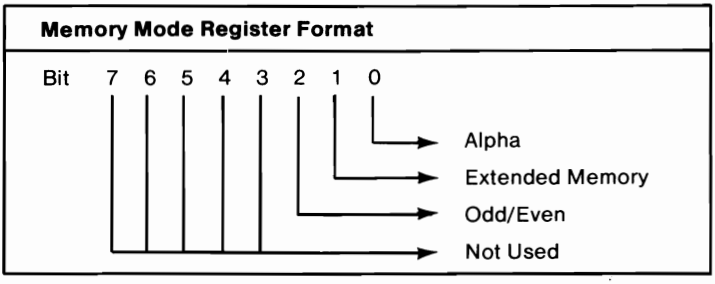
Bits 3	2	Map Selected	Table Location
Value			
0	0	0	1st 8K of Plane 2 Bank 0
0	1	1	2nd 8K of Plane 2 Bank 1
1	0	2	3rd 8K of Plane 2 Bank 2
1	1	3	4th 8K of Plane 2 Bank 3

In alphanumeric modes, bit 3 of the attribute byte normally has the function of turning the foreground intensity on or off. This bit however may be redefined as a switch between character sets. This function is enabled when there is a difference between the value in Character Map Select A and the value in Character Map Select B. Whenever these two values are the same, the character select function is disabled. The memory mode register bit 1 must be a 1 (indicates the memory extension card is installed in the unit) to enable this function; otherwise, bank 0 is always selected.

128K of graphics memory is required to support two character sets. 256K supports four character sets. Asynchronous reset clears this register to 0. This should be done only when the sequencer is reset.

Memory Mode Register

This is a write-only register pointed to when the value in the address register is hex 04. The processor output port address for this register is 3C5.



Bit 0 Alpha—A logical 0 indicates that a non-alpha mode is active. A logical 1 indicates that alpha mode is active and enables the character generator map select function.

Bit 1 Extended Memory—A logical 0 indicates that the memory expansion card is not installed. A logical 1 indicates that the memory expansion card is installed and enables access to the extended memory through address bits 14 and 15.

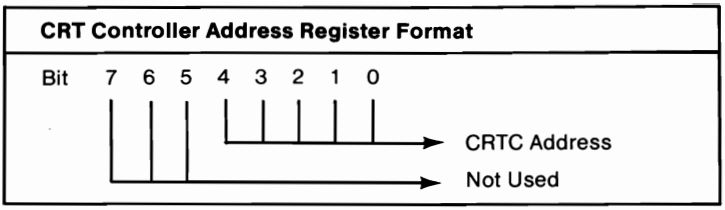
Bit 2 Odd/Even—A logical 0 directs even processor addresses to access maps 0 and 2, while odd processor addresses access maps 1 and 3. A logical 1 causes processor addresses to sequentially access data within a bit map. The maps are accessed according to the value in the map mask register.

CRT Controller Registers

Name	Port	Index
Address Register	3?4	-
Horizontal Total	3?5	00
Horizontal Display End	3?5	01
Start Horizontal Blank	3?5	02
End Horizontal Blank	3?5	03
Start Horizontal Retrace	3?5	04
End Horizontal Retrace	3?5	05
Vertical Total	3?5	06
Overflow	3?5	07
Preset Row Scan	3?5	08
Max Scan Line	3?5	09
Cursor Start	3?5	0A
Cursor End	3?5	0B
Start Address High	3?5	0C
Start Address Low	3?5	0D
Cursor Location High	3?5	0E
Cursor Location Low	3?5	0F
Vertical Retrace Start	3?5	10
Light Pen High	3?5	10
Vertical Retrace End	3?5	11
Light Pen Low	3?5	11
Vertical Display End	3?5	12
Offset	3?5	13
Underline Location	3?5	14
Start Vertical Blank	3?5	15
End Vertical Blank	3?5	16
Mode Control	3?5	17
Line Compare	3?5	18
? = B in Monochrome Modes and D in Color Modes		

CRT Controller Address Register

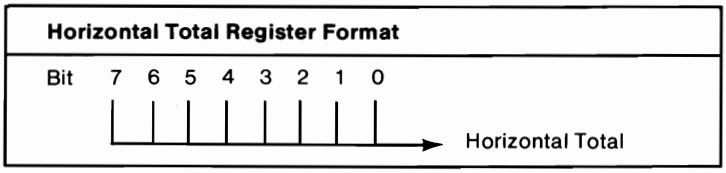
The Address register is a pointer register located at hex 3B4 or hex 3D4. If an IBM Monochrome Display is attached to the adapter, address 3B4 is used. If a color display is attached to the adapter, address 3D4 is used. This register is loaded with a binary value that points to the CRT Controller data register where data is to be written. This value is referred to as "Index" in the table above.



Bit 0-Bit 4 CRT Controller Address Bits—A binary value pointing to the CRT Controller register where data is to be written.

Horizontal Total Register

This is a write-only register pointed to when the value in the CRT Controller address register is hex 00. The processor output port address for this register is hex 3B5 or hex 3D5.

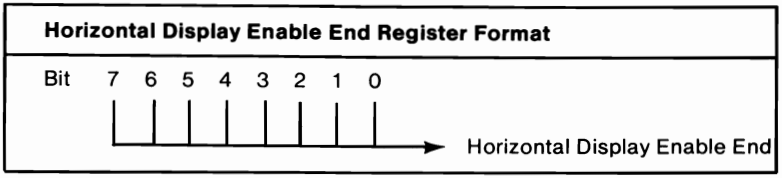


This register defines the total number of characters in the horizontal scan interval including the retrace time. The value directly controls the period of the horizontal retrace output signal. An internal horizontal character counter counts character clock inputs to the CRT Controller, and all horizontal and vertical timings are based upon the horizontal register. Comparators are used to compare register values with horizontal character values to provide horizontal timings.

Bit 0-Bit 7 Horizontal Total—The total number of characters less 2.

Horizontal Display Enable End Register

This is a write-only register pointed to when the value in the CRT Controller address register is hex 01. The processor output port address for this register is hex 3B5 or hex 3D5.

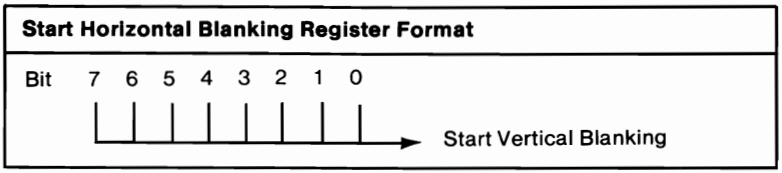


This register defines the length of the horizontal display enable signal. It determines the number of displayed character positions per horizontal line.

Bit 0-Bit 7 Horizontal display enable end —A value one less than the total number of displayed characters.

Start Horizontal Blanking Register

This is a write-only register pointed to when the value in the CRT Controller address register is hex 02. The processor output port address for this register is hex 3B5 or hex 3D5.

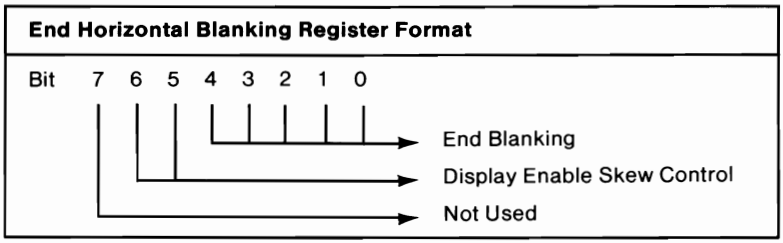


This register determines when the horizontal blanking output signal becomes active. The row scan address and underline scan line decode outputs are multiplexed on the memory address outputs and cursor outputs respectively during the blanking interval. These outputs are latched external to the CRT Controller with the falling edge of the BLANK output signal. The row scan address and underline signals remain on the output signals for one character count beyond the end of the blanking signal.

Bit 0-Bit 7 Start Horizontal Blanking—The horizontal blanking signal becomes active when the horizontal character counter reaches this value.

End Horizontal Blanking Register

This is a write-only register pointed to when the value in the CRT Controller address register is hex 03. The processor output port address for this register is hex 3B5 or hex 3D5.



This register determines when the horizontal blanking output signal becomes inactive. The row scan address and underline scan line decode outputs are multiplexed on the memory address outputs and the cursor outputs respectively during the blanking interval. These outputs are latched external to the CRT Controller with the falling edge of the BLANK output signal. The row scan address and underline signals remain on the output signals for one character count beyond the end of the blanking signal.

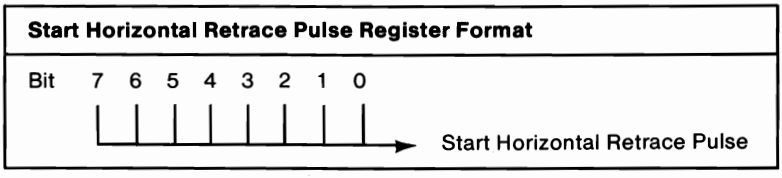
Bit 0-Bit 4 End Horizontal Blanking—A value equal to the five least significant bits of the horizontal character counter value at which time the horizontal blanking signal becomes inactive (logical 0). To obtain a blanking signal of width W, the following algorithm is used: Value of Start Blanking Register + Width of Blanking signal in character clock units = 5-bit result to be programmed into the End Horizontal Blanking Register.

Bit 5-Bit 6 Display Enable Skew Control—These two bits determine the amount of display enable skew. Display enable skew control is required to provide sufficient time for the CRT Controller to access the display buffer to obtain a character and attribute code, access the character generator font, and then go through the Horizontal Pel Panning Register in the Attribute Controller. Each access requires the display enable signal to be skewed one character clock unit so that the video output is in synchronization with the horizontal and vertical retrace signals. The bit values and amount of skew are shown in the following table:

Bits 6 5	
0 0	Zero character clock skew
0 1	One character clock skew
1 0	Two character clock skew
1 1	Three character clock skew

Start Horizontal Retrace Pulse Register

This is a write-only register pointed to when the value in the CRT Controller address register is hex 04. The processor output port address for this register is hex 3B5 or hex 3D5.

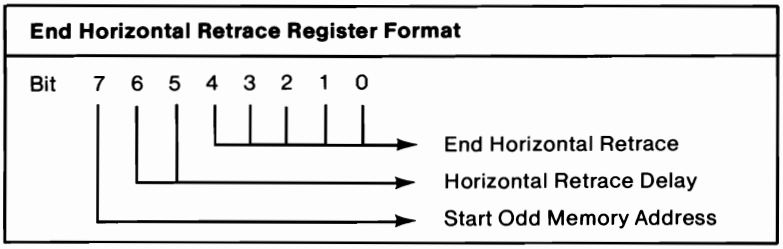


This register is used to center the screen horizontally, and to specify the character position at which the Horizontal Retrace Pulse becomes active.

Bit 0-Bit 7 Start Horizontal Retrace Pulse—The value programmed is a binary count of the character position number at which the signal becomes active.

End Horizontal Retrace Register

This is a write-only register pointed to when the value in the CRT Controller address register is hex 05. The processor output port address for this register is hex 3B5 or hex 3D5.



This register specifies the character position at which the Horizontal Retrace Pulse becomes inactive (logical 0).

Bit 0-Bit 4 End Horizontal Retrace—A value equal to the five least significant bits of the horizontal character counter value at which time the horizontal retrace signal becomes inactive (logical 0). To obtain a retrace signal of width W, the following algorithm is used: Value of Start Retrace Register + width of horizontal retrace signal in character clock units = 5-bit result to be programmed into the End Horizontal Retrace Register.

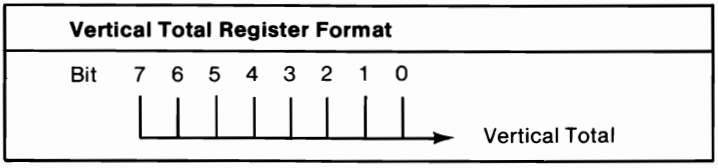
Bit 5-Bit 6 Horizontal Retrace Delay—These bits control the skew of the horizontal retrace signal. Binary 00 equals no Horizontal Retrace Delay. For some modes, it is necessary to provide a horizontal retrace signal that takes up the entire blanking interval. Some internal timings are generated by the falling edge of the horizontal retrace signal. To guarantee the signals are

latched properly, the retrace signal is started before the end of the display enable signal, and then skewed several character clock times to provide the proper screen centering.

Bit 7 Start Odd/Even Memory Address—This bit controls whether the first CRT memory address output after a horizontal retrace begins with an even or an odd address. A logical 0 selects even addresses; a logical 1 selects odd addresses. This bit is used for horizontal pel panning applications. Generally, this bit should be set to a logical 0.

Vertical Total Register

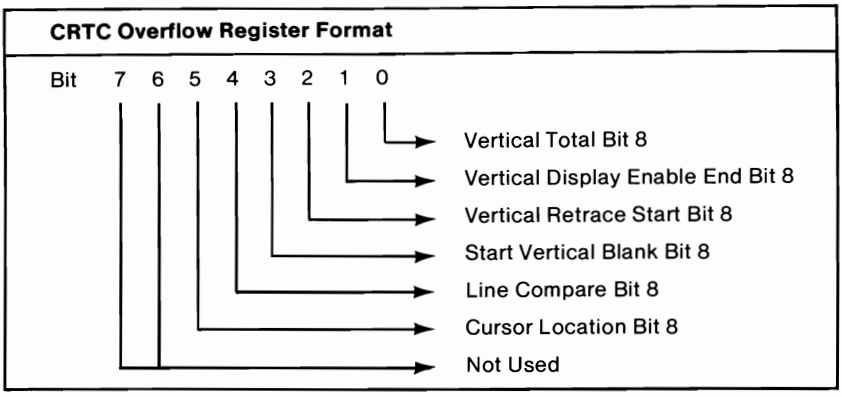
This is a write-only register pointed to when the value in the CRT Controller address register is hex 06. The processor output port address for this register is hex 3B5 or 3D5.



Bit 0-Bit 7 Vertical Total—This is the low-order eight bits of a nine-bit register. The binary value represents the number of horizontal raster scans on the CRT screen, including vertical retrace. The value in this register determines the period of the vertical retrace signal. Bit 8 of this register is contained in the CRT Controller Overflow Register hex 07 bit 0.

CRT Controller Overflow Register

This is a write-only register pointed to when the value in the CRT Controller Address Register is hex 07. The processor output port address for this register is hex 3B5 or hex 3D5.



Bit 0 Vertical Total—Bit 8 of the Vertical Total register (index hex 06).

Bit 1 Vertical Display Enable End—Bit 8 of the Vertical Display Enable End register (index hex 12).

Bit 2 Vertical Retrace Start—Bit 8 of the Vertical Retrace Start register (index hex 10).

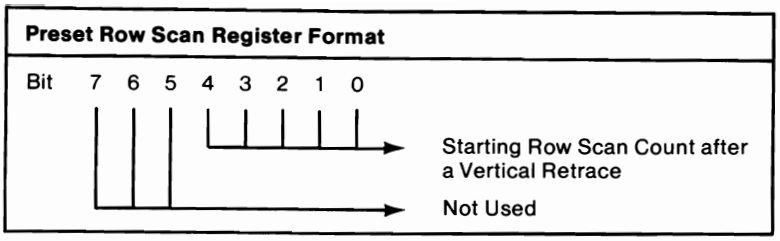
Bit 3 Start Vertical Blank—Bit 8 of the Start Vertical Blank register (index hex 15).

Bit 4 Line Compare—Bit 8 of the Line Compare register (index hex 18).

Bit 5 Cursor Location—Bit 8 of the Cursor Location register (index hex 0A).

Preset Row Scan Register

This is a write-only register pointed to when the value in the CRT Controller address register is hex 08. The processor output port address for this register is hex 3B5 or hex 3D5.

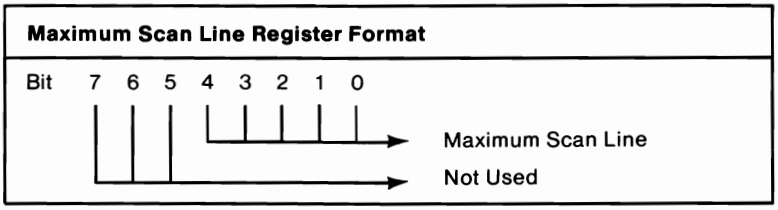


This register is used for pel scrolling.

Bit 0-Bit 4 Preset Row Scan (Pel Scrolling)—This register specifies the starting row scan count after a vertical retrace. The row scan counter increments each horizontal retrace time until a maximum row scan occurs. At maximum row scan compare time the row scan is cleared (not preset).

Maximum Scan Line Register

This is a write-only register pointed to when the value in the CRT Controller address register is hex 09. The processor output port address for this register is hex 3B5 or hex 3D5.

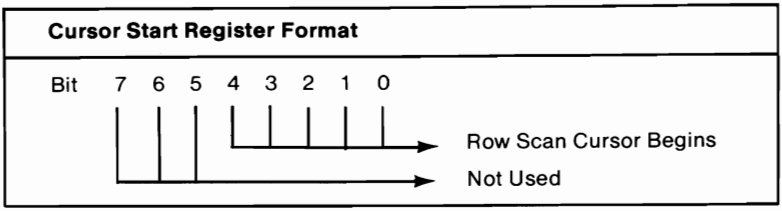


Bit 0-Bit 4 Maximum Scan Line—This register specifies the number of scan lines per character row. The number to be programmed is the maximum row scan number minus one.

Cursor Start Register

This is a write-only register pointed to when the value in the CRT Controller address register is hex 0A. The processor output port

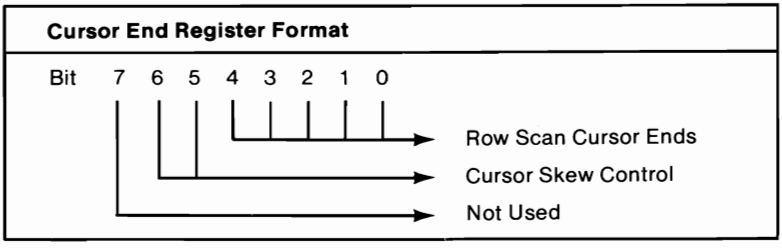
address for this register is hex 3B5 or hex 3D5.



Bit 0-Bit 4 Cursor Start—This register specifies the row scan of a character line where the cursor is to begin. The number programmed should be one less than the starting cursor row scan.

Cursor End Register

This is a write-only register pointed to when the value in the CRT Controller address register is hex 0B. The processor output port address for this register is hex 3B5 or hex 3D5.



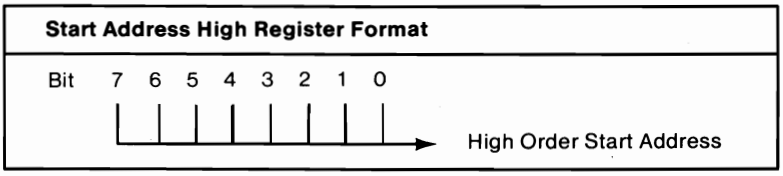
Bit 0-Bit 4 Cursor End—These bits specify the row scan where the cursor is to end.

Bit 5-Bit 6 Cursor Skew—These bits control the skew of the cursor signal.

Bits 6 5	
0 0	Zero character clock skew
0 1	One character clock skew
1 0	Two character clock skew
1 1	Three character clock skew

Start Address High Register

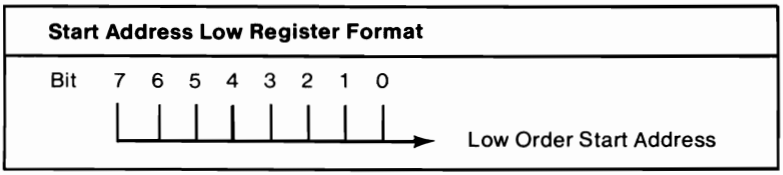
This is a read/write register pointed to when the value in the CRT Controller address register is hex 0C. The processor input/output port address for this register is hex 3B5 or hex 3D5.



Bit 0-Bit 7 Start Address High—These are the high-order eight bits of the start address. The 16-bit value, from the high-order and low-order start address registers, is the first address after the vertical retrace on each screen refresh.

Start Address Low Register

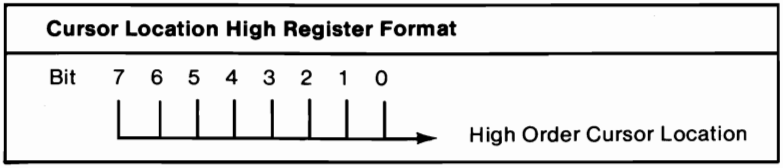
This is a read/write register pointed to when the value in the CRT Controller address register is hex 0D. The processor input/output port address for this register is hex 3B5 or hex 3D5.



Bit 0-Bit 7 Start Address Low—These are the low-order 8 bits of the start address.

Cursor Location High Register

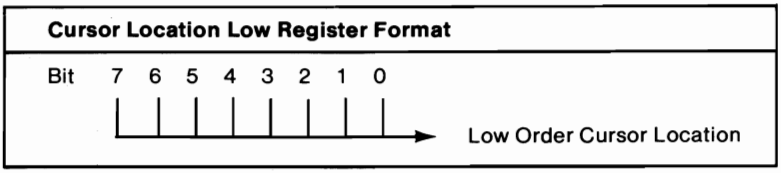
This is a read/write register pointed to when the value in the CRT Controller address register is hex 0E. The processor input/output port address for this register is hex 3B5 or hex 3D5.



Bit 0-Bit 7 Cursor Location High—These are the high-order 8 bits of the cursor location.

Cursor Location Low Register

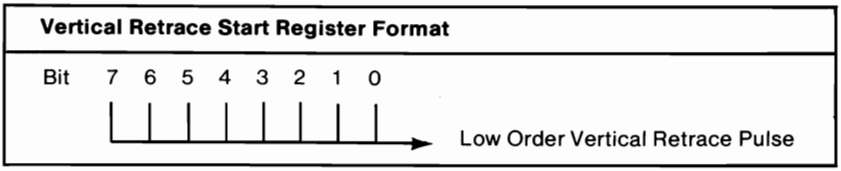
This is a read/write register pointed to when the value in the CRT Controller address register is hex 0F. The processor input/output port address for this register is hex 3B5 or Hex 3D5.



Bit 0-Bit 7 Cursor Location Low— These are the low-order 8 bits of the cursor location.

Vertical Retrace Start Register

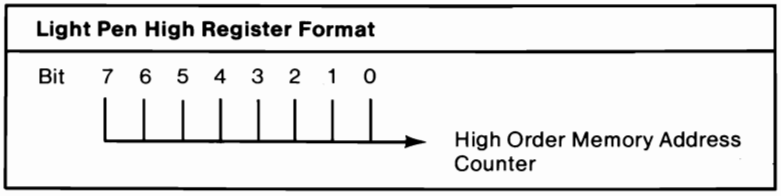
This is a write-only register pointed to when the value in the CRT Controller address register is hex 10. The processor output port address for this register is hex 3B5 or hex 3D5.



Bit 0-Bit 7 Vertical Retrace Start—This is the low-order 8 bits of the vertical retrace pulse start position programmed in horizontal scan lines. Bit 8 is in the overflow register location hex 07.

Light Pen High Register

This is a read-only register pointed to when the value in the CRT Controller address register is hex 10. The processor input port address for this register is hex 3B5 or hex 3D5.

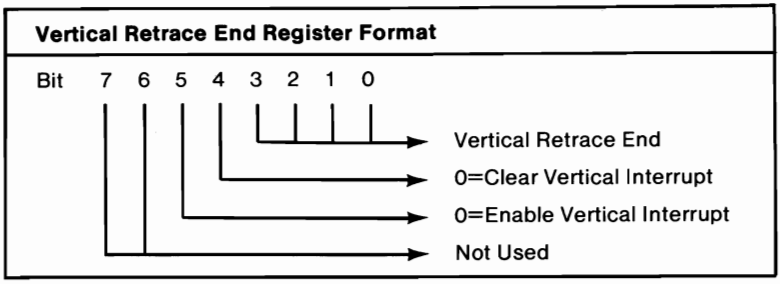


Bit 0-Bit 7 Light Pen High—This is the high order 8 bits of the memory address counter at the time the light pen was triggered.

Vertical Retrace End Register

This is a write-only register pointed to when the value in the CRT Controller address register is hex 11. The processor output port

address for this register is hex 3B5 or hex 3D5.



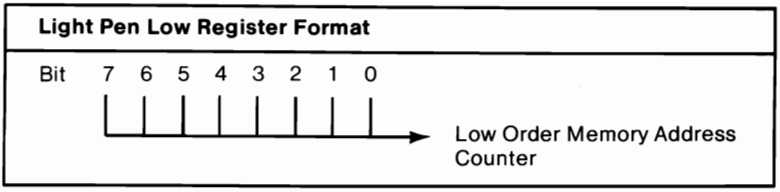
Bit 0-Bit 3 Vertical Retrace End—These bits determine the horizontal scan count value when the vertical retrace output signal becomes inactive. The register is programmed in units of horizontal scan lines. To obtain a vertical retrace signal of width W, the following algorithm is used: Value of Start Vertical Retrace Register + width of vertical retrace signal in horizontal scan units = 4-bit result to be programmed into the End Horizontal Retrace Register.

Bit 4 Clear Vertical Interrupt—A logical 0 will clear a vertical interrupt.

Bit 5 Enable Vertical Interrupt—A logical 0 will enable vertical interrupt.

Light Pen Low Register

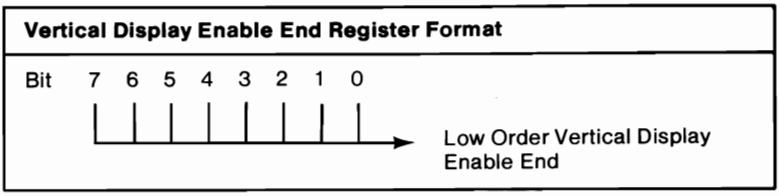
This is a read-only register pointed to when the value in the CRT Controller address register is hex 11. The processor input port address for this register is hex 3B5 or 3D5.



Bit 0-Bit 7 Light Pen Low—This is is the low-order 8 bits of the memory address counter at the time the light pen was triggered.

Vertical Display Enable End Register

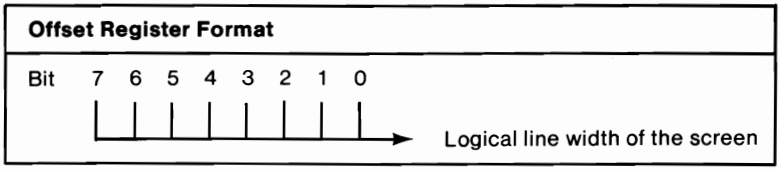
This is a write-only register pointed to when the value in the CRT Controller address register is hex 12. The processor output port address for this register is hex 3B5 or hex 3D5.



Bit 0-Bit 7 Vertical Display Enable End—These are the low-order 8 bits of the vertical display enable end position. This address specifies which scan line ends the active video area of the screen. Bit 8 is in the overflow register location hex 07.

Offset Register

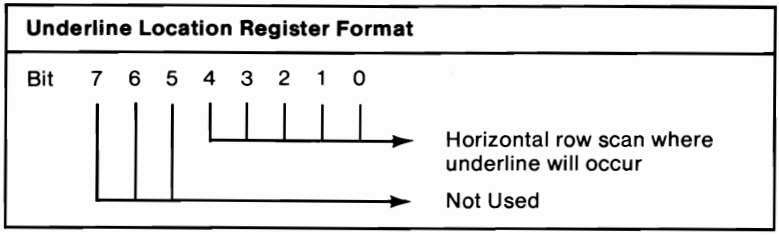
This is a write-only register pointed to when the value in the CRT Controller address register is hex 13. The processor output port address for this register is hex 3B5 or hex 3D5.



Bit 0-Bit 7 Offset—This register specifies the logical line width of the screen. The starting memory address for the next character row is larger than the current character row by this amount. The Offset Register is programmed with a word address. Depending upon the method of clocking the CRT Controller, this word address is either a word or double word address.

Underline Location Register

This is a write-only register pointed to when the value in the CRT Controller address register is hex 14. The processor output port address for this register is hex 3B5 or hex 3D5.

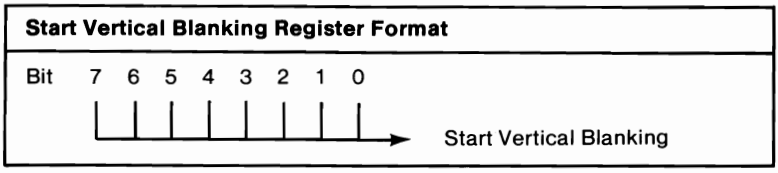


Bit 0-Bit 4 Underline Location—This register specifies the horizontal row scan on which underline will occur. The value programmed is one less than the scan line number desired.

Start Vertical Blanking Register

This is a write-only register pointed to when the value in the CRT Controller address register is hex 15. The processor output port

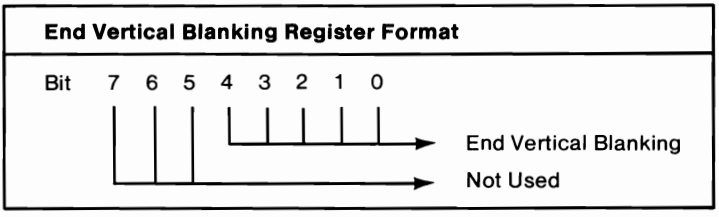
address for this register is hex 3B5 or hex 3D5.



Bit 0-Bit 7 Start Vertical Blank—These are the low 8 bits of the horizontal scan line count, at which the vertical blanking signal becomes active. Bit 8 bit is in the overflow register hex 07.

End Vertical Blanking Register

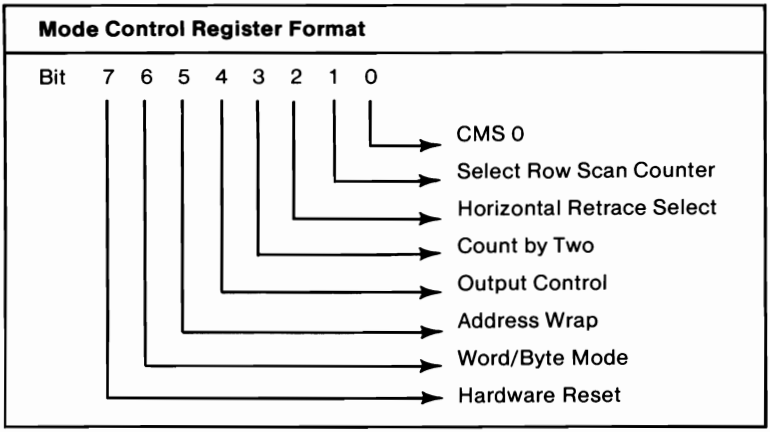
This is a write-only register pointed to when the value in the CRT Controller address register is hex 16. The processor output port address for this register is hex 3B5 or hex 3D5.



Bit 0-Bit 4 End Vertical Blank—This register specifies the horizontal scan count value when the vertical blank output signal becomes inactive. The register is programmed in units of horizontal scan lines. To obtain a vertical blank signal of width W, the following algorithm is used: Value of Start Vertical Blank Register + width of vertical blank signal in horizontal scan units = 5-bit result to be programmed into the End Vertical Blank Register.

Mode Control Register

This is a write-only register pointed to when the value in the CRT Controller address register is hex 17. The processor output port address for this register is hex 3B5 or hex 3D5.



Bit 0 Compatibility Mode Support— When this bit is a logical 0, the row scan address bit 0 is substituted for memory address bit 13 during active display time. A logical 1 enables memory address bit 13 to appear on the memory address output bit 13 signal of the CRT Controller. The CRT Controller used on the IBM Color/Graphics Monitor Adapter is the 6845. The 6845 has 128 horizontal scan line address capability. To obtain 640 by 200 graphics resolution, the CRTC was programmed for 100 horizontal scan lines with 2 row scan addresses per character row. Row scan address bit 0 became the most significant address bit to the display buffer. Successive scan lines of the display image were displaced in memory by 8K bytes. This bit allows compatibility with the 6845 and Color Graphics APA modes of operation.

Bit 1 Select Row Scan Counter—A logical 0 selects row scan counter bit 1 on MA 14 output pin. A logical 1 selects MA 14 counter bit on MA 14 output pin.

Bit 2 Horizontal Retrace Select—This bit selects Horizontal Retrace or Horizontal Retrace divided by 2 as the clock that controls the vertical timing counter. This bit can be used to effectively double the vertical resolution capability of the CRT Controller. The vertical counter has a maximum resolution of 512 scan lines due to the 9-bit wide Vertical Total Register. If the vertical counter is clocked with the horizontal retrace divided by 2 clock, then the vertical resolution is doubled to 1024 horizontal scan lines. A logical 0 selects HRTC and a logical 1 selects HRTC divided by 2.

Bit 3 Count By Two— When this bit is set to 0, the memory address counter is clocked with the character clock input. A logical 1 clocks the memory address counter with the character clock input divided by 2. This bit is used to create either a byte or word refresh address for the display buffer.

Bit 4 Output Control—A logical 0 enables the module output drivers. A logical 1 forces all outputs into high impedance state.

Bit 5 Address Wrap—This bit selects Memory Address counter bit MA 13 or bit MA 15, and it appears on the MA 0 output pin in the word address mode. If you are not in the word address mode, MA 0 counter output appears on the MA 0 output pin. A logical 1 selects MA 15. In odd/even mode, bit MA 13 should be selected when the 64K memory is installed on the board. Bit MA 15 should be selected when greater then 64K memory is installed. This function is used to implement Color Graphics Monitor Adapter compatibility.

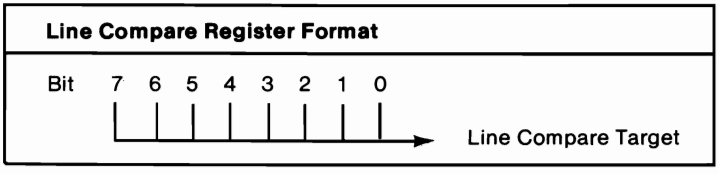
Bit 6 Word Mode or Byte Mode—When this bit is a logical 0, the Word Mode shifts all memory address counter bits down one bit, and the most significant bit of the counter appears on the least significant bit of the memory address outputs. See table below for address output details. A logical 1 selects the Byte Address mode.

	Internal Memory Address Counter Wiring to the Output Multiplexer	
CRTC Out Pin	**Byte Address Mode**	**Word Address Mode**
MA 0/RFA 0	MA 0	MA 15 or MA 13
MA 1/RFA 1	MA 1	MA 0
MA 2/RFA 2	MA 2	MA 1
MA 3/RFA 3	MA 3	MA 2
*	*	*
*	*	*
*	*	*
MA 14/RS 3	MA 14	MA 13
MA 15/RS 4	MA 15	MA 14

Bit 7 Hardware Reset—A logical 0 forces horizontal and vertical retrace to clear. A logical 1 forces horizontal and vertical retrace to be enabled.

Line Compare Register

This is a write-only register pointed to when the value in the CRT Controller address register is hex 18. The processor output port address for this register is hex 3B5 or hex 3D5.



Bit 0-Bit 7 Line Compare—This register is the low-order 8 bits of the compare target. When the vertical

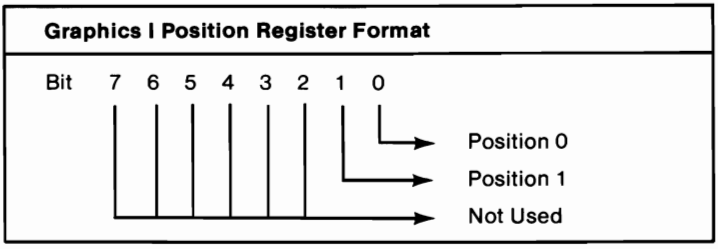
counter reaches this value, the internal start of the line counter is cleared. This allows an area of the screen to be immune to scrolling. Bit 8 of this register is in the overflow register hex 07.

Graphics Controller Registers

Name	Port	Index
Graphics 1 Position	3CC	-
Graphics 2 Position	3CA	-
Graphics 1 & 2 Address	3CE	-
Set/Reset	3CF	00
Enable Set/Reset	3CF	01
Color Compare	3CF	02
Data Rotate	3CF	03
Read Map Select	3CF	04
Mode Register	3CF	05
Miscellaneous	3CF	06
Color Don't Care	3CF	07
Bit Mask	3CF	08

Graphics 1 Position Register

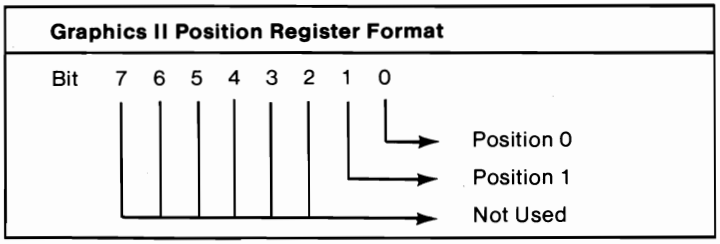
This is a write-only register. The processor output port address for this register is hex 3CC.



Bit 0-Bit 1 Position—These 2 bits are binary encoded hierarchy bits for the graphics chips. The position register controls which 2 bits of the processor data bus each chip responds to. Graphics 1 must be programmed with a position register value of 0 for this card.

Graphics 2 Position Register

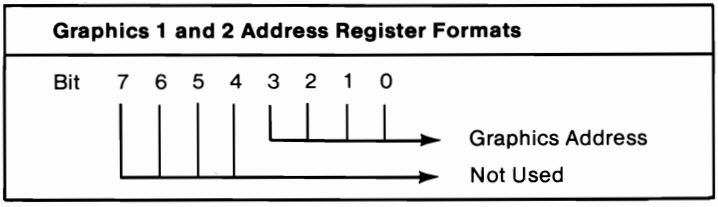
This is a write-only register. The processor output port address for this register is hex 3CA.



Bit 0-Bit 1 Position—These 2 bits are binary encoded hierarchy bits for the graphics chips. The position register controls which 2 bits of the processor data bus to which each chip responds. Graphics 2 must be programmed with a position register value of 1 for this card.

Graphics 1 and 2 Address Register

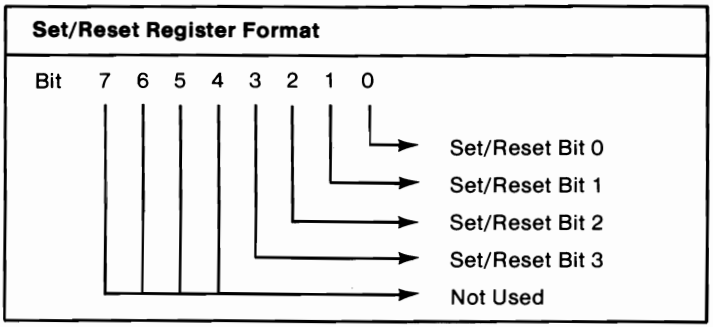
This is a write-only register and the processor output port address for this register is hex 3CE.



Bit 0-Bit 3 Graphics 1 and 2 Address Bits—This output loads the address register in both graphics chips simultaneously. This register points to the data register of the graphics chips.

Set/Reset Register

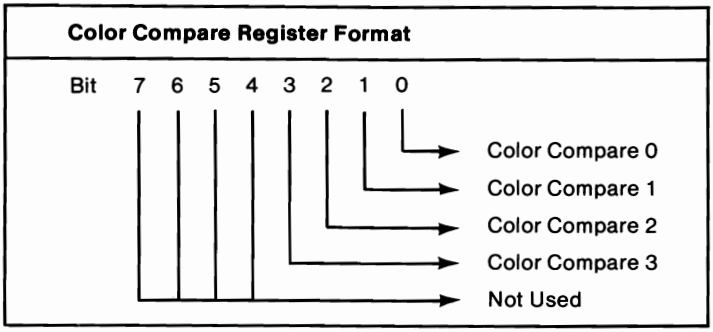
This is a write-only register pointed to by the value in the Graphics 1 and 2 address register. This value must be hex 00 before writing can take place. The processor output port address for this register is hex 3CF.



Bit 0-Bit 3 Set/Reset—These bits represent the value written to the respective memory planes when the processor does a memory write with write mode 0 selected and set/reset mode is enabled. Set/Reset can be enabled on a plane by plane basis with separate OUT commands to the Set/Reset register.

Enable Set/Reset Register

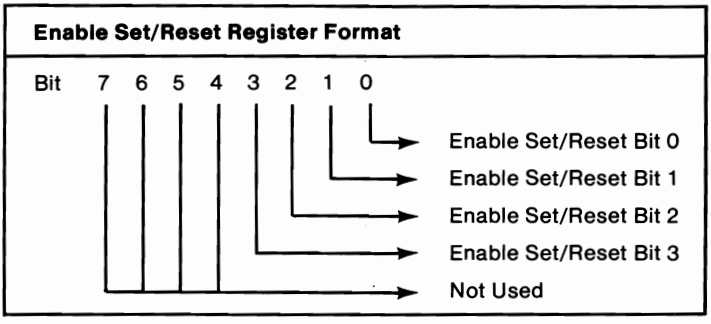
This is a write-only register and is pointed to by the value in the Graphics 1 and 2 address register. This value must be hex 01 before writing can take place. The processor output port for this register is hex 3CF.



Bit 0-Bit 3 Enable Set/Reset—These bits enable the set/reset function. The respective memory plane is written with the value of the Set/Reset register provided the write mode is 0. When write mode is 0 and Set/Reset is not enabled on a plane, that plane is written with the value of the processor data.

Color Compare Register

This is a write-only register pointed to by the value in the Graphics 1 and 2 address register. This value must be hex 02 before writing can take place. The processor output port address for this register is hex 3CF.

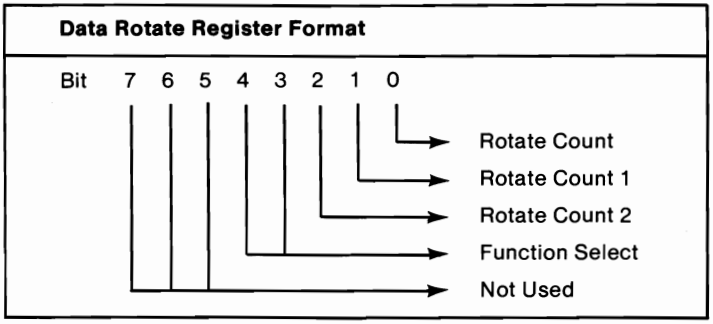


Bit 0-Bit 3 Color Compare—These bits represent a 4 bit color value to be compared. If the processor sets

read mode 1 on the graphics chips, and does a memory read, the data returned from the memory cycle will be a 1 in each bit position where the 4 bit planes equal the color compare register.

Data Rotate Register

This is a write-only register pointed to by the value in the Graphics 1 and 2 address register. This value must be hex 03 before writing can take place. The processor output port address for this register is hex 3CF.



Bit 0-Bit 2 Rotate Count—These bits represent a binary encoded value of the number of positions to rotate the processor data bus during processor memory writes. This operation is done when the write mode is 0. To write unrotated data the processor must select a count of 0.

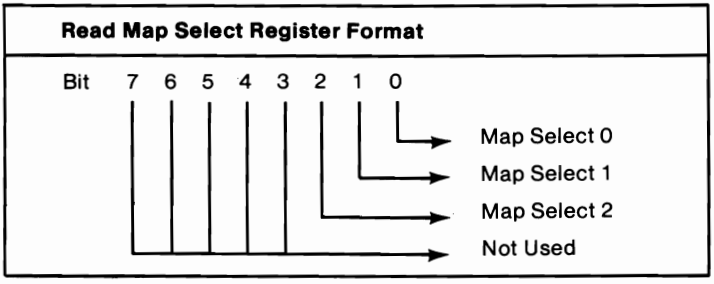
Bit 3-Bit 4 Function Select—Data written to memory can operate logically with data already in the processor latches. The bit functions are defined in the following table.

Bits 4 3	
0 0	Data unmodified.
0 1	Data AND'ed with latched data.
1 0	Data OR'ed with latched data.
1 1	Data XOR'ed with latched data.

Data may be any of the choices selected by the Write Mode Register except processor latches. If rotated data is selected, the rotate applies before the logical function.

Read Map Select Register

This is a write-only register pointed to by the value in the Graphics 1 and 2 address register. This value must be hex 04 before writing can take place. The processor output port address for this register is hex 3CF.

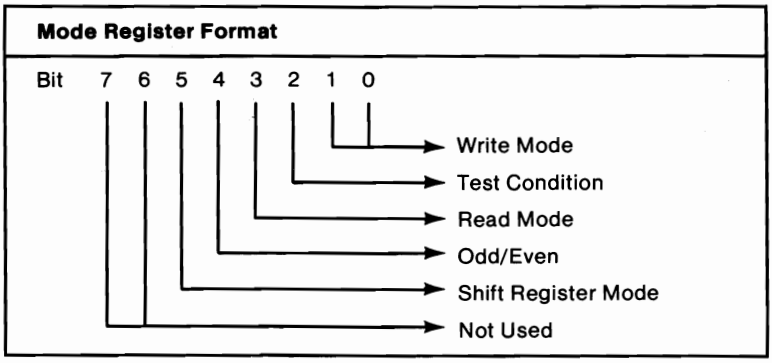


Bit 0-Bit 2 Map Select—These bits represent a binary encoded value of the memory plane number from which the processor reads data. This register has no effect on the color compare read mode described elsewhere in this section.

Mode Register

This is a write-only register pointed to by the value in the Graphics 1 and 2 address register. This value must be hex 05

before writing can take place. The processor output port address for this register is 3CF.



Bit 0–Bit 1 Write Mode

Bits 1 0	
0 0	Each memory plane is written with the processor data rotated by the number of counts in the rotate register, unless Set/Reset is enabled for the plane. Planes for which Set/Reset is enabled are written with 8 bits of the value contained in the Set/Reset register for that plane.
0 1	Each memory plane is written with the contents of the processor latches. These latches are loaded by a processor read operation.
1 0	Memory plane *n* (0 through 3) is filled with 8 bits of the value of data bit *n*.
1 1	Not Valid

The logic function specified by the function select register also applies.

Bit 2 Test Condition—A logical 1 directs graphics controller outputs to be placed in high impedance state for testing.

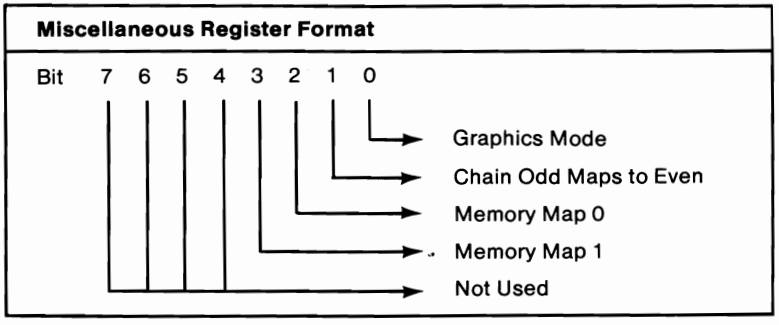
Bit 3 Read Mode—When this bit is a logical 0, the processor reads data from the memory plane selected by the read map select register. When this bit is a logical 1, the processor reads the results of the comparison of the 4 memory planes and the color compare register.

Bit 4 Odd/Even—A logical 1 selects the odd/even addressing mode, which is useful for emulation of the Color Graphics Monitor Adapter compatible modes. Normally the value here follows the value of the Memory Mode Register bit 3 of the Sequencer.

Bit 5 Shift Register—A logical 1 directs the shift registers on each graphics chip to format the serial data stream with even numbered bits on the even numbered maps and odd numbered bits on the odd maps.

Miscellaneous Register

This is a write-only register pointed to by the value in the Graphics 1 and 2 address register. This value must be hex 06 before writing can take place. The processor output port for this register is hex 3CF.



Bit 0 Graphics Mode—This bit controls alpha-mode addressing. A logical 1 selects graphics mode. When set to graphics mode, the character generator address latches are disabled.

Bit 1 Chain Odd Maps To Even Maps—When set to 1, this bit directs the processor address bit 0 to be replaced by a higher order bit and odd/even maps to be selected with odd/even values of the processor A0 bit, respectively.

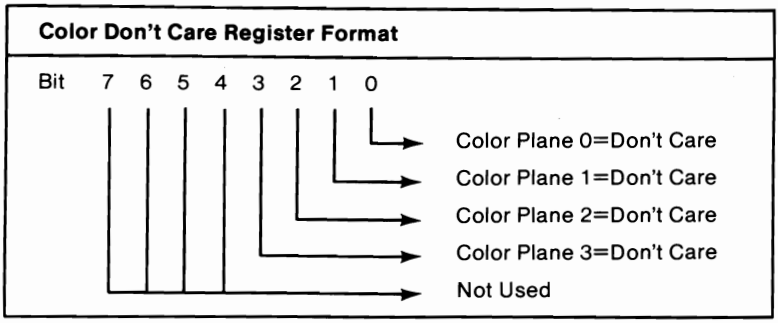
Bit 2-Bit 3 Memory Map—These bits control the mapping of the regenerative buffer into the processor address space.

Bits 3 2	
0 0	Hex A000 for 128K bytes.
0 1	Hex A000 for 64K bytes.
1 0	Hex B000 for 32K bytes
1 1	Hex B800 for 32K bytes.

If the display adapter is mapped at address hex A000 for 128K bytes, no other adapter can be installed in the system.

Color Don't Care Register

This is a write-only register and is pointed to by the value in the Graphics 1 and 2 address register. This value must be hex 07 before writing can take place. The processor output port for this register is hex 3CF.



Bit 0 Color Don't Care—Color plane 0=don't care when reading color compare when this bit is set to 1.

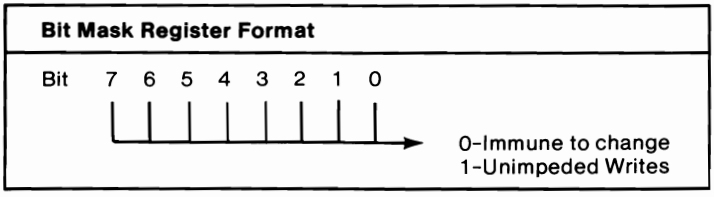
Bit 1 Color Don't Care—Color plane 1=don't care when reading color compare when this bit is set to 1.

Bit 2 Color Don't Care—Color plane 2=don't care when reading color compare when this bit is set to 1.

Bit 3 Color Don't Care—Color plane 3=don't care when reading color compare when this bit is set to 1.

Bit Mask Register

This is a write-only register and is pointed to by the value in the Graphics 1 and 2 address register. This value must be hex 08 before writing can take place. The processor output port for this register is hex 3CF.



Bit 0-Bit 7 Bit Mask—Any bit programmed to *n* causes the corresponding bit *n*in each bit plane to be immune to change provided that the location being written was the last location read by the processor. Bits programmed to a 1 allow unimpeded writes to the corresponding bits in the bit planes.

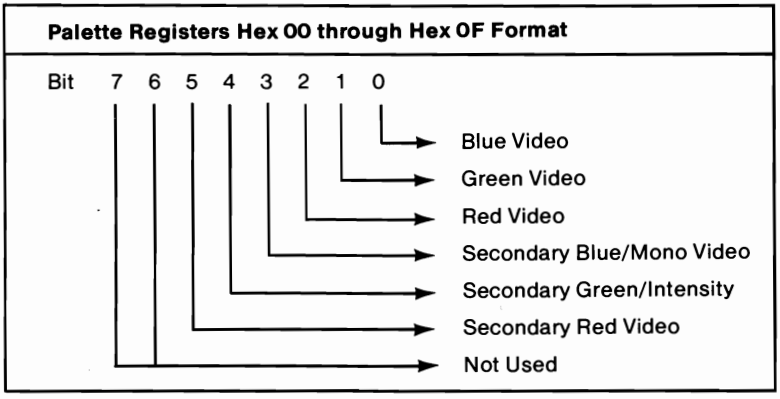
The bit mask applies to any data written by the processor (rotate, AND'ed, OR'ed, XOR'ed, DX, and S/R). To preserve bits using the bit mask, data must be latched internally by reading the location. When data is written to preserve the bits, the most current data in latches is written in those positions. The bit mask applies to all bit planes simultaneously.

Attribute Controller Registers

Name	Port	Index
Address Register	3C0	-
Palette Registers	3C0	00-0F
Mode Control Register	3C0	10
Overscan Color Register	3C0	11
Color Plane Enable Register	3C0	12
Horizontal Pel Panning Register	3C0	13

Attribute Address Register

This is a write-only register. The processor output port is hex 3C0.



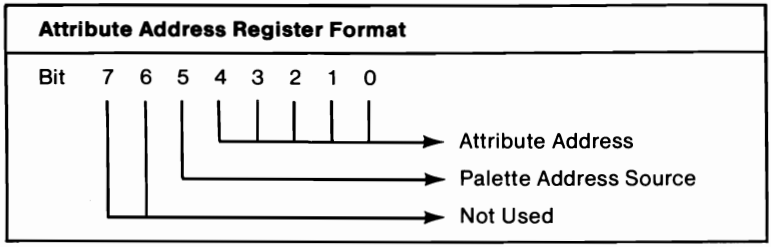
Bit 0-Bit 4 Attribute Address Bits—The Address Register is a pointer register located at hex 3C0. This register is loaded with a binary value that points to the attribute data register where data is to be written. The Attribute Controller does not have an address bit input to control selection of the address and data registers. An internal address flip-flop controls selection of either the address or data registers. To initialize the flip-flop, an IOR instruction is issued to the Attribute Controller at address 3BA or 3DA. This clears the flip-flop, and selects the Address Register. After the Address Register has been loaded, the

next OUT instruction loads the data register. The flip-flop toggles each time an OUT is issued to the Attribute Controller.

Bit 5 Palette Address Source—When loading the color palette registers, bit 5 must be cleared to 0. To enable the memory data to access the color palette, bit 5 must be set to 1.

Palette Register Hex 00 through Hex 0F

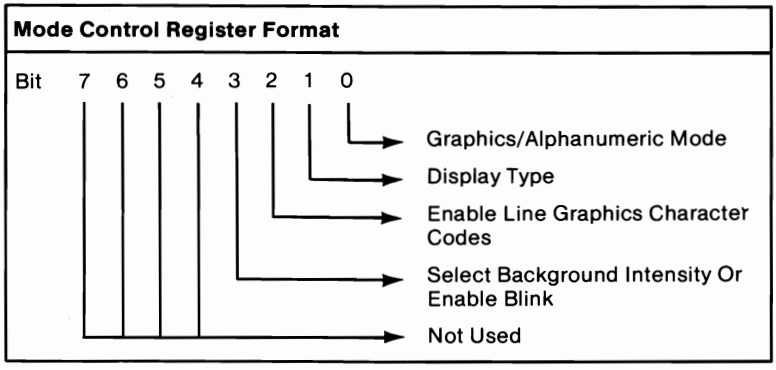
This is a write-only register. The processor output port is hex 3C0.



Bit 0-Bit 5 Palette—These 6-bit registers allow a dynamic mapping between the text attribute or graphic color input value and the display color in the CRT screen. A logical 1 selects the appropriate color. A logical 0 de-selects. The color palette register should be modified only during the vertical retrace interval to avoid glitches in the displayed image. Note that some color monitors do not have an intensity input and only a maximum of eight colors are be available. Monitors with four color inputs display sixteen colors, and monitors with six color inputs display 64 colors.

Mode Control Register

This is a write-only register pointed to by the value in the Attribute address register. This value must be hex 10 before writing can take place. The processor output port address for this register is hex 3C0.



Bit 0 Graphics/Alphanumeric Mode—A logical 0 selects selects alphanumeric mode. A logical 1 selects graphics mode.

Bit 1 Monochrome Display/Color Display—A logical 0 selects color display attributes. A logical 1 selects IBM Monochrome Display attributes.

Bit 2 Enable Line Graphics Character Codes—When this bit is set to 0, the ninth dot will be the same as the background. A logical 1 enables the special line graphics character codes for the IBM Monochrome Display adapter. This bit when enabled forces the ninth dot of a line graphic character to be identical to the eighth dot of the character. The line graphics character codes for the Monochrome Display Adapter are Hex C0 through Hex DF.

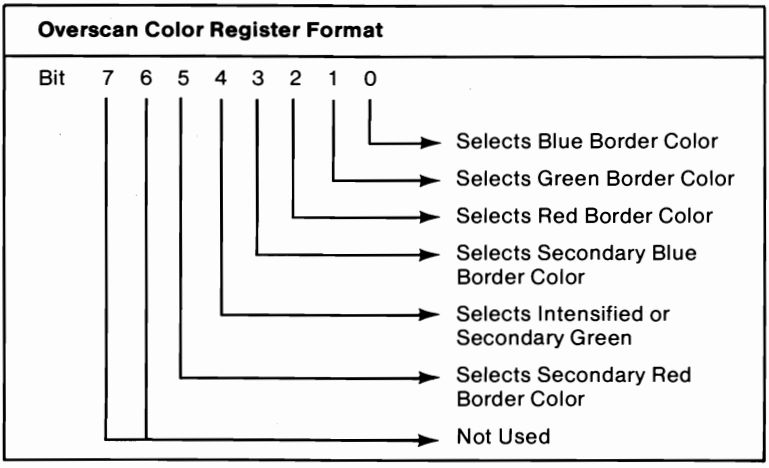
For character fonts that do not utilize the line graphics character codes in the range of Hex C0

through Hex DF, bit 2 of this register should be a logical 0. Otherwise unwanted video information will be displayed on the CRT screen.

Bit 3 Enable Blink/Select Background Intensity—A logical 0 selects the background intensity of the attribute input. This mode was available on the Monochrome and Color Graphics adapters. A logical 1 enables the blink attribute in alphanumeric modes. This bit must also be set to 1 for blinking graphics modes.

Overscan Color Register

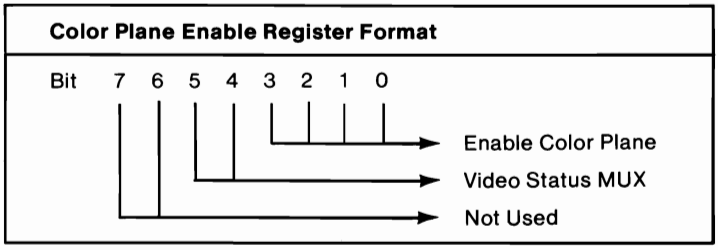
This is a write-only register pointed to by the value in the Attribute address register. This value must be hex 11 before writing can take place. The processor output port address for this register is hex 3C0.



Bit 0-Bit 5 Overscan Color—This 6-bit register determines the overscan (border) color displayed on the CRT screen. For monochrome display this register should be set to a value of 0. A logical 1 selects the appropriate color.

Color Plane Enable Register

This is a write-only register pointed to by the value in the Attribute address register. This value must be hex 12 before writing can take place. The processor output port address for this register is 3C0.



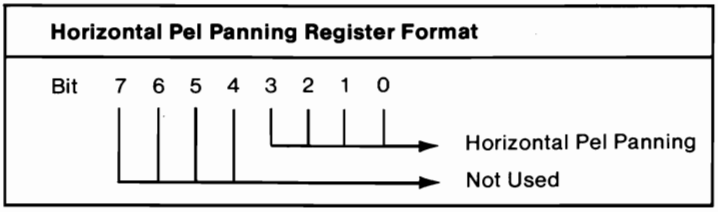
Bit 0-Bit 3 Enable Color Plane—Writing a logical 1 in any of bits 0 through 3 enables the respective display memory color plane.

Bit 4-Bit 5 Video Status MUX—Selects two of the six color outputs to be available on the status port. The following table illustrates the combinations available and the color output wiring.

COLOR PLANE ENABLE REGISTER		INPUT STATUS REGISTER ONE	
Bit 5	**Bit 4**	**Bit 5**	**Bit 4**
0	0	Red	Blue
0	1	Secondary Blue	Green
1	0	Secondary Red	Secondary Green
1	1	Not Used	Not Used

Horizontal Pel Panning Register

This is a write-only register pointed to by the value in the Attribute address register. This value must be hex 12 before writing can take place. The processor output port address for this register is hex 3C0.



Bit 0-Bit 3 Horizontal Pel Panning—This 4 bit register selects the number of picture elements (pels) to shift the video data horizontally to the left. Pel panning is available in both A/N and APA modes. In Monochrome A/N mode, the image can be shifted a maximum of 9 pels. In all other A/N and APA modes, the image can be shifted a maximum of 8 pels. The sequence for shifting the image is given below:

9 pels/character : 8, 0, 1, 2, 3, 4, 5, 6, 7 (Monochrome A/N mode only)

8 pels/character : 0, 1, 2, 3, 4, 5, 6, 7 (All other Modes)

Programming Considerations

Programming the Registers

Each of the LSI devices has an address register and a number of data registers. The address register serves as a pointer to the other registers on the LSI device. It is a write-only register that is loaded by the processor by executing an 'OUT' instruction to its I/O address with the index of the selected data register.

The data registers on each LSI device are accessed through a common I/O address. They are distinguished by the pointer (index) in the address register. To write to a data register, the address register is loaded with the index of the appropriate data register, then the selected data register is loaded by executing an 'OUT' instruction to the common I/O address.

The external registers that are not part of an LSI device and the Graphics I and II registers are not accessed through an address register; they are written to directly.

The following tables define the values that are loaded into the registers by BIOS to support the different modes of operation supported by this adapter.

Register			Mode of Operation																	
Name	Port	Index	0	1	2	3	4	5	6	7	D	E	F	10	F‡	10‡	0*	1*	2*	3*
Miscellaneous	3C2	–	23	23	23	23	23	23	23	A6	23	23	A2	A7	A2	A7	A7	A7	A7	A7
Feature Cntrl	3?A	–	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
Input Stat 0	3C2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Input Stat 1	3?2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
? = B in monochrome modes ? = D in color modes																				
*Values for these modes when the IBM Enhanced Color Display is attached																				
‡Values for these modes when greater than 64K Graphics Memory is installed																				

External Registers

Register			Mode of Operation																	
Name	Port	Index	0	1	2	3	4	5	6	7	D	E	F	10	F‡	10‡	0*	1*	2*	3*
Seq Address	3C4	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Reset	3C5	00	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03
Clock Mode	3C5	01	0B	0B	01	01	0B	0B	01	00	0B	01	05	05	01	01	0B	0B	01	01
Map Mask	3C5	02	03	03	03	03	03	03	01	03	0F	0F	0F	0F	0F	0F	03	03	03	03
Char Gen Sel	3C5	03	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
Memory Mode	3C5	04	03	03	03	03	02	02	06	03	06	06	00	00	06	06	03	03	03	03
*Values for these modes when the IBM Enhanced Color Display is attached																				
‡Values for these modes when greater than 64K Graphics Memory is installed																				

Sequencer Registers

Register			Mode of Operation																	
Name	Port	Index	0	1	2	3	4	5	6	7	D	E	F	10	F‡	10‡	0*	1*	2*	3*
Address Reg	3?4	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Horiz Total	3?5	00	37	37	70	70	37	37	70	60	37	70	60	5B	60	5B	2D	2D	5B	5B
Hrz Disp End	3?5	01	27	27	4F	4F	27	27	4F	4F	27	4F	4F	4F	4F	4F	27	27	4F	4F
Strt Hrz Blk	3?5	02	2D	2D	5C	5C	2D	2D	59	56	2D	56	56	53	56	53	28	28	53	53
End Hrz Blk	3?5	03	37	37	2F	2F	37	37	2D	3A	37	2D	1A	17	3A	37	2D	2D	37	37
Strt Hrz Retr	3?5	04	31	31	5F	5F	30	30	5E	51	30	5E	50	50	50	52	28	28	51	51
End Hrz Retr	3?5	05	15	15	07	07	14	14	06	60	14	06	E0	BA	60	00	6D	6D	5B	5B
Vert Total	3?5	06	04	04	04	04	04	04	04	70	04	04	70	6C	70	6C	6C	6C	6C	6C
Overflow	3?5	07	11	11	11	11	11	11	11	1F	11	11	1F	1F	1F	1F	1F	1F	1F	1F
Preset Row SC	3?5	08	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
Max Scan Line	3?5	09	07	07	07	07	01	01	01	0D	00	00	00	00	00	00	0D	0D	0D	0D
Cursor Start	3?5	0A	06	06	06	06	00	00	00	0B	00	00	00	00	00	00	0B	0B	0B	0B
Cursor End	3?5	0B	07	07	07	07	00	00	00	0C	00	00	00	00	00	00	0C	0C	0C	0C
Strt Addr Hi	3?5	0C	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Strt Addr Lo	3?5	0D	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

? = B in monochrome modes ? = D in color modes

*Values for these modes when the IBM Enhanced Color Display is attached

‡Values for these modes when greater than 64K Graphics Memory is installed

CRT Controller Registers (1 of 2)

Register			Mode of Operation																	
Name	Port	Index	0	1	2	3	4	5	6	7	D	E	F	10	F*	10*	0*	1*	2*	3*
Cursor LC Hi	3?5	0E	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Cursor LC Low	3?5	0F	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Vrt Retr Strt	3?5	10	E1	E1	E1	E1	E1	E1	E0	5E	E1	E0	5E	5E	5E	5E	5E	5E	5E	5E
Light Pen Hi	3?5	10	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Vert Retr End	3?5	11	24	24	24	24	24	24	23	2E	24	23	2E	2B	2E	2B	2B	2B	2B	2B
Light Pen Low	3?5	11	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Vrt Disp End	3?5	12	C7	C7	C7	C7	C7	C7	C7	5D	C7	C7	5D	5D	5D	5D	5D	5D	5D	5D
Offset	3?5	13	14	14	28	28	14	14	28	28	14	28	14	14	28	28	14	14	28	28
Underline Loc	3?5	14	08	08	08	08	00	00	00	0D	00	00	0D	0F	0D	0F	0F	0F	0F	0F
Strt Vert Blk	3?5	15	E0	E0	E0	E0	E0	E0	DF	5E	E0	DF	5E	5F	5E	5F	5E	5E	5E	5E
End Vert Blk	3?5	16	F0	F0	F0	F0	F0	F0	EF	6E	F0	EF	6E	0A	6E	0A	0A	0A	0A	0A
Mode Control	3?5	17	A3	A3	A3	A3	A2	A2	C2	A3	E3	E3	8B	8B	E3	E3	A3	A3	A3	A3
Line Compare	3?5	18	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF
? = B in monochrome modes ? = D in color modes																				
*Values for these modes when the IBM Enhanced Color Display is attached																				
‡Values for these modes when greater than 64K Graphics Memory is installed																				

CRT Controller Registers (2 of 2)

Register			Mode of Operation																	
Name	Port	Index	0	1	2	3	4	5	6	7	D	E	F	10	F‡	10‡	0*	1*	2*	3*
Grphx I Pos	3CC	–	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
Grphx II Pos	3CA	–	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01
Grphx I II AD	3CE	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Set Reset	3CF	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
Enable S/R	3CF	01	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
Color Compare	3CF	02	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
Data Rotate	3CF	03	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
Read Map Sel	3CF	04	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
Mode Register	3CF	05	10	10	10	10	30	30	00	10	00	00	10	10	00	00	10	10	10	10
Miscellaneous	3CF	06	0E	0E	0E	0E	0F	0F	0D	0A	05	05	07	07	05	05	0E	0E	0E	0E
Color No Care	3CF	07	00	00	00	00	00	00	00	00	0F	0F	0F	0F	0F	0F	00	00	00	00
Bit Mask	3CF	08	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF
*Values for these modes when the IBM Enhanced Color Display is attached																				
‡Values for these modes when greater than 64K Graphics Memory is installed																				

Graphics SI Registers

Register			Mode of Operation																	
Name	Port	Index	0	1	2	3	4	5	6	7	D	E	F	10	F‡	10‡	0*	1*	2*	3*
Address	3?A	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Palette	3C0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
Palette	3C0	01	01	01	01	01	13	13	17	08	01	01	08	01	08	01	01	01	01	01
Palette	3C0	02	02	02	02	02	15	15	17	08	02	02	00	00	00	02	02	02	02	02
Palette	3C0	03	03	03	03	03	17	17	17	08	03	03	00	00	00	03	03	03	03	03
Palette	3C0	04	04	04	04	04	02	02	17	08	04	04	18	04	18	04	04	04	04	04
Palette	3C0	05	05	05	05	05	04	04	17	08	05	05	18	07	18	05	05	05	05	05
Palette	3C0	06	06	06	06	06	06	06	17	08	06	06	00	00	00	06	14	14	14	14
Palette	3C0	07	07	07	07	07	07	07	17	08	07	07	00	00	00	07	07	07	07	07
Palette	3C0	08	10	10	10	10	10	10	17	10	10	10	00	00	00	38	38	38	38	38
Palette	3C0	09	11	11	11	11	11	11	17	18	11	11	08	01	08	39	39	39	39	39
Palette	3C0	0A	12	12	12	12	12	12	17	18	12	12	00	00	00	3A	3A	3A	3A	3A
Palette	3C0	0B	13	13	13	13	13	13	17	18	13	13	00	00	00	3B	3B	3B	3B	3B
? = B in monochrome modes ? = D in color modes																				
*Values for these modes when the IBM Enhanced Color Display is attached																				
‡Values for these modes when greater than 64K Graphics Memory is installed																				

Attribute Registers (1 of 2)

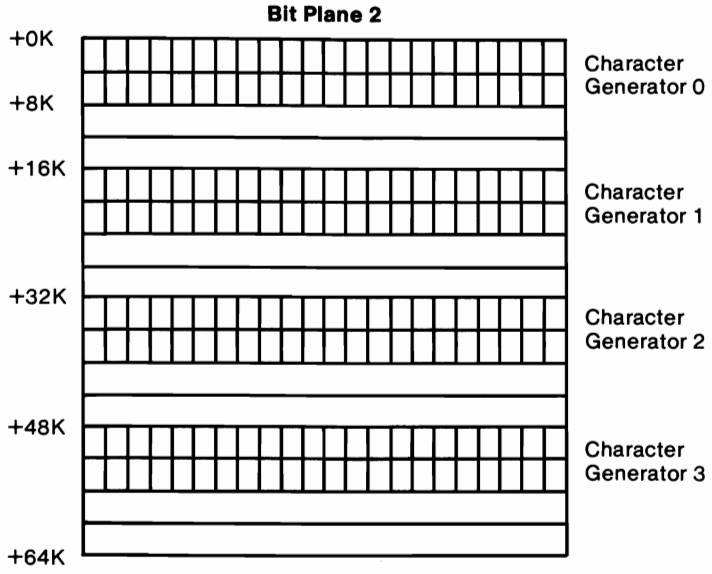
Register			Mode of Operation																	
Name	Port	Index	0	1	2	3	4	5	6	7	D	E	F	10	F‡	10‡	0*	1*	2*	3*
Palette	3C0	0C	14	14	14	14	14	14	17	18	14	14	00	04	00	3C	3C	3C	3C	3C
Palette	3C0	0D	15	15	15	15	15	15	17	18	15	15	18	07	18	3D	3D	3D	3D	3D
Palette	3C0	0E	16	16	16	16	16	16	17	18	16	16	00	00	00	3E	3E	3E	3E	3E
Palette	3C0	0F	17	17	17	17	17	17	18	17	17	00	00	00	3F	3F	3F	3F	3F	3F
Mode Control	3C0	10	08	08	08	08	01	01	01	0E	01	01	0B	0B	0B	01	08	08	08	08
Overscan	3C0	11	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
Color Plane	3C0	12	0F	0F	0F	0F	03	03	01	0F	0F	0F	05	05	05	0F	0F	0F	0F	0F
Hrz Panning	3C0	13	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
*Values for these modes when the IBM Enhanced Color Display is attached																				
‡Values for these modes when greater than 64K Graphics Memory is installed																				

Attribute Registers (2 of 2)

RAM Loadable Character Generator

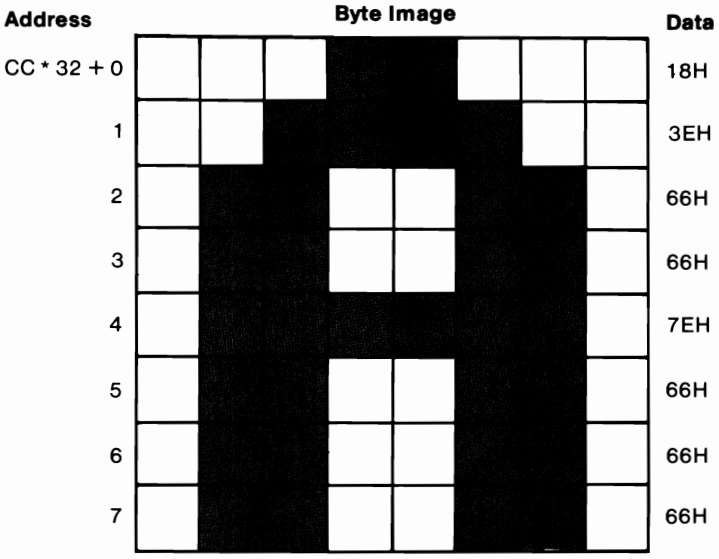
The character generator on the adapter is RAM loadable and can support characters up to 32 scan lines high. Two character generators are stored within the BIOS and one is automatically loaded into the RAM by the BIOS when an alphanumeric mode is selected. The Character Map Select Register can be programmed to define the function of bit 3 of the attribute byte to be a character generator switch. This allows the user to select between any two character sets residing in bit plane 2. This effectively gives the user access to 512 characters instead of 256. character tables may be loaded off line.The adapter must have 128K bytes of storage to support this function. Up to four tables can be loaded can be loaded with 256K of graphics memory installed.

The structure of the character tables is described in the following figure. The character generator is in bit plane 2 and must be protected using the map mask function.



The following figure illustrates the structure of each character pattern. If the CRT controller is programmed to generate *n* row

scans, then *n* bytes must be filled in for each character in the character generator. The example assumes eight row scans per character.



CC = Value of the character code. For example, 41H in the case of an ASCII "A".

Creating a 512 Character Set

This section describes how to create a 512 character set on the IBM Color Display. Note that only 256 characters can be printed on the printer. This is a special application which the Enhanced Graphics Adapter will support. The 9 by 14 characters will be displayed when attribute bit 3 is a logical 0, and the IBM Color/Graphics Monitor Adapter 8 by 8 characters will be displayed when the attribute bit 3 is a logical 1. This example is for demonstrative purposes only. The assembly language routine for creating 512 characters is given below. Debug 2.0 was used for this example. The starting assembly address is 100 and the character string is stored in location 200. This function requires 128K or more of graphics memory.

```
a100
mov ax,1102          ;load 8x8 character font in character
mov bl,02            ;generator number 2
int 10

mov ax,1103          ;select 512 character operation
mov bl,08            ;if attribute bit 3=1 use 8x8 font
int 10               ;if attribute bit 3=0 use 9x14 font

mov ax,1000          ;set color plane enable to 7H to disable
mov bx,0712          ;attribute bit 3 in the color palette
int 10               ;lookup table

mov ax,1301
mov bx,000F          ;write char. string with attribute bit 3=1
mov cx,003A          ;cx = character string length
mov dx,1600          ;write character on line 22 of display
mov bp,0200          ;pointer to character string location
push cs
pop es
int 10

mov ax ,1301
mov bx,0007          ;write char. string with attribute bit 3=0
mov cx,003A          ;cx = character string length
mov dx,1700          ;write character on line 23 of display
mov bp,0200          ;pointer to character string location
push cs
pop es
int 10
int 3

a200 db              "This character string is used to show 512
                     characters"
```

Creating an 80 by 43 Alphanumeric Mode

The following examples show how to create 80 column by 43 row, both alphanumeric and graphics, images on the IBM Monochrome Display. The BIOS Interface supports an 80 column by *n* row display by using the character generator load routine call. The print screen routine must be revectored to

handle the additional character rows on the screen. The assembly language required for both an alphanumeric and a graphics screen is shown below.

```
mov al,7          ;Monochrome alphanumeric mode
int 10            ;video interrupt call
mov ax,1112       ;character generator BIOS routine
mov bl,0          ;load 8 by 8 double dot character font
int 10            ;video interrupt call
mov ax,1200       ;alternate screen routine
move bl,20        ;select alternate print screen routine
int 10            ;video interrupt call
int 3

mov ax,f          ;Monochrome graphic mode
int 10            ;video interrupt call
mov ax,1123       ;character generator BIOS routine
mov bl,0          ;load 8 by 8 double dot character font
mov dl,2B         ;43 character rows
int 10            ;video interrupt call
mov ax,1200       ;alternate screen routine
mov bl,20         ;alternate print screen routine
int 10            ;video interrupt call
int 3
```

Vertical Interrupt Feature

The Enhanced Graphics Adapter can be programmed to create an interrupt each time the vertical display refresh time has ended. An interrupt handler routine must be written by the application to take advantage of this feature. The CRT Vertical interrupt is on IRQ2. The CPU can poll the Enhanced Graphics Adapter Input Status Register 0 (bit 7) to determine whether the CRTC caused the interrupt to occur.

The Vertical Retrace End Register (11H) in the CRT controller contains two bits which are used to control the interrupt circuitry. The remaining bits must be output as per the value in the mode table.

Bit 5 Enable Vertical Interrupt—A logical 0 will enable vertical interrupt.

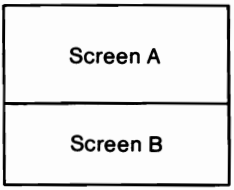
Bit 4 Clear Vertical Interrupt—A logical 0 will clear a vertical interrupt.

The sequence of events which occur in an interrupt handler are outlined below.

1. Clear IRQ latch and enable driver
2. Enable IRQ latch
3. Wait for vertical interrupt
4. Poll Interrupt Status Register 0 to determine if CRTC has caused the interrupt
5. If CRTC interrupt, then clear IRQ latch; if not, then branch to next interrupt handler.
6. Enable IRQ latch
7. Update Enhanced Graphics Adapter during vertical blanking interval
8. Wait for next vertical interrupt

Creating a Split Screen

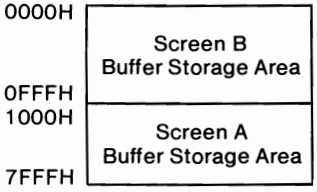
The Enhanced Graphics Adapter hardware supports an alphanumeric mode dual screen display. The top portion of the screen is designated as screen A, and the bottom portion of the screen is designated as screen B as per the following figure.



Dual Screen Definition

The following figure shows the screen mapping for a system containing a 32K byte alphanumeric storage buffer. Note that the Enhanced Graphics Adapter has a 32K byte storage buffer in alphanumeric mode. Information displayed on screen A is

defined by the start address high and low registers (0CH and 0DH) of the CRTC. Information displayed on screen B always begins at address 0000H.



Screen Mapping Within the Display Buffer Address Space

The Line Compare Register (18H) of the CRT Controller is utilized to perform the split screen function. The CRTC has an internal horizontal scan counter, and logic which compares the horizontal scan counter value to the Line Compare Register value and clears the memory address generator when a compare occurs. The linear address generator then sequentially addresses the display buffer starting at location zero, and each subsequent row address is is determined by the 16 bit addition of the start of line latch and the offset register.

Screen B can be smoothly scrolled onto the CRT screen by updating the Line compare in synchronization with the vertical retrace signal. The information on screen B is immune from scrolling operations which utilize the Start Address High and Low registers to scroll through the Screen A address map.

Compatibility Issues

The CRT Controller on the IBM Enhanced Graphics Adapter is a custom design, and is different than the 6845 controller used on the IBM Monochrome Monitor Adapter and the IBM Color/Graphics Monitor Adapter. It should be noted that several CRTC register addresses differ between the adapters. The following figure illustrates the registers which do not map directly across the two controllers.

Register	6485 Function	EGA CRTC Function
02H	Start Horiz. Retrace	Start Horiz. Blanking
03H	End Horiz. Retrace	End Horiz. Blanking
04H	Vertical Total	Start Horiz. Retrace
05H	Vertical Total Adjust	End Horiz. Retrace
06H	Vertical Displayed	Vertical Total
07H	Vertical Sync Position	Overflow
08H	Interlace Mode and Skew	Preset Row Scan

Existing applications which utilize the BIOS interface will generally be compatible with the Enhanced Graphics Adapter.

Horizontal screen centering was required on the IBM Color/Graphics Monitor Adapter in order to center the screen when generating composite video. This was done through the Horizontal Sync Position Register. Since the Enhanced Graphics Adapter does not support a composite video monitor, programs which do screen centering may cause loss of the screen image if centering is attempted.

The Enhanced Graphics Adapter offers a wider variety of displayable monochrome character attributes than the IBM Monochrome Display Adapter. Some attribute values may display differently between the two Adapters. The values listed in the table below, in any combinations with the blink and intensity attributes, will display identically.

Background R G B	Foreground R G B	Function
0 0 0	0 0 0	Non-Display
0 0 0	0 0 1	Underline
0 0 0	1 1 1	White Character/Black Background
1 1 1	0 0 0	Reverse Video

Software which explicitly addresses 3D8 (Mode Select Register) or 3D9 (Color Select Register) on the Color Graphics Monitor Adapter may produce different results on the Enhanced Graphics Adapter. For example, blinking which is disabled by writing to 3D8 on the Color Graphics Adapter will not be disabled on the Enhanced Graphics Adapter.

Interface

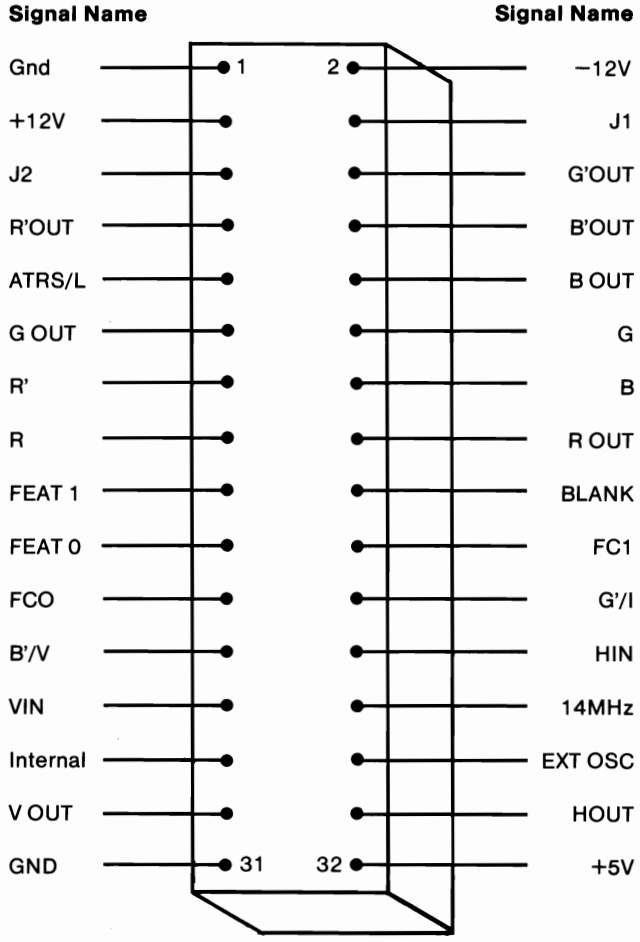
Feature Connector

The following is a description of the Enhanced Graphics Adapter feature connector. Note that signals coming from the Enhanced Graphics Adapter are labeled "inputs" and the signals coming to the Enhanced Graphics Adapter through the feature connector are labeled "outputs".

Signal	Description
J2	This pin is connected to auxiliary jack 2 on the rear panel of the adapter.
R'OUT	Secondary red output
ATRS/L	Attribute shift load. This signal controls the serialization of the video information. The shift register parallel loads at the dot clock leading edge when this signal is low.
G OUT	Primary green output
R'	Secondary red input
R	Primary red input
FC1	This signal is input from bit 1 (Feature Control Bit 1) of the Feature Control Register.
FC0	This signal is input from bit 0 (Feature Control Bit 0) of the Feature control Register.
FEAT 0	This signal is output to bit 5 (Feature Code 0) of Input Status Register 0.
B'/V	Secondary blue input/Monochrome video
VIN	Vertical retrace input

Internal	This signal is output to bit 4 (Disable Internal Video Drivers) of the Miscellaneous Output Register.
V OUT	Vertical retrace output
J1	This pin is connected to auxiliary jack 1 on the rear panel of the adapter.
G'OUT	Secondary green output
B'OUT	Secondary blue output
B OUT	Blue output
G	Green input
B	Blue input
R OUT	Red output
BLANK	This is a composite horizontal and vertical blanking signal from the CRTC.
FEAT 1	This signal is output to bit 6 (Feature Code 1) of Input Status Register 0.
G'/I	Secondary green/Intensity input
HIN	Horizontal retrace input from the CRTC
14MHZ	14 MHz signal from the system board
EXT OSC	External dot clock output
HOUT	Horizontal retrace output

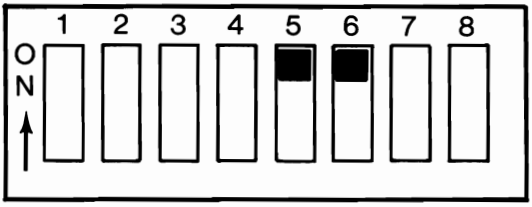
The following figure shows the layout and pin numbering of the feature connector.



Feature Connector Diagram

System Board Switches

The following figure shows the proper system board DIP switch settings for the IBM Enhanced Graphics Adapter when used with the Personal Computer and the Personal Computer XT. The switch block locations are illustrated in the Technical Reference Manual "System Board Component Diagram". The Personal Computer has two DIP switch blocks; the switch settings shown pertain to DIP Switch Block 1. The Personal Computer XT has one DIP switch block.

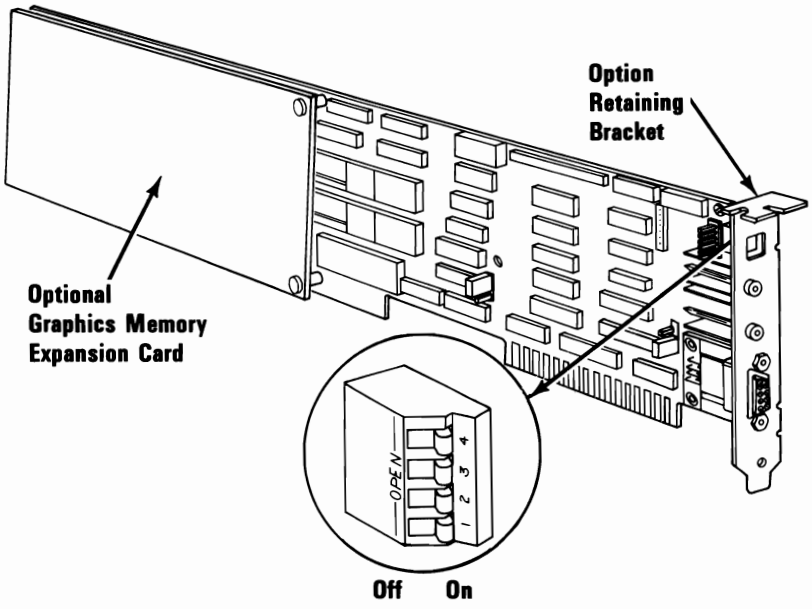


Switch Block (1)

Note: The DIP switches must be set as shown whenever the IBM Enhanced Graphics Adapter is installed, regardless of display type. This is true even when a second display adapter is installed in the system.

Configuration Switches

The following diagram shows the location and orientation of the configuration switches on the Enhanced Graphics Adapter.



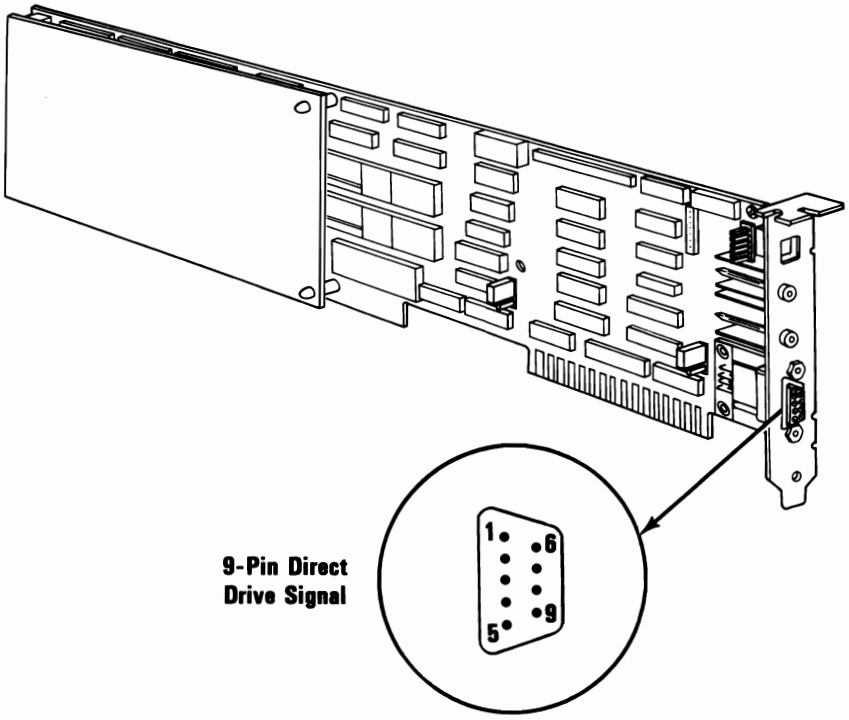
Configuration Switch Settings

The configuration switches on the Enhanced Graphics Adapter determine the type of display support the adapter provides, as follows:

Switch Settings for Enhanced Graphics Adapter as Primary Display Adapter						
				Configuration		
SW1	SW2	SW3	SW4	Enhanced Adapter	Monochrome Adapter	Color/Graphics Adapter
On	Off	Off	On	Color Display 40x25	Secondary	–
Off	Off	Off	On	Color Display 80x25	Secondary	–
On	On	On	Off	Enhanced Display Emulation Mode	Secondary	–
Off	On	On	Off	Enhanced Display Hi Res Mode	Secondary	–
On	Off	On	Off	Monochrome	–	Secondary 40x25
Off	Off	On	Off	Monochrome	–	Secondary 80x25

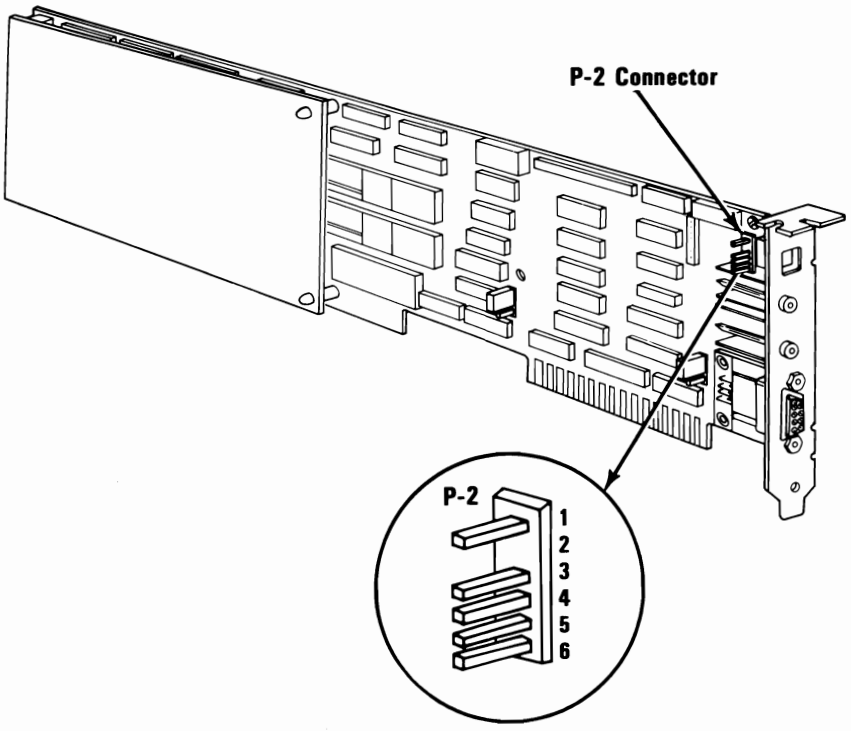
Switch Settings for Enhanced Graphics Adapter as Secondary Display Adapter						
				Configuration		
SW1	SW2	SW3	SW4	Enhanced Adapter	Monochrome Adapter	Color/Graphics Adapter
On	On	On	On	Color Display 40x25	Primary	–
Off	On	On	On	Color Display 80x25	Primary	–
On	Off	On	On	Enhanced Display Emulation Mode	Primary	–
Off	Off	On	On	Enhanced Display Hi Res Mode	Primary	–
On	On	Off	On	Monochrome	–	Primary 40x25
Off	On	Off	On	Monochrome	–	Primary 80x25

Direct Drive Connector



	Signal Name - Description	Pin	
Direct Drive Display	Ground	1	Enhanced Graphics Adapter
	Secondary Red	2	
	Primary Red	3	
	Primary Green	4	
	Primary Blue	5	
	Secondary Green/Intensity	6	
	Secondary Blue/Mono Video	7	
	Horizontal Retrace	8	
	Vertical Retrace	9	

Light Pen Interface



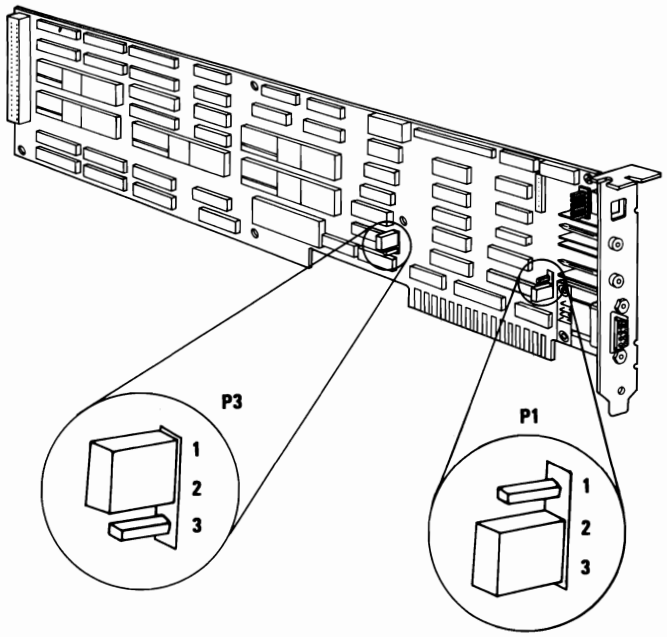
	P-2 Connector	Pin	
Light Pen Attachment	+Light Pen Input	1	**Enhanced Graphics Adapter**
	Not used	2	
	+Light Pen Switch	3	
	Ground	4	
	+5 Volts	5	
	12 Volts	6	

Jumper Descriptions

Located on the adapter are two jumpers designated P1 and P3. Jumper P1 changes the function of pin 2 on the direct drive interface. When placed on pins 2 and 3, jumper P1 selects ground as the function of direct drive interface, pin 2. This selection is for displays that support five color outputs, such as the IBM Color Display. When P1 is placed on pins 1 and 2, red prime output is placed on pin 2 of the direct drive interface connector. This supports the IBM Enhanced Color Display, which utilizes six color outputs on the direct drive interface.

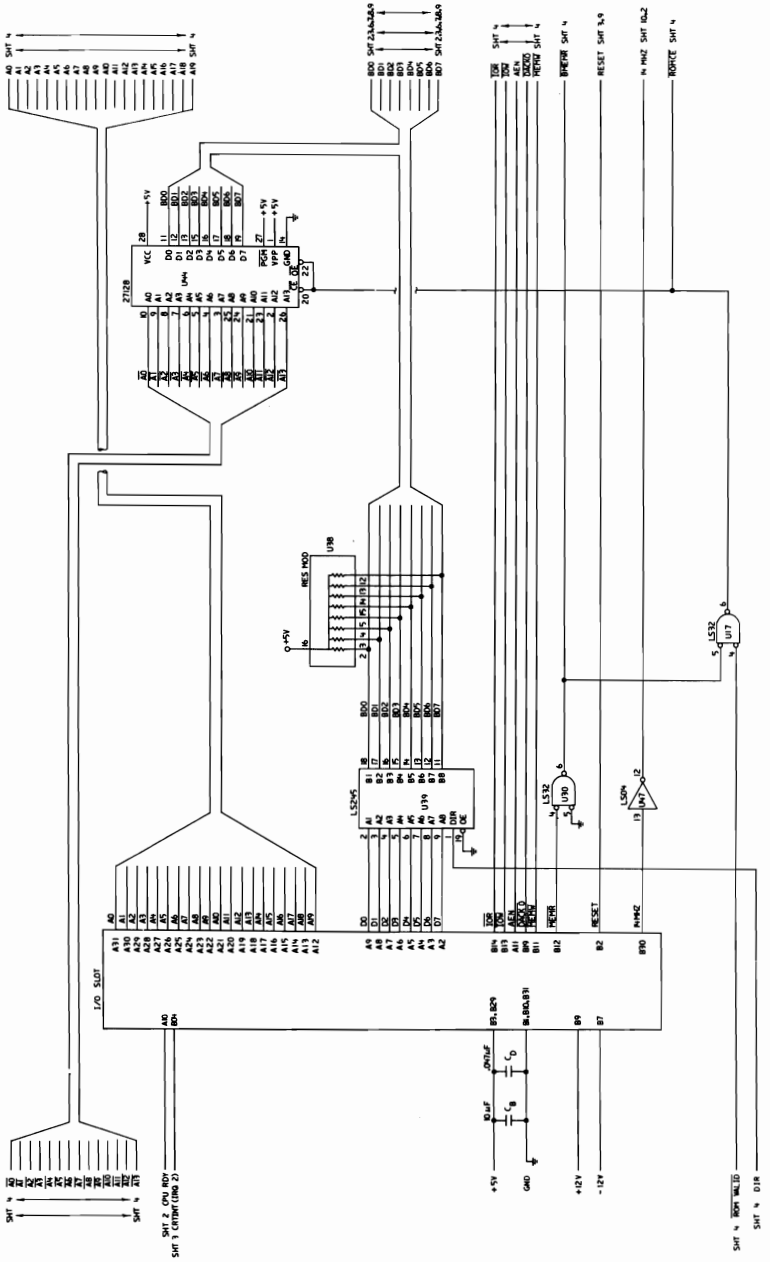
Jumper P3 changes the I/O address port of the Enhanced Graphics Adapter within the system. In its normal position, (pins 1 and 2), all Enhanced Graphics Adapter addresses are in the range 3XX. Moving jumper P3 to pins 2 and 3 changes the addresses to 2XX. Operation of the adapter in the 2XX mode is not supported in BIOS.

The following figure shows the location of the jumpers and numbering of the connectors.

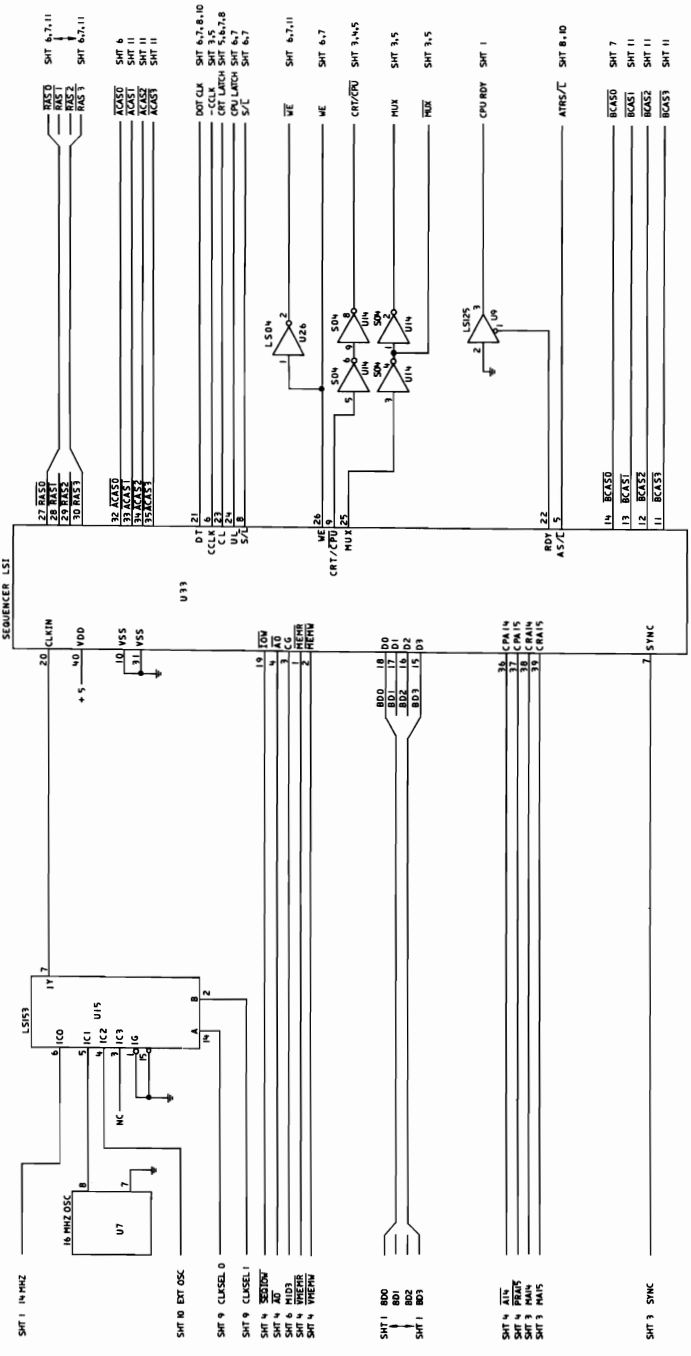


Logic Diagrams

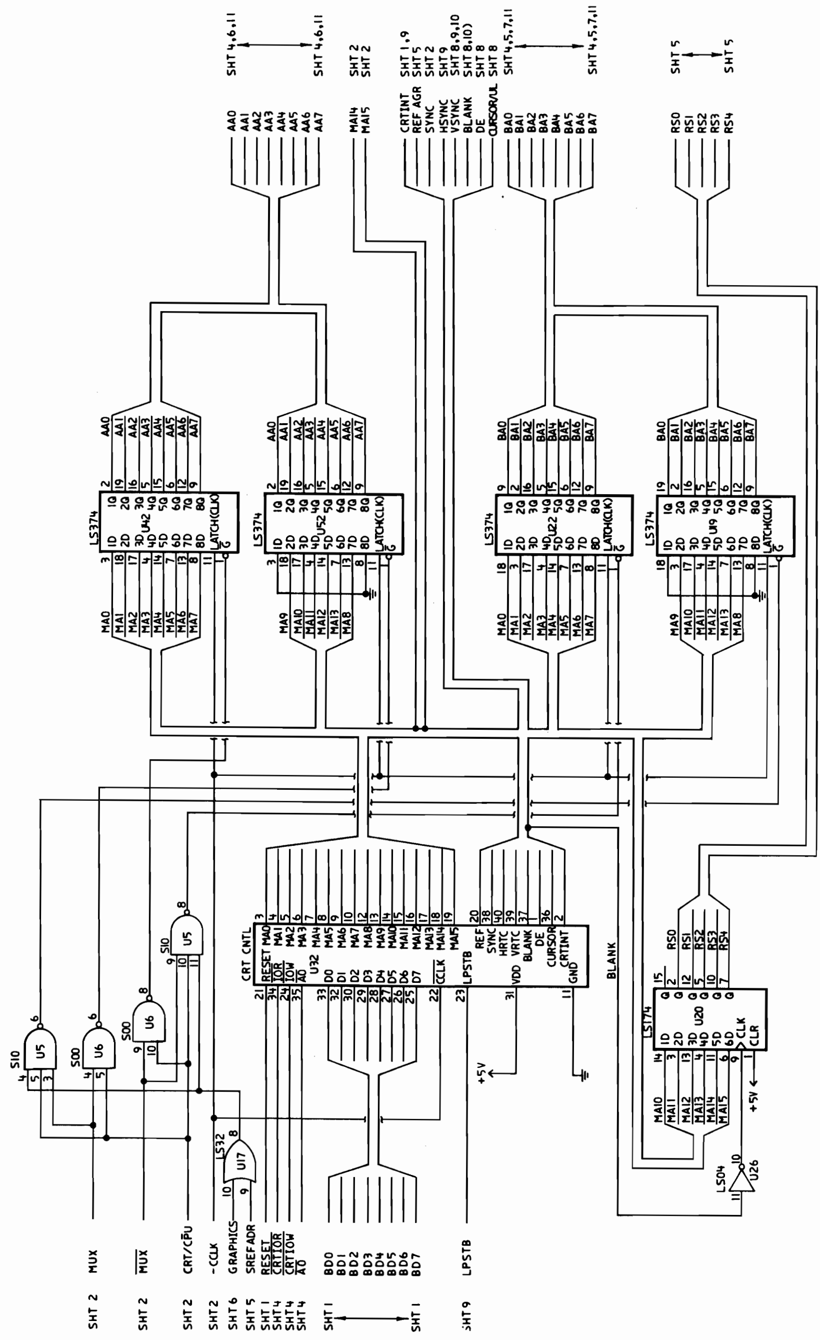
ENHANCED GRAPHICS ADAPTER



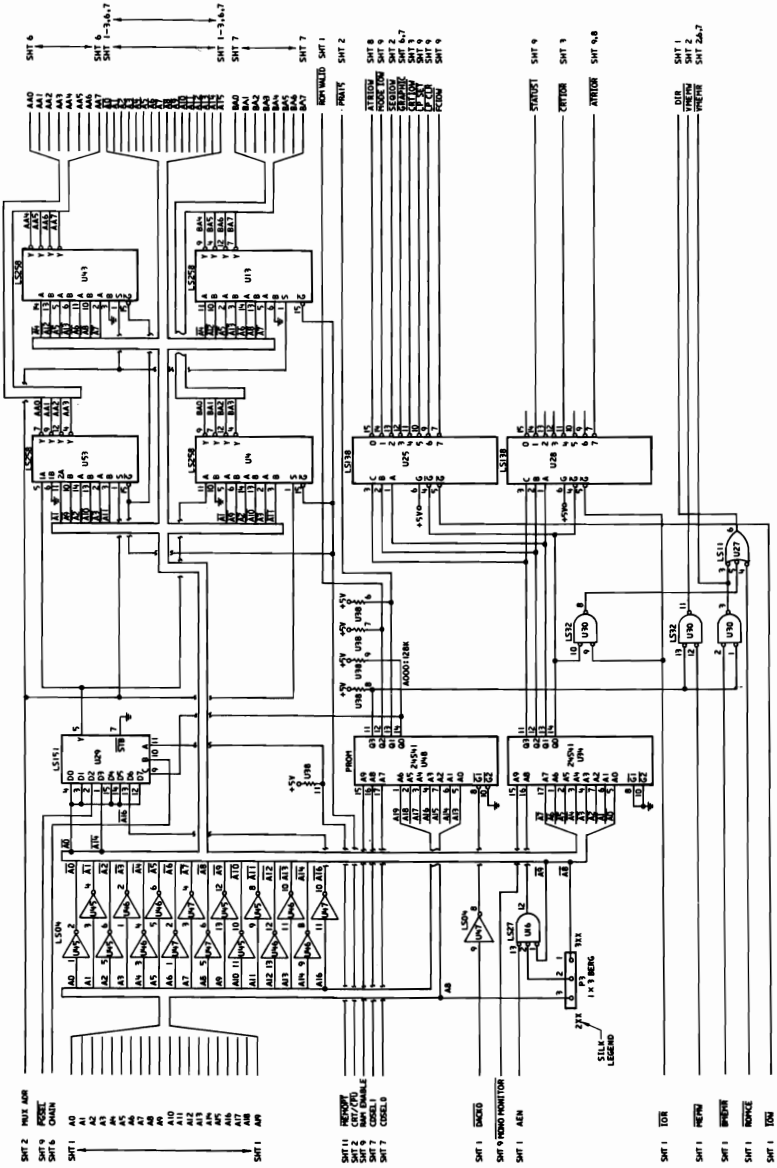
Enhanced Graphics Adapter Sheet 1 of 11



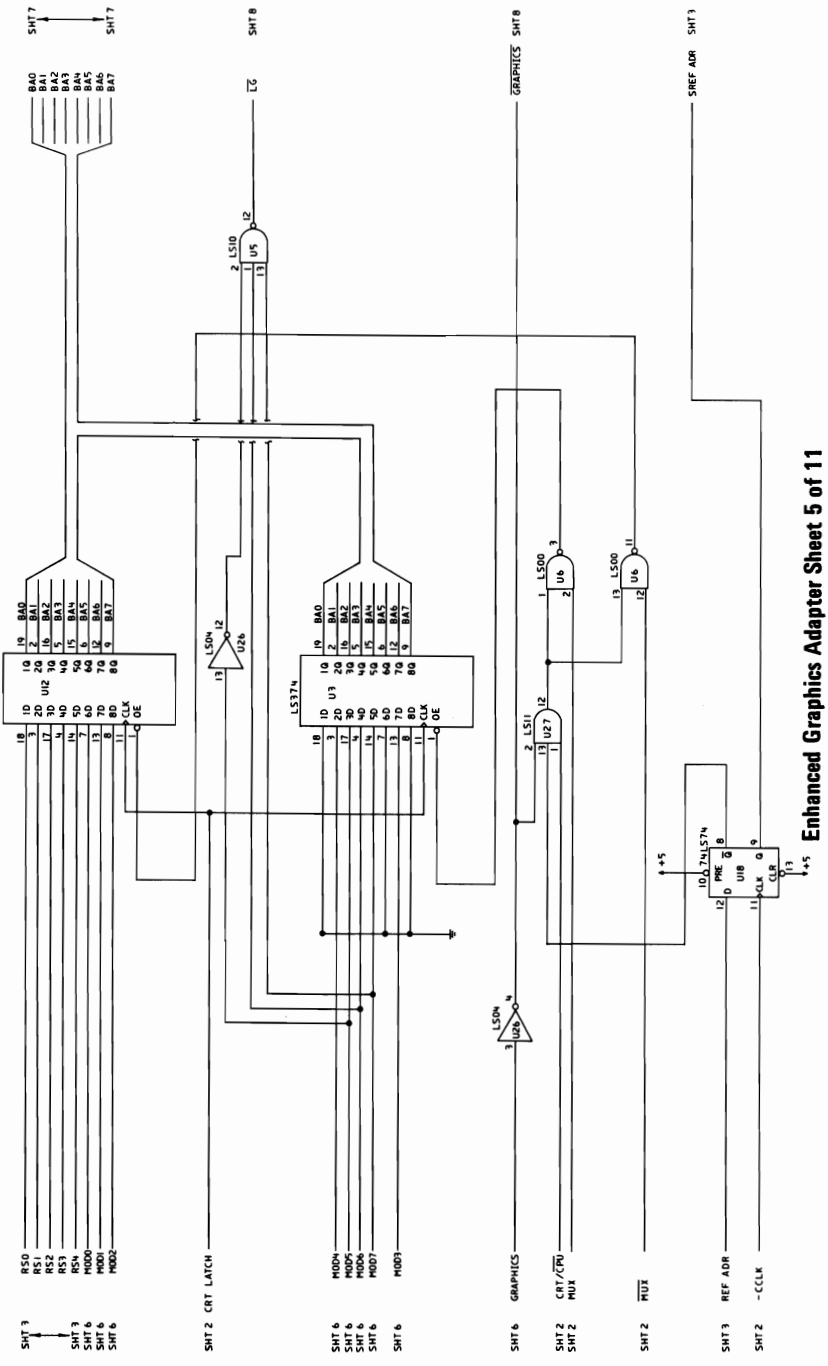
Enhanced Graphics Adapter Sheet 2 of 11



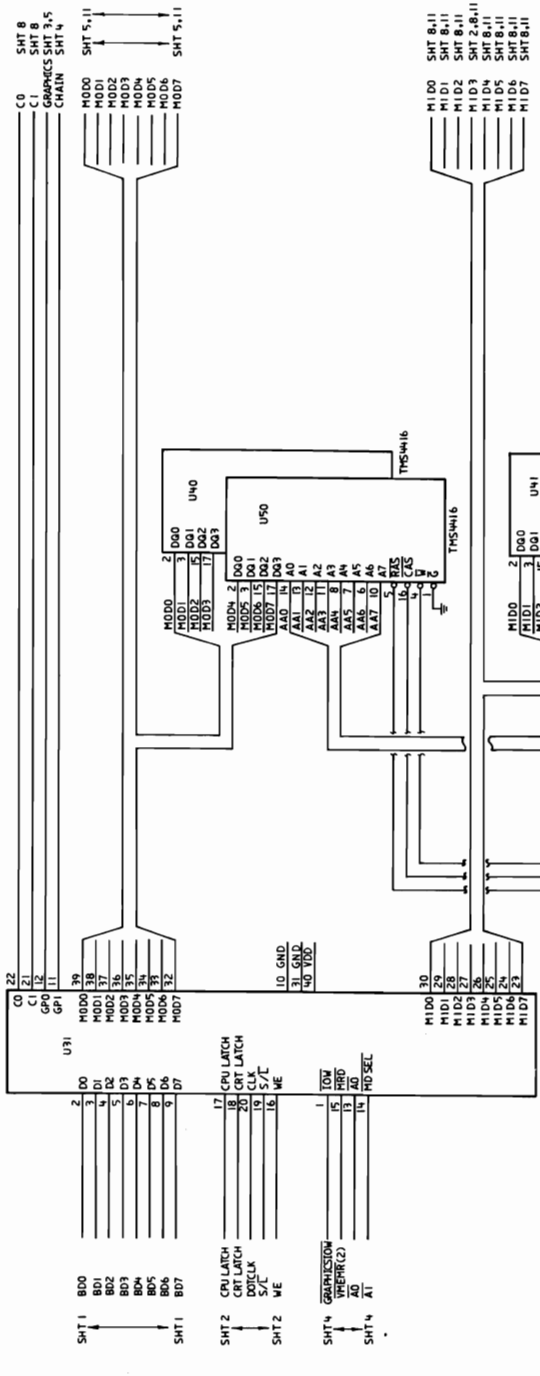
Enhanced Graphics Adapter Sheet 3 of 11



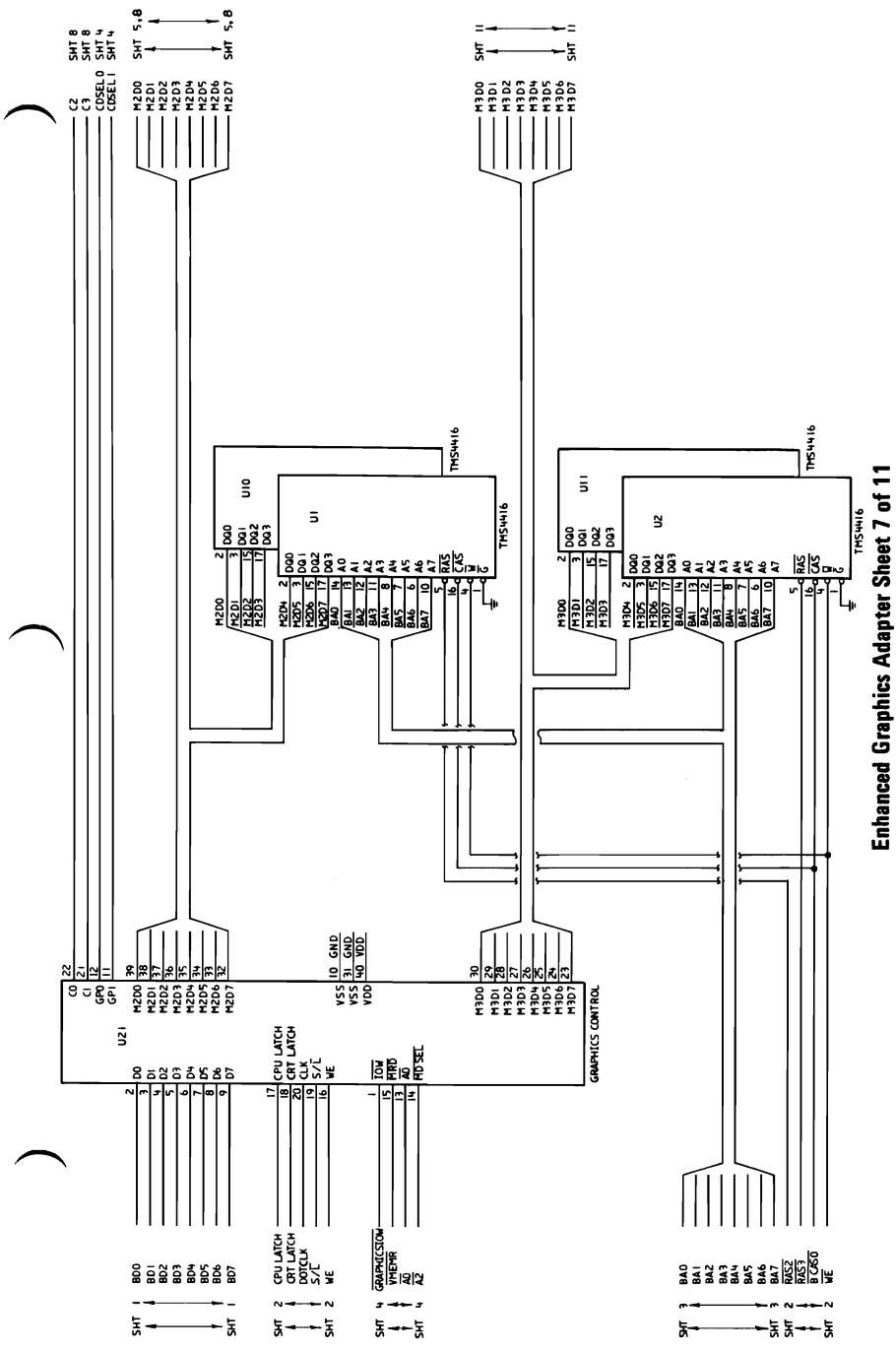
Enhanced Graphics Adapter Sheet 4 of 11



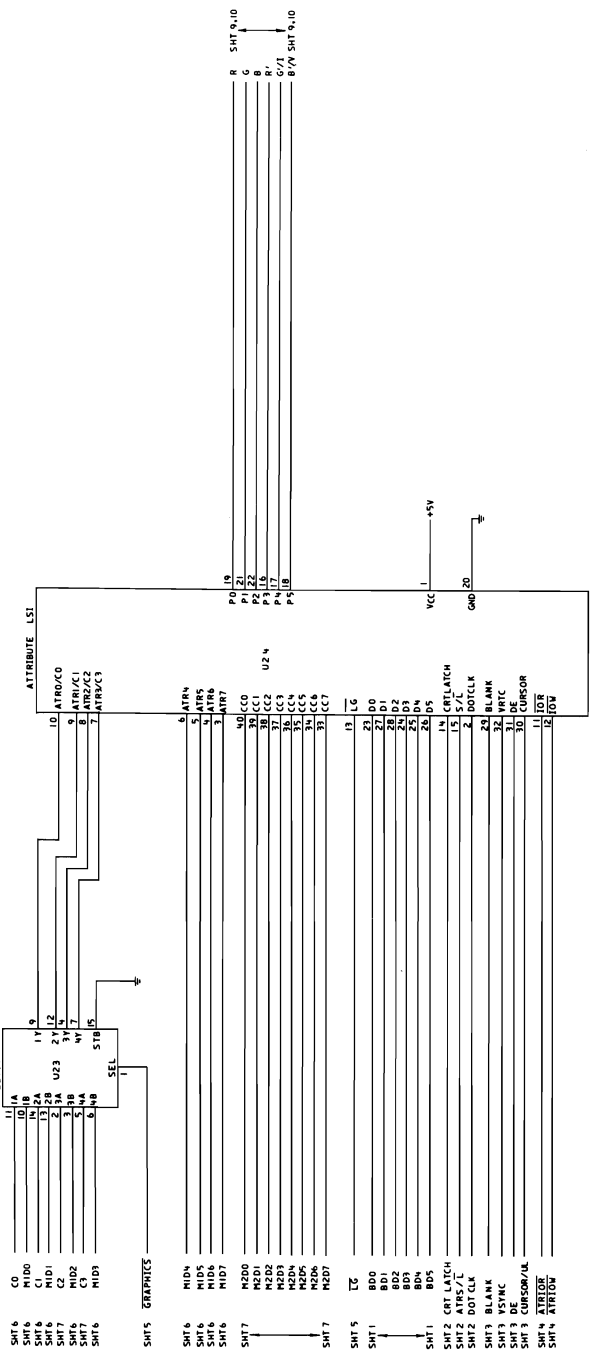
Enhanced Graphics Adapter Sheet 5 of 11



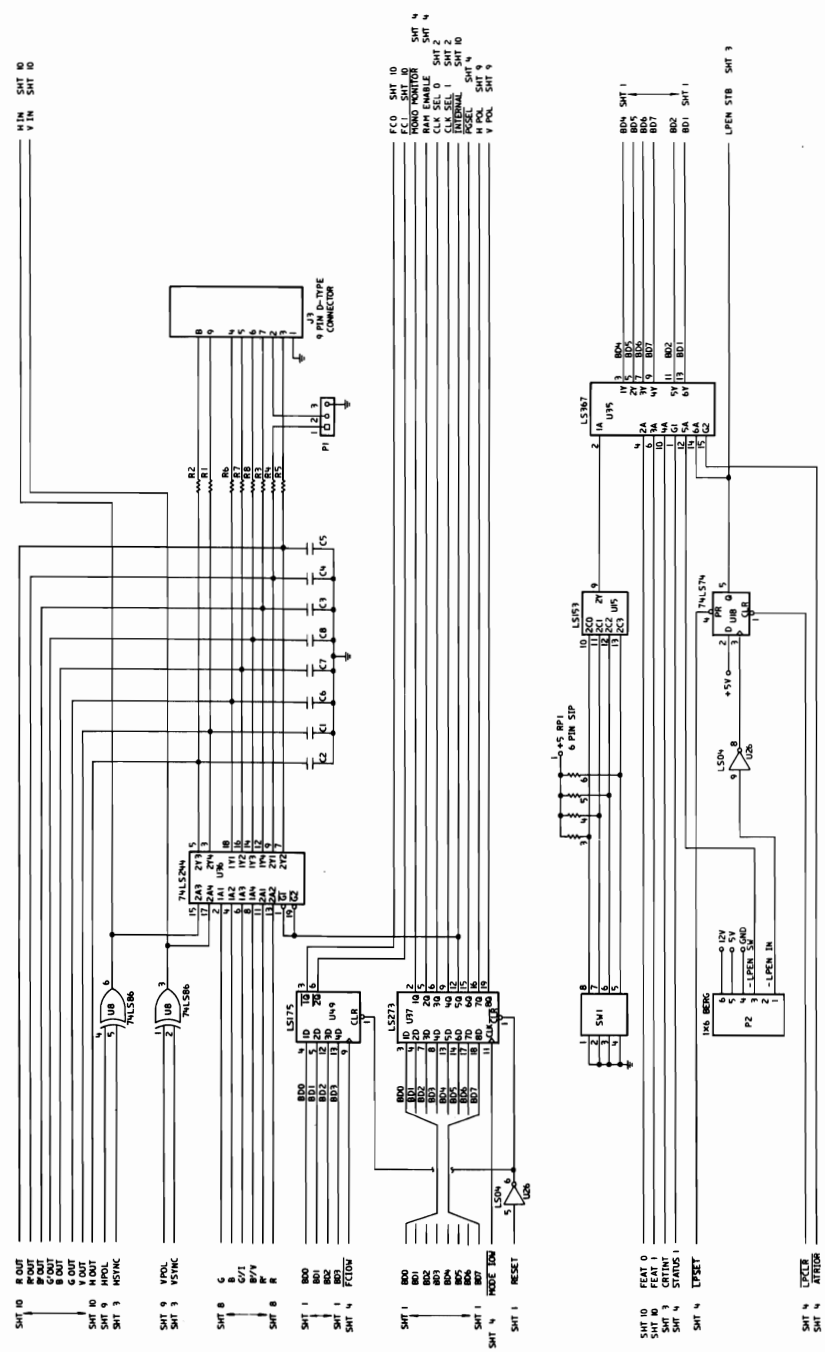
Enhanced Graphics Adapter Sheet 6 of 11



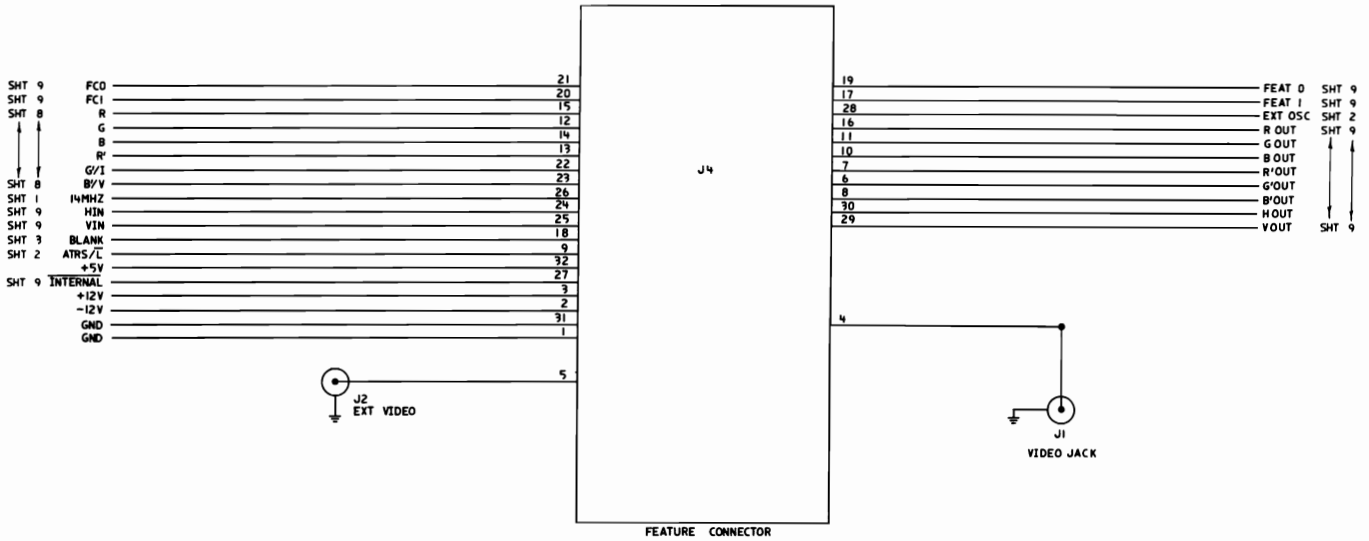
Enhanced Graphics Adapter Sheet 7 of 11



Enhanced Graphics Adapter Sheet 8 of 11



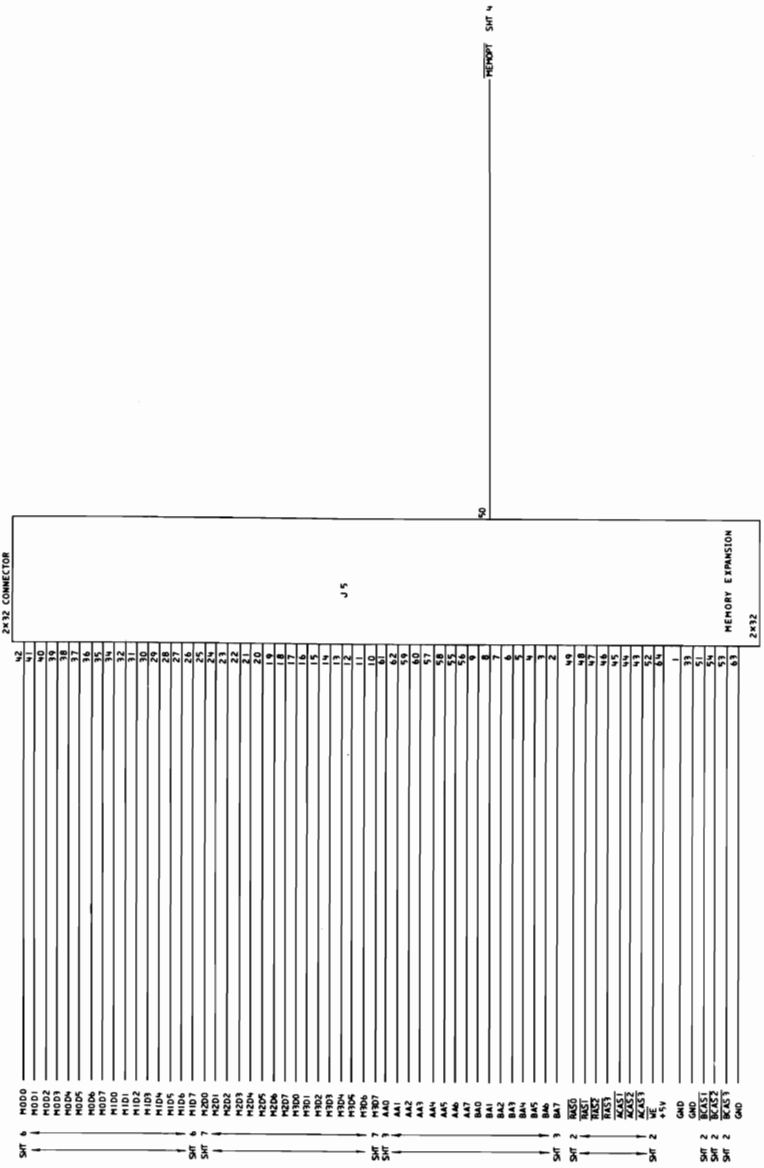
Enhanced Graphics Adapter Sheet 9 of 11



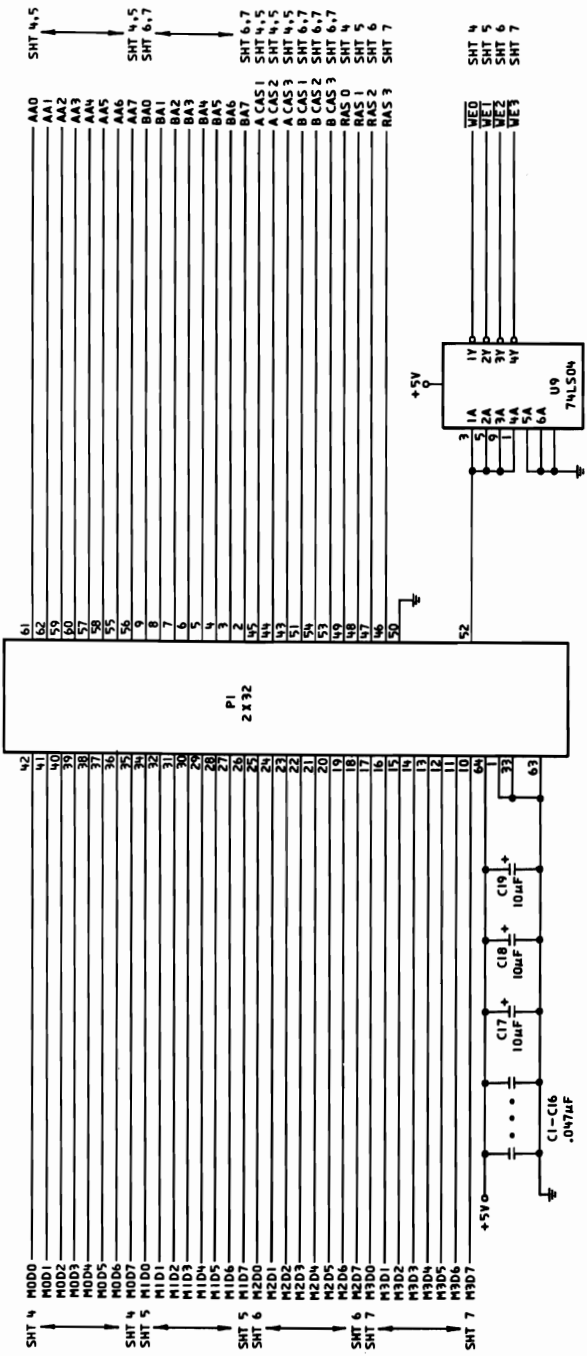
NOTE :

1 GROUNDS – ONE AT EACH END OF CONNECTOR.

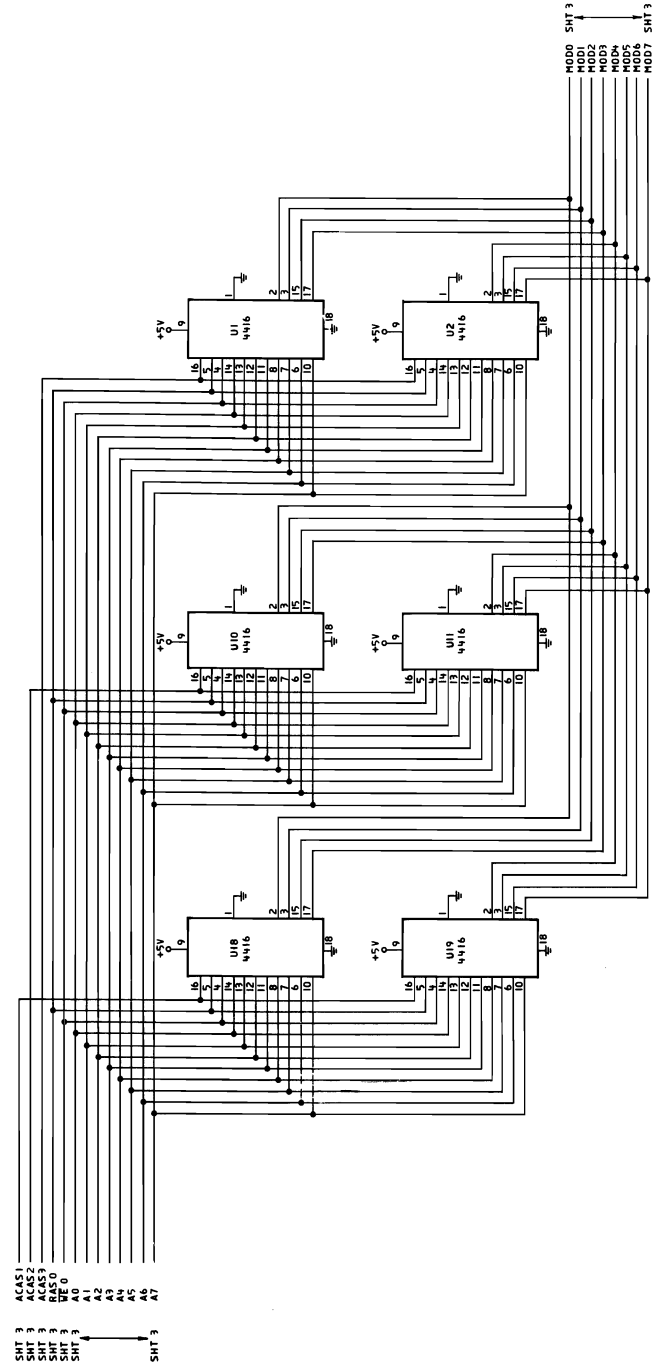
Enhanced Graphics Adapter Sheet 10 of 11



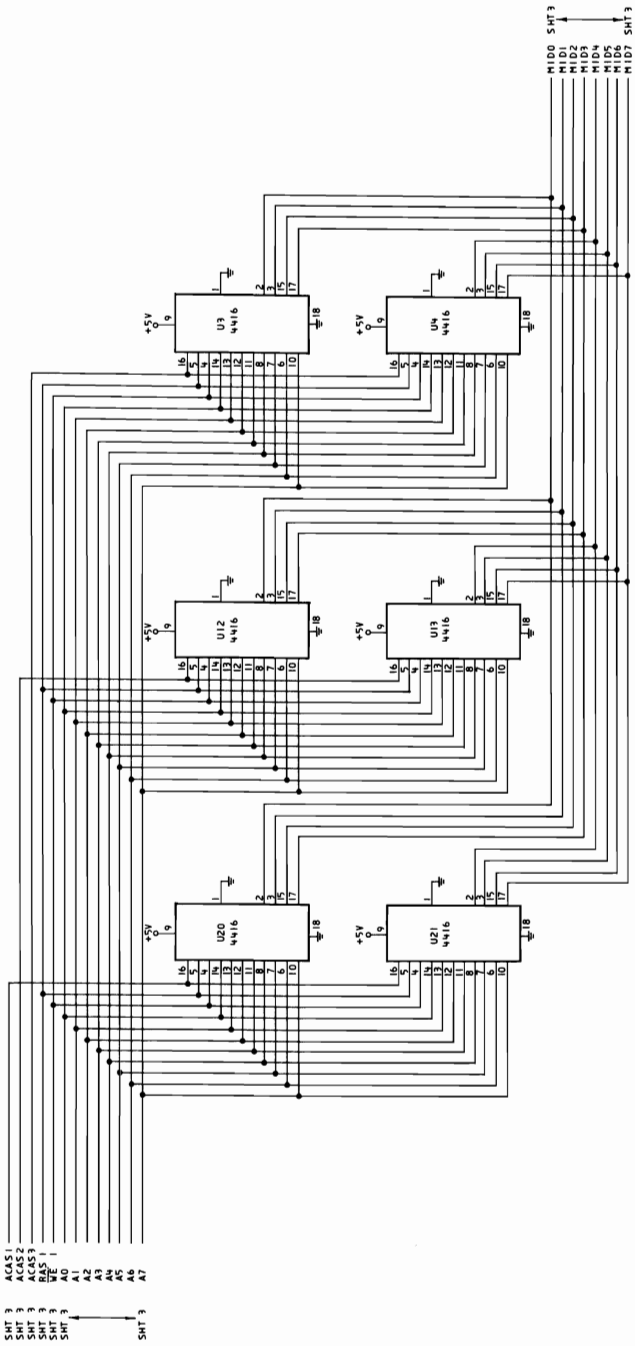
Enhanced Graphics Adapter Sheet 11 of 11



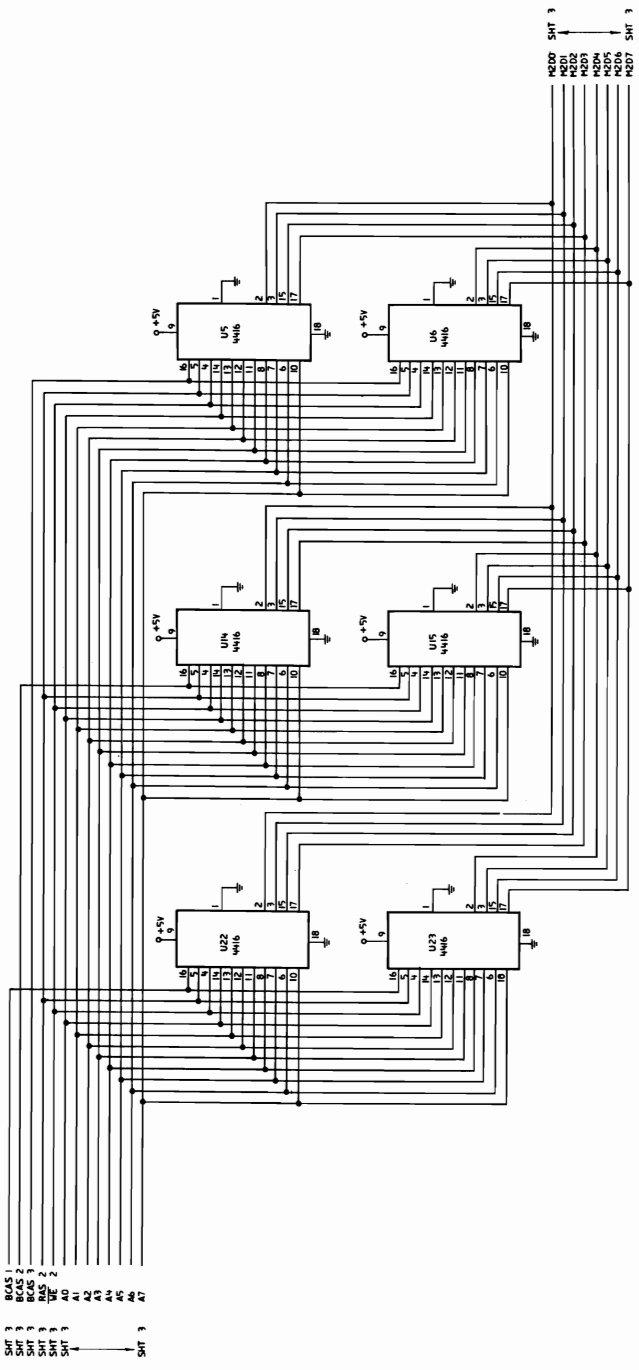
Graphics Memory Expansion Card Sheet 1 of 5



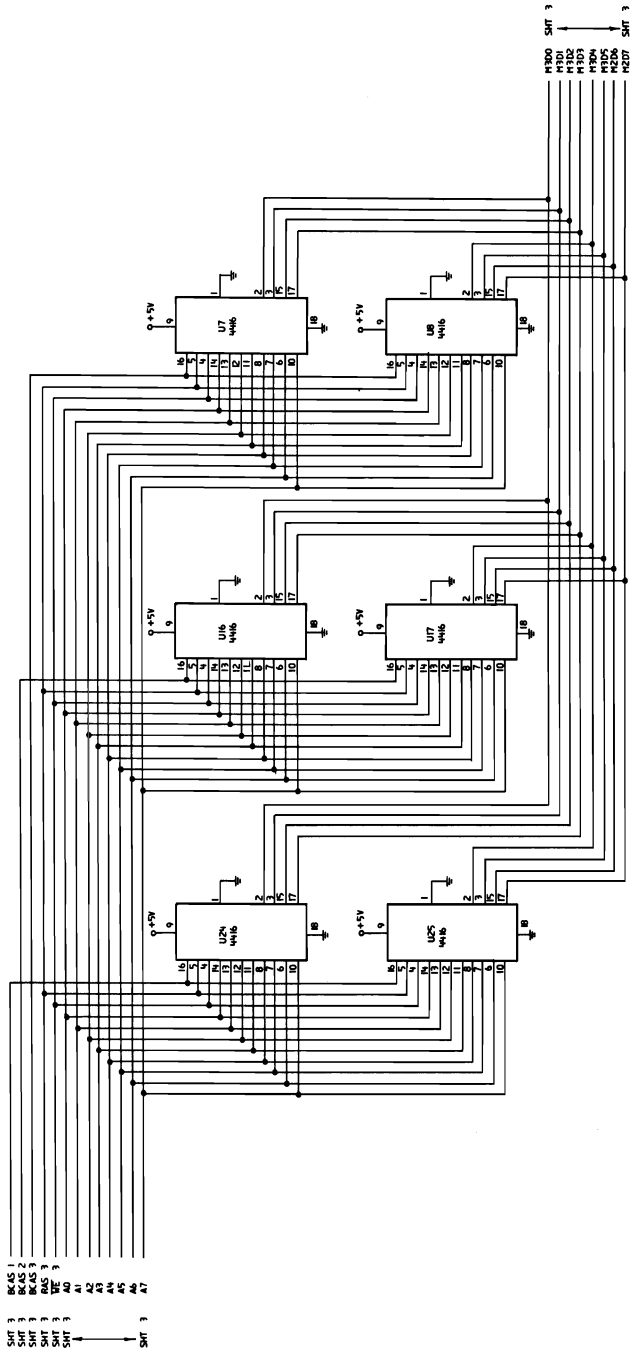
Graphics Memory Expansion Card Sheet 2 of 5



Graphics Memory Expansion Card Sheet 3 of 5



Graphics Memory Expansion Card Sheet 4 of 5



Graphics Memory Expansion Card Sheet 5 of 5

Vectors with Special Meanings

Interrupt Hex 42 - Reserved

When an IBM Enhanced Graphics Adapter is installed, the BIOS routines use interrupt 42 to revector the video pointer.

Interrupt Hex 43 - IBM Enhanced Graphics Video Parameters

When an IBM Enhanced Graphics Adapter is installed, the BIOS routines use this vector to point to a data region containing the parameters required for the initializing of the IBM Enhanced Graphics Adapter. Note that the format of the table must adhere to the BIOS conventions established in the listing. The power-on routines initialize this vector to point to the parameters contained in the IBM Enhanced Graphics Adapter ROM.

Interrupt Hex 44 - Graphics Character Table

When an IBM Enhanced Graphics Adapter is installed the BIOS routines use this vector to point to a table of dot patterns that will be used when graphics characters are to be displayed. This table will be used for the first 128 code points in video modes 4, 5, and 6. This table will be used for 256 characters in all additional graphics modes. See the appropriate BIOS interface for additional information on setting and using the graphics character table pointer.

```
                PAGE,120
                TITLE   ENHANCED GRAPHICS ADAPTER BIOS
                EXTRN   CGMN:NEAR, CGDDOT:NEAR, INT_1F_1:NEAR, CGMN_FDG:NEAR
                EXTRN   END_ADDRESS:NEAR

        ;--------------------------------------------------------------------
        ;       THE  BIOS ROUTINES ARE MEANT TO BE ACCESSED THROUGH         :
        ;       SOFTWARE INTERRUPTS ONLY.  ANY ADDRESSES PRESENT IN         :
        ;       THE LISTINGS  ARE INCLUDED  ONLY FOR  COMPLETENESS,         :
        ;       NOT FOR  REFERENCE.  APPLICATIONS WHICH  REFERENCE          :
        ;       ABSOLUTE   ADDRESSES   WITHIN   THE   CODE  SEGMENT         :
        ;       VIOLATE THE STRUCTURE AND DESIGN OF BIOS.                   :
        ;--------------------------------------------------------------------

        .LIST
C               INCLUDE         VFRONT.INC
C               SUBTTL  VFRONT.INC
C               PAGE
C
C       ;--- INT 10 ------------------------------------------------------------
C       ; VIDEO_IO                                                           :
C       ;       THESE ROUTINES PROVIDE THE CRT INTERFACE                     :
C       ;       THE FOLLOWING FUNCTIONS ARE PROVIDED:                        :
C       ;       (AH)=0  SET MODE (AL) CONTAINS MODE VALUE                    :
C       ;                                                                    :
C       ;       AL AD   TYPE    RES       NOTES  DF-DIM  DISPLAY      MAX PGS :
C       ;       ------------------------------------------------------------ :
C       ;         * 0 B8   ALPHA   640X200          40X25   COLOR - BW      8 :
C       ;           1 B8   ALPHA   640X200          40X25   COLOR           8 :
C       ;         * 2 B8   ALPHA   640X200          80X25   COLOR - BW      8 :
C       ;           3 B8   ALPHA   640X200          80X25   COLOR           8 :
C       ;           4 B8   GRPHX   320X200          40X25   COLOR           1 :
C       ;           5 B8   GRPHX   320X200          40X25   COLOR - BW      1 :
C       ;           6 B8   GRPHX   640X200          80X25   COLOR - BW      1 :
C       ;         * 7 B0   ALPHA   720X350          80X25   MONOCHROME      8 :
C       ;                                                                    :
C       ;           8      RESERVED                                          :
C       ;           9      RESERVED                                          :
C       ;           A      RESERVED                                          :
C       ;           B      RESERVED - INTERNAL USE                           :
C       ;           C      RESERVED - INTERNAL USE                           :
C       ;                                                                    :
C       ;           D A0   GRPHX   320X200          40X25   COLOR           8 :
C       ;           E A0   GRPHX   640X200          80X25   COLOR           4 :
C       ;           F A0   GRPHX   640X350          80X25   MONOCHROME      2 :
C       ;          10 A0   GRPHX   640X350          80X25   HI RES          2 :
C       ;                                                                    :
C       ;                                                                    :
C       ;                   NOTE : HIGH BIT AL SET PREVENTS REGEN BUFFER CLEAR ON :
C       ;                          MODES RUNNING ON THE COMBO VIDEO ADAPTER  :
C       ;                                                                    :
C       ;                   *** NOTE BW MODES OPERATE SAME AS COLOR MODES, BUT :
C       ;                       COLOR BURST IS NOT ENABLED                   :
C       ;           (AH)=1  SET CURSOR TYPE                                  :
C       ;                   (CH) =  BITS 4-0 = START LINE FOR CURSOR         :
C       ;                           ** HARDWARE WILL ALWAYS CAUSE BLINK      :
C       ;                           ** SETTING BIT 5 OR 6 WILL CAUSE ERRATIC :
C       ;                              BLINKING OR NO CURSOR AT ALL          :
C       ;                   (CL) =  BITS 4-0 = END LINE FOR CURSOR           :
C       ;           (AH)=2  SET CURSOR POSITION                              :
C       ;                   (DH,DL) = ROW,COLUMN  (0,0) IS UPPER LEFT        :
C       ;                   (BH) = PAGE NUMBER                               :
C       ;           (AH)=3  READ CURSOR POSITION                             :
C       ;                   (BH) = PAGE NUMBER                               :
C       ;                   ON EXIT (DH,DL) = ROW,COLUMN OF CURRENT CURSOR   :
C       ;                           (CH,CL) = CURSOR MODE CURRENTLY SET      :
C       ;           (AH)=4  READ LIGHT PEN POSITION                          :
C       ;                   ON EXIT:                                         :
C       ;                   (AH) = 0 -- LIGHT PEN SWITCH NOT DOWN/NOT TRIGGERED :
C       ;                   (AH) = 1 -- VALID LIGHT PEN VALUE IN REGISTERS   :
C       ;                           (DH,DL) = ROW,COLUMN OF CHARACTER LP POSN :
C       ;                           (CH) = RASTER LINE (0-199)               :
C       ;                           (CX) = RASTER LINE (0-MNN) NEW GRAPHICS MODES :
C       ;                           (BX) = PIXEL COLUMN (0-319,639)          :
C       ;           (AH)=5  SELECT ACTIVE DISPLAY PAGE                       :
C       ;                   (AL) = NEW PAGE VALUE, SEE AH=0 FOR PAGE INFO    :
C       ;           (AH)=6  SCROLL ACTIVE PAGE UP                            :
C       ;                   (AL) = NUMBER OF LINES, INPUT LINES BLANKED AT BOTTOM :
C       ;                          OF WINDOW                                 :
C       ;                           AL = 0 MEANS BLANK ENTIRE WINDOW         :
C       ;                   (CH,CL) = ROW,COLUMN OF UPPER LEFT CORNER OF SCROLL :
C       ;                   (DH,DL) = ROW,COLUMN OF LOWER RIGHT CORNER OF SCROLL :
C       ;                   (BH) = ATTRIBUTE TO BE USED ON BLANK LINE        :
C       ;           (AH)=7  SCROLL ACTIVE PAGE DOWN                          :
C       ;                   (AL) = NUMBER OF LINES, INPUT LINES BLANKED AT TOP :
C       ;                          OF WINDOW                                 :
C       ;                           AL = 0 MEANS BLANK ENTIRE WINDOW         :
C       ;                   (CH,CL) = ROW,COLUMN OF UPPER LEFT CORNER OF SCROLL :
C       ;                   (DH,DL) = ROW,COLUMN OF LOWER RIGHT CORNER OF SCROLL :
C       ;                   (BH) = ATTRIBUTE TO BE USED ON BLANK LINE        :
C       ;                                                                    :
C       ;           CHARACTER HANDLING ROUTINES                              :
C       ;                                                                    :
C       ;           (AH) = 8 READ ATTRIBUTE/CHARACTER AT CURRENT CURSOR POSITION :
C       ;                   (BH) = DISPLAY PAGE                              :
C       ;                   ON EXIT:                                         :
C       ;                   (AL) = CHAR READ                                 :
C       ;                   (AH) = ATTRIBUTE OF CHARACTER READ (ALPHA MODES ONLY) :
C       ;           (AH) = 9 WRITE ATTRIBUTE/CHARACTER AT CURRENT CURSOR POSITION :
C       ;                   (BH) = DISPLAY PAGE                              :
C       ;                   (CX) = COUNT OF CHARACTERS TO WRITE              :
C       ;                   (AL) = CHAR TO WRITE                             :
C       ;                   (BL) = ATTRIBUTE OF CHARACTER (ALPHA)/COLOR OF CHAR :
C       ;                          (GRAPHICS)                                :
C       ;                           SEE NOTE ON WRITE DOT FOR BIT 7 OF BL = 1. :
C       ;           (AH) = A  WRITE CHARACTER ONLY AT CURRENT CURSOR POSITION :
C       ;                   (BH) = DISPLAY PAGE                              :
C       ;                   (CX) = COUNT OF CHARACTERS TO WRITE              :
C       ;                   (AL) = CHAR TO WRITE                             :
C       ;           FOR READ/WRITE CHARACTER INTERFACE WHILE IN GRAPHICS MODE, THE :
C       ;                   CHARACTERS ARE FORMED FROM A CHARACTER GENERATOR IMAGE :
C       ;                   MAINTAINED IN THE SYSTEM ROM.  ONLY THE 1ST 128 CHARS :
C       ;                   ARE CONTAINED THERE.  TO READ/WRITE THE SECOND 128 :
C       ;                   CHARS,  THE USER MUST INITIALIZE THE POINTER AT  :
C       ;                   INTERRUPT 1FH (LOCATION 0007CH) TO POINT TO THE 1K BYTE :
C       ;                   TABLE CONTAINING THE CODE POINTS FOR THE SECOND  :
C       ;                   128 CHARS (128-255).                             :
C       ;                                                                    :
C       ;                   FOR THE NEW GRAPHICS MODES 256 GRAPHICS CHARS ARE :
C       ;                   SUPPLIED IN THE SYSTEM ROM.                      :
C       ;                                                                    :
C       ;           FOR WRITE CHARACTER INTERFACE IN GRAPHICS MODE, THE REPLICATION :
C       ;                   FACTOR CONTAINED IN (CX) ON ENTRY WILL PRODUCE VALID :
C       ;                   RESULTS ONLY FOR CHARACTERS CONTAINED ON THE SAME ROW. :
C       ;                   CONTINUATION TO SUCCEEDING LINES WILL NOT PRODUCE :
C       ;                   CORRECTLY.                                       :
```

```
127     C ;
128     C ;       GRAPHICS INTERFACE
129     C ;       (AH) = B  SET COLOR PALETTE
130     C ;                 FOR USE IN COMPATIBILITY MODES
131     C ;                 (BH) = PALETTE COLOR ID BEING SET (0-127)
132     C ;                 (BL) = COLOR VALUE TO BE USED WITH THAT COLOR ID
133     C ;                    NOTE: FOR THE CURRENT COLOR CARD, THIS ENTRY POINT
134     C ;                          HAS MEANING ONLY FOR 320X200 GRAPHICS.
135     C ;                          COLOR ID = 0 SELECTS THE BACKGROUND COLOR (0-15)
136     C ;                          COLOR ID = 1 SELECTS THE PALETTE TO BE USED:
137     C ;                                  0 = GREEN(1)/RED(2)/BROWN(3)
138     C ;                                  1 = CYAN(1)/MAGENTA(2)/WHITE(3)
139     C ;                          IN 40X25 OR 80X25 ALPHA MODES, THE VALUE SET
140     C ;                                FOR PALETTE COLOR 0 INDICATES THE
141     C ;                                BORDER COLOR TO BE USED (VALUES 0-31,
142     C ;                                WHERE 16-31 SELECT THE HIGH INTENSITY
143     C ;                                BACKGROUND SET).
144     C ;       (AH) = C  WRITE DOT
145     C ;                 (BH) = PAGE
146     C ;                 (DX) = ROW NUMBER
147     C ;                 (CX) = COLUMN NUMBER
148     C ;                 (AL) = COLOR VALUE
149     C ;                        IF BIT 7 OF AL = 1, THEN THE COLOR VALUE IS
150     C ;                        EXCLUSIVE OR'D WITH THE CURRENT CONTENTS OF
151     C ;                        THE DOT
152     C ;       (AH) = D  READ DOT
153     C ;                 (BH) = PAGE
154     C ;                 (DX) = ROW NUMBER
155     C ;                 (CX) = COLUMN NUMBER
156     C ;                 (AL) RETURNS THE DOT READ
157     C ;
158     C ; ASCII TELETYPE ROUTINE FOR OUTPUT
159     C ;
160     C ;       (AH) = E  WRITE TELETYPE TO ACTIVE PAGE
161     C ;                 (AL) = CHAR TO WRITE
162     C ;                 (BL) = FOREGROUND COLOR IN GRAPHICS MODE
163     C ;                 NOTE -- SCREEN WIDTH IS CONTROLLED BY PREVIOUS MODE SET
164     C ;
165     C ;       (AH) = F  CURRENT VIDEO STATE
166     C ;                 RETURNS THE CURRENT VIDEO STATE
167     C ;                 (AL) = MODE CURRENTLY SET  (SEE AH=0 FOR EXPLANATION)
168     C ;                 (AH) = NUMBER OF CHARACTER COLUMNS ON SCREEN
169     C ;                 (BH) = CURRENT ACTIVE DISPLAY PAGE
170     C ;
171     C ;       (AH) = 10  SET PALETTE REGISTERS
172     C ;
173     C ;                  (AL) = 0        SET INDIVIDUAL PALETTE REGISTER
174     C ;                   BL = PALETTE REGISTER TO BE SET
175     C ;                   BH = VALUE TO SET
176     C ;
177     C ;                  AL = 1        SET OVERSCAN REGISTER
178     C ;                  BH = VALUE TO SET
179     C ;
180     C ;                  AL = 2        SET ALL PALETTE REGISTERS AND OVERSCAN
181     C ;                  ES:DX POINTS TO A 17 BYTE TABLE
182     C ;                  BYTES 0 - 15 ARE THE PALETTE VALUES, RESPECTIVELY
183     C ;                  BYTE 16 IS THE OVERSCAN VALUE
184     C ;
185     C ;                  AL = 3          TOGGLE INTENSIFY/BLINKING BIT
186     C ;                         BL = 0  ENABLE INTENSIFY
187     C ;                         BL = 1  ENABLE BLINKING
188     C ;
189     C ;       (AH) = 11  CHARACTER GENERATOR ROUTINE
190     C ;                 NOTE : THIS CALL WILL INITIATE A MODE SET, COMPLETELY
191     C ;                        RESETTING THE VIDEO ENVIRONMENT BUT MAINTAINING
192     C ;                        THE REGEN BUFFER.
193     C ;
194     C ;                  AL = 00   USER ALPHA LOAD
195     C ;                         ES:BP - POINTER TO USER TABLE
196     C ;                         CX    - COUNT TO STORE
197     C ;                         DX    - CHARACTER OFFSET INTO TABLE
198     C ;                         BL    - BLOCK TO LOAD
199     C ;                         BH    - NUMBER OF BYTES PER CHARACTER
200     C ;                  AL = 01   ROM MONOCHROME SET
201     C ;                         BL    - BLOCK TO LOAD
202     C ;                  AL = 02   ROM 8X8 DOUBLE DOT
203     C ;                         BL    - BLOCK TO LOAD
204     C ;                  AL = 03   SET BLOCK SPECIFIER
205     C ;                         BL    - CHAR GEN BLOCK SPECIFIER
206     C ;                                 D3-D2  ATTR BIT 3 ONE,  CHAR GEN 0-3
207     C ;                                 D1-D0  ATTR BIT 3 ZERO, CHAR GEN 0-3
208     C ;                         NOTE : WHEN USING AL = 03 A FUNCTION CALL
209     C ;                                AX = 1000H
210     C ;                                BX = 0712H
211     C ;                                IS RECOMMENDED TO SET THE COLOR PLANES
212     C ;                                RESULTING IN 512 CHARACTERS AND EIGHT
213     C ;                                CONSISTENT COLORS.
214     C ;
215     C ;       NOTE : THE FOLLOWING INTERFACE (AL=1X) IS SIMILAR IN FUNCTION
216     C ;                TO (AL=0X) EXCEPT THAT :
217     C ;                         - PAGE ZERO MUST BE ACTIVE
218     C ;                         - POINTS (BYTES/CHAR) WILL BE RECALCULATED
219     C ;                         - ROWS WILL BE CALCULATED FROM THE FOLLOWING:
220     C ;                                 INT[(200 OR 350) / POINTS] - 1
221     C ;                         - CRT_LEN WILL BE CALCULATED FROM :
222     C ;                                 (ROWS + 1) * CRT_COLS * 2
223     C ;                         - THE CRTC WILL BE REPROGRAMMED AS FOLLOWS :
224     C ;                                 R09H = POINTS - 1       MAX SCAN LINE
225     C ;                                                         R09H DONE ONLY IN MODE 7
226     C ;                                 R0AH = POINTS - 2       CURSOR START
227     C ;                                 R0BH = 0                CURSOR END
228     C ;                                 R12H =                  VERT DISP END
229     C ;                                        [(ROWS + 1) * POINTS] - 1
230     C ;                                 R14H = POINTS           UNDERLINE LOC
231     C ;
232     C ;                THE ABOVE REGISTER CALCULATIONS MUST BE CLOSE TO THE
233     C ;                ORIGINAL TABLE VALUES OR UNDETERMINED RESULTS WILL
234     C ;                OCCUR.
235     C ;
236     C ;                NOTE : THE FOLLOWING INTERFACE IS DESIGNED TO BE
237     C ;                       CALLED ONLY IMMEDIATELY AFTER A MODE SET HAS
238     C ;                       BEEN ISSUED. FAILURE TO ADHERE TO THIS PRACTICE
239     C ;                       MAY CAUSE UNDETERMINED RESULTS.
240     C ;
241     C ;                  AL = 10   USER ALPHA LOAD
242     C ;                         ES:BP - POINTER TO USER TABLE
243     C ;                         CX    - COUNT TO STORE
244     C ;                         DX    - CHARACTER OFFSET INTO TABLE
245     C ;                         BL    - BLOCK TO LOAD
246     C ;                         BH    - NUMBER OF BYTES PER CHARACTER
247     C ;                  AL = 11   ROM MONOCHROME SET
248     C ;                         BL    - BLOCK TO LOAD
249     C ;                  AL = 12   ROM 8X8 DOUBLE DOT
250     C ;                         BL    - BLOCK TO LOAD
251     C ;
252     C ;
```

```
                                253     C ;               NOTE : THE FOLLOWING INTERFACE IS DESIGNED TO BE        :
                                254     C ;                      CALLED ONLY IMMEDIATELY AFTER A MODE SET HAS     :
                                255     C ;                      BEEN ISSUED. FAILURE TO ADHERE TO THIS PRACTICE  :
                                256     C ;                      MAY CAUSE UNDETERMINED RESULTS.                  :
                                257     C ;                                                                       :
                                258     C ;               AL = 20   USER GRAPHICS CHARS  INT 01FH (8X8)           :
                                259     C ;                      ES:BP - POINTER TO USER TABLE                    :
                                260     C ;               AL = 21   USER GRAPHICS CHARS                           :
                                261     C ;                      ES:BP - POINTER TO USER TABLE                    :
                                262     C ;                      CX    - POINTS (BYTES PER CHARACTER)             :
                                263     C ;                      BL    - ROW SPECIFIER                            :
                                264     C ;                                                                       :
                                265     C ;                              BL = 0  USER                             :
                                266     C ;                                      DL - ROWS                        :
                                267     C ;                              BL = 1  14 (0EH)                         :
                                268     C ;                              BL = 2  25 (19H)                         :
                                269     C ;                              BL = 3  43 (2BH)                         :
                                270     C ;                                                                       :
                                271     C ;               AL = 22   ROM 8 X 14 SET                                :
                                272     C ;                      BL    - ROW SPECIFIER                            :
                                273     C ;               AL = 23   ROM 8 X 8 DOUBLE DOT                          :
                                274     C ;                      BL    - ROW SPECIFIER                            :
                                275     C ;                                                                       :
                                276     C ;                                                                       :
                                277     C ;               AL = 30   INFORMATION                                   :
                                278     C ;                                CX    - POINTS                         :
                                279     C ;                                DL    - ROWS                           :
                                280     C ;                       BH    - 0       RETURN CURRENT INT 1FH PTR      :
                                281     C ;                                ES:BP - PTR TO TABLE                   :
                                282     C ;                       BH    - 1       RETURN CURRENT INT 44H PTR      :
                                283     C ;                                ES:BP - PTR TO TABLE                   :
                                284     C ;                       BH    - 2       RETURN ROM 8 X 14 PTR           :
                                285     C ;                                ES:BP - PTR TO TABLE                   :
                                286     C ;                       BH    - 3       RETURN ROM DOUBLE DOT PTR       :
                                287     C ;                                ES:BP - PTR TO TABLE                   :
                                288     C ;                       BH    - 4       RETURN ROM DOUBLE DOT PTR (TOP) :
                                289     C ;                                ES:BP - PTR TO TABLE                   :
                                290     C ;                       BH    - 5       RETURN ROM ALPHA ALTERNATE 9X14 :
                                291     C ;                                ES:BP - PTR TO TABLE                   :
                                292     C ;                                                                       :
                                293     C ;         (AH) = 12   ALTERNATE SELECT                                  :
                                294     C ;                                                                       :
                                295     C ;                 BL = 10  RETURN EGA INFORMATION                       :
                                296     C ;                          BH = 0 - COLOR MODE IN EFFECT <3><D><X>      :
                                297     C ;                               1 - MONOC MODE IN EFFECT <3><B><X>      :
                                298     C ;                          BL = MEMORY VALUE                            :
                                299     C ;                                0 0 - 064K      0 1 - 128K             :
                                300     C ;                                1 0 - 192K      1 1 - 256K             :
                                301     C ;                          CH = FEATURE BITS                            :
                                302     C ;                          CL = SWITCH SETTING                          :
                                303     C ;                                                                       :
                                304     C ;                 BL = 20  SELECT ALTERNATE PRINT SCREEN ROUTINE        :
                                305     C ;                                                                       :
                                306     C ;         (AH) = 13   WRITE STRING                                      :
                                307     C ;                          ES:BP - POINTER TO STRING TO BE WRITTEN      :
                                308     C ;                          CX    - CHARACTER ONLY COUNT                 :
                                309     C ;                          DX    - POSITION TO BEGIN STRING, IN CURSOR  :
                                310     C ;                                  TERMS                                :
                                311     C ;                          BH    - PAGE NUMBER                          :
                                312     C ;                                                                       :
                                313     C ;                 AL = 0                                            :
                                314     C ;                          BL    - ATTRIBUTE                            :
                                315     C ;                          STRING - (CHAR, CHAR, CHAR, ...)             :
                                316     C ;                          CURSOR NOT MOVED                             :
                                317     C ;                 AL = 1                                            :
                                318     C ;                          BL    - ATTRIBUTE                            :
                                319     C ;                          STRING - (CHAR, CHAR, CHAR, ...)             :
                                320     C ;                          CURSOR  IS MOVED                             :
                                321     C ;                 AL = 2                                            :
                                322     C ;                          STRING - (CHAR, ATTR, CHAR, ATTR, ...)       :
                                323     C ;                          CURSOR NOT MOVED                             :
                                324     C ;                 AL = 3                                            :
                                325     C ;                          STRING - (CHAR, ATTR, CHAR, ATTR, ...)       :
                                326     C ;                          CURSOR  IS MOVED                             :
                                327     C ;                                                                       :
                                328     C ;                 NOTE : CHAR RET, LINE FEED, BACKSPACE, AND BELL ARE   :
                                329     C ;                        TREATED AS COMMANDS RATHER THAN PRINTABLE      :
                                330     C ;                        CHARACTERS.                                    :
                                331     C ;                                                                       :
                                332     C ;-----------------------------------------------------------------------
                                333     C
                                334     C SRLOAD  MACRO   SEGREG,VALUE
                                335     C         IFNB <VALUE>
                                336     C         IFIDN <VALUE>,<0>
                                337     C         SUB     DX,DX
                                338     C         ELSE
                                339     C         MOV     DX,VALUE
                                340     C         ENDIF
                                341     C         ENDIF
                                342     C         MOV     SEGREG,DX
                                343     C         ENDM
                                344     C
                                345     C
                                346     C ;----- LOW MEMORY SEGMENT
                                347     C
0000                            348     C ABS0    SEGMENT AT    0
0014                            349     C         ORG     005H*4                          ; PRINT SCREEN VECTOR
0014                            350     C INT5_PTR        LABEL   DWORD
0040                            351     C         ORG     010H*4                          ; VIDEO I/O VECTOR
0040                            352     C VIDEO           LABEL   DWORD
007C                            353     C         ORG     01FH*4                          ; GRAPHIC CHARS 128-255
007C                            354     C EXT_PTR         LABEL   DWORD
                                355     C
0108                            356     C         ORG     042H*4                          ; REVECTORED 10H*4
0108                            357     C PLANAR_VIDEO    LABEL   DWORD
                                358     C
010C                            359     C         ORG     043H*4                          ; GRAPHIC CHARS 0-255
010C                            360     C GRX_SET         LABEL   DWORD
                                361     C
0410                            362     C         ORG     0410H
0410                            363     C EQUIP_LOW       LABEL   BYTE
0410  ????                      364     C EQUIP_FLAG      DW      ?
                                365     C
                                366     C ;----- REUSE RAM FROM PLANAR BIOS
                                367     C
0449                            368     C         ORG     449H
0449  ??                        369     C CRT_MODE        DB      ?
044A  ????                      370     C CRT_COLS        DW      ?
044C  ????                      371     C CRT_LEN         DW      ?
044E  ????                      372     C CRT_START       DW      ?
0450     08 [                   373     C CURSOR_POSN     DW      8 DUP(?)
            ????
               ]                374     C
                                375     C
                                376     C
0460  ????                      377     C CURSOR_MODE     DW      ?
0462  ??                        378     C ACTIVE_PAGE     DB      ?
```

```
0463  ????                379     C  ADDR_6845        DW      ?
0465  ??                  380     C  CRT_MODE_SET     DB      ?
0466  ??                  381     C  CRT_PALETTE      DB      ?
                          382     C
0472                      383     C                   ORG     0472H
0472  ????                384     C  RESET_FLAG       DW      ?
0484                      385     C                   ORG     0484H
0484  ??                  386     C  ROWS             DB      ?                       ; ROWS ON THE SCREEN
0485  ????                387     C  POINTS           DW      ?                       ; BYTES PER CHARACTER
                          388     C
0487  ??                  389     C  INFO             DB      ?
                          390     C
                          391     C  ; INFO
                          392     C  ;       D7 - HIGH BIT OF MODE SET, CLEAR/NOT CLEAR REGEN
                          393     C  ;       D6 - MEMORY  D6 D5 = 0 0 - 064K    0 1 - 128K
                          394     C  ;       D5 - MEMORY          1 0 - 192K    1 1 - 256K
                          395     C  ;       D4 - RESERVED
                          396     C  ;       D3 - EGA ACTIVE MONITOR (0), EGA NOT ACTIVE (1)
                          397     C  ;       D2 - WAIT FOR DISPLAY ENABLE (1)
                          398     C  ;       D1 - EGA HAS A MONOCHROME ATTACHED (1)
                          399     C  ;       D0 - SET C_TYPE EMULATE ACTIVE (0)
                          400     C
0488  ??                  401     C  INFO_3           DB      ?
                          402     C
                          403     C  ; INFO_3
                          404     C  ;       D7-D4   FEATURE BITS
                          405     C  ;       D3-D0   SWITCHES
                          406     C
04A8                      407     C                   ORG     04A8H
04A8                      408     C  SAVE_PTR         LABEL   DWORD
                          409     C
                          410     C  ;----- SAVE_PTR
                          411     C  ;
                          412     C  ;       SAVE_PTR IS A POINTER TO A TABLE AS DESCRIBED AS FOLLOWS :
                          413     C  ;
                          414     C  ;       DWORD_1          VIDEO PARAMETER TABLE POINTER
                          415     C  ;       DWORD_2          DYNAMIC SAVE AREA POINTER
                          416     C  ;       DWORD_3          ALPHA MODE AUXILIARY CHAR GEN POINTER
                          417     C  ;       DWORD_4          GRAPHICS MODE AUXILIARY CHAR GEN POINTER
                          418     C  ;       DWORD_5          RESERVED
                          419     C  ;       DWORD_6          RESERVED
                          420     C  ;       DWORD_7          RESERVED
                          421     C  ;
                          422     C  ;       DWORD_1          PARAMETER TABLE POINTER
                          423     C  ;                        INITIALIZED TO BIOS EGA PARAMETER TABLE.
                          424     C  ;                        THIS VALUE MUST EXIST.
                          425     C  ;
                          426     C  ;       DWORD_2          PARAMETER SAVE AREA POINTER
                          427     C  ;                        INITIALIZED TO 0000:0000, THIS VALUE IS OPTIONAL.
                          428     C  ;                        WHEN NON-ZERO, THIS POINTER WILL BE USED AS POINTER
                          429     C  ;                        TO A RAM AREA WHERE CERTAIN DYNAMIC VALUES ARE TO
                          430     C  ;                        BE SAVED. WHEN IN EGA OPERATION THIS RAM AREA WILL
                          431     C  ;                        HOLD THE 16 EGA PALETTE REGISTER VALUES PLUS
                          432     C  ;                        THE OVERSCAN VALUE IN BYTES 0-16D RESPECTIVELY.
                          433     C  ;                        AT LEAST 256 BYTES MUST BE ALLOCATED FOR THIS AREA.
                          434     C  ;
                          435     C  ;       DWORD_3          ALPHA MODE AUXILIARY POINTER
                          436     C  ;                        INITIALIZED TO 0000:0000, THIS VALUE IS OPTIONAL.
                          437     C  ;                        WHEN NON-ZERO, THIS POINTER IS USED AS A POINTER
                          438     C  ;                        TO A TABLES DESCRIBED AS FOLLOWS :
                          439     C  ;
                          440     C  ;                        BYTE    BYTES/CHARACTER
                          441     C  ;                        BYTE    BLOCK TO LOAD, SHOULD BE ZERO FOR NORMAL
                          442     C  ;                                OPERATION
                          443     C  ;                        WORD    COUNT TO STORE, SHOULD BE 256D FOR NORMAL
                          444     C  ;                                OPERATION
                          445     C  ;                        WORD    CHARACTER OFFSET, SHOULD BE ZERO FOR NORMAL
                          446     C  ;                                OPERATION
                          447     C  ;                        DWORD   POINTER TO A FONT TABLE
                          448     C  ;                        BYTE    DISPLAYABLE ROWS
                          449     C  ;                                IF 'FF' THE MAXIMUM CALCULATED VALUE WILL BE
                          450     C  ;                                USED, ELSE THIS VALUE WILL BE USED
                          451     C  ;                        BYTE    CONSECUTIVE BYTES OF MODE VALUES FOR WHICH
                          452     C  ;                                THIS FONT DESCRIPTION IS TO BE USED.
                          453     C  ;                                THE END OF THIS STREAM IS INDICATED BY A
                          454     C  ;                                BYTE CODE OF 'FF'
                          455     C  ;
                          456     C  ;                        NOTE : USE OF THIS POINTER MAY CAUSE UNEXPECTED
                          457     C  ;                               CURSOR TYPE OPERATION. FOR AN EXPLANATION
                          458     C  ;                               OF CURSOR TYPE SEE AH = 01 IN THE INTERFACE
                          459     C  ;                               SECTION.
                          460     C  ;
                          461     C  ;       DWORD_4          GRAPHICS MODE AUXILIARY POINTER
                          462     C  ;                        INITIALIZED TO 0000:0000, THIS VALUE IS OPTIONAL.
                          463     C  ;                        WHEN NON-ZERO, THIS POINTER IS USED AS A POINTER
                          464     C  ;                        TO A TABLES DESCRIBED AS FOLLOWS :
                          465     C  ;
                          466     C  ;                        BYTE    DISPLAYABLE ROWS
                          467     C  ;                        WORD    BYTES PER CHARACTER
                          468     C  ;                        DWORD   POINTER TO A FONT TABLE
                          469     C  ;                        BYTE    CONSECUTIVE BYTES OF MODE VALUES FOR WHICH
                          470     C  ;                                THIS FONT DESCRIPTION IS TO BE USED.
                          471     C  ;                                THE END OF THIS STREAM IS INDICATED BY A
                          472     C  ;                                BYTE CODE OF 'FF'
                          473     C  ;
                          474     C  ;       DWORD_5 THRU DWORD_7
                          475     C  ;                        RESERVED AND SET TO 0000:0000.
                          476     C  ;
                          477     C
0500                      478     C                   ORG     0500H
0500  ??                  479     C  STATUS_BYTE      DB      ?
0501                      480     C  ABSO             ENDS
                          481     C
= 0061                    482     C  PORT_B           EQU     61H                     ; 8255 PORT B ADDR
= 0040                    483     C  TIMER            EQU     40H
                          484     C
                          485     C  ;----- EQUATES FOR CARD PORT ADDRESSES
                          486     C
= 03C4                    487     C           SEQ_ADDR        EQU     3C4H
= 03C5                    488     C           SEQ_DATA        EQU     3C5H
= 03D4                    489     C           CRTC_ADDR       EQU     3D4H
= 03B4                    490     C           CRTC_ADDR_B     EQU     3B4H
= 03D5                    491     C           CRTC_DATA       EQU     3D5H            ; OR 3B5H
= 03CC                    492     C           GRAPH_1_POS     EQU     3CCH
= 03CA                    493     C           GRAPH_2_POS     EQU     3CAH
= 03CE                    494     C           GRAPH_ADDR      EQU     3CEH
= 03CF                    495     C           GRAPH_DATA      EQU     3CFH
= 03C2                    496     C           MISC_OUTPUT     EQU     3C2H
= 03C2                    497     C           IN_STAT_0       EQU     3C2H
= 03BA                    498     C           INPUT_STATUS_B  EQU     3BAH
= 03DA                    499     C           INPUT_STATUS    EQU     3DAH
= 03DA                    500     C           ATTR_READ       EQU     3DAH
= 03C0                    501     C           ATTR_WRITE      EQU     3C0H
                          502     C
                          503     C  ;----- EQUATES FOR ADDRESS REGISTER VALUES
                          504     C
```

```
= 0000                          S_RESET         EQU     00H
= 0001                          S_CLOCK         EQU     01H
= 0002                          S_MAP           EQU     02H
= 0003                          S_CGEN          EQU     03H
= 0004                          S_MEM           EQU     04H

= 0000                          C_HRZ_TOT       EQU     00H
= 0001                          C_HRZ_DSP       EQU     01H
= 0002                          C_STRT_HRZ_BLK  EQU     02H
= 0003                          C_END_HRZ_BLK   EQU     03H
= 0004                          C_STRT_HRZ_SYN  EQU     04H
= 0005                          C_END_HRZ_SYN   EQU     05H
= 0006                          C_VRT_TOT       EQU     06H
= 0007                          C_OVERFLOW      EQU     07H
= 0008                          C_PRE_ROW       EQU     08H
= 0009                          C_MAX_SCAN_LN   EQU     09H
= 000A                          C_CRSR_START    EQU     0AH
= 000B                          C_CRSR_END      EQU     0BH
= 000C                          C_STRT_HGH      EQU     0CH
= 000D                          C_STRT_LOW      EQU     0DH
= 000E                          C_CRSR_LOC_HGH  EQU     0EH
= 000F                          C_CRSR_LOC_LOW  EQU     0FH
= 0010                          C_VRT_SYN_STRT  EQU     10H             ; WRITE ONLY
= 0010                          C_LGHT_PEN_HGH  EQU     10H             ; READ ONLY
= 0011                          C_VRT_SYN_END   EQU     11H             ; WRITE ONLY
= 0011                          C_LGHT_PEN_LOW  EQU     11H             ; READ ONLY
= 0012                          C_VRT_DSP_END   EQU     12H
= 0013                          C_OFFSET        EQU     13H
= 0014                          C_UNDERLN_LOC   EQU     14H
= 0015                          C_STRT_VRT_BLK  EQU     15H
= 0016                          C_END_VRT_BLK   EQU     16H
= 0017                          C_MODE_CNTL     EQU     17H
= 0018                          C_LN_COMP       EQU     18H

= 0000                          G_SET_RESET     EQU     00H
= 0001                          G_ENBL_SET      EQU     01H
= 0002                          G_CLR_COMP      EQU     02H
= 0003                          G_DATA_ROT      EQU     03H
= 0004                          G_READ_MAP      EQU     04H
= 0005                          G_MODE          EQU     05H
= 0006                          G_MISC          EQU     06H
= 0007                          G_COLOR         EQU     07H
= 0008                          G_BIT_MASK      EQU     08H

= 0010                          P_MODE          EQU     10H
= 0011                          P_OVERSC        EQU     11H
= 0012                          P_CPLANE        EQU     12H
= 0013                          P_HPEL          EQU     13H

                                SUBTTL

                            ;----- CODE SEGMENT

0000                        CODE    SEGMENT PUBLIC

                                INCLUDE         VPOST.INC
                                SUBTTL  VPOST.INC
                                PAGE

                            ;----- POST

                                ASSUME  CS:CODE,DS:ABSO
0000                            ORG     0H
0000  55                        DB      055H                            ; SIGNATURE
0001  AA                        DB      0AAH                            ;  BYTES
0002  20                        DB      020H                            ; LENGTH INDICATOR

                            ;----- NOTE : DO NOT USE THE SIGNATURE BYTES AS A PRESENCE TEST

                            ;       PLANAR VIDEO SWITCH SETTINGS

                            ;       0 0 - UNUSED
                            ;       0 1 - 40 X 25 COLOR
                            ;       1 0 - 80 X 25 COLOR
                            ;       1 1 - 80 X 25 MONOCHROME
                            ; NOTE : 0 0 MUST BE SET WHEN THIS ADAPTER IS INSTALLED.

                            ;       VIDEO ADAPTER SWITCH SETTINGS

                            ;       0 0 0 0 - MONOC PRIMARY, EGA COLOR, 40X25
                            ;       0 0 0 1 - MONOC PRIMARY, EGA COLOR, 80X25
                            ;       0 0 1 0 - MONOC PRIMARY, EGA HI RES EMULATE (SAME AS 0001)
                            ;       0 0 1 1 - MONOC PRIMARY, EGA HI RES ENHANCED
                            ;       0 1 0 0 - COLOR 40 PRIMARY, EGA MONOCHROME
                            ;       0 1 0 1 - COLOR 80 PRIMARY, EGA MONOCHROME

                            ;       0 1 1 0 - MONOC SECONDARY, EGA COLOR, 40X25
                            ;       0 1 1 1 - MONOC SECONDARY, EGA COLOR, 80X25
                            ;       1 0 0 0 - MONOC SECONDARY, EGA HI RES EMULATE (SAME AS 0111)
                            ;       1 0 0 1 - MONOC SECONDARY, EGA HI RES ENHANCED
                            ;       1 0 1 0 - COLOR 40 SECONDARY, EGA MONOCHROME
                            ;       1 0 1 1 - COLOR 80 SECONDARY, EGA MONOCHROME

                            ;       1 1 0 0 - RESERVED
                            ;       1 1 0 1 - RESERVED
                            ;       1 1 1 0 - RESERVED
                            ;       1 1 1 1 - RESERVED

                            ;----- SETUP ROUTINE FOR THIS MODULE

0003                        VIDEO_SETUP     PROC    FAR
0003  EB 28                     JMP     SHORT   L1
0005  32 34 30 30               DB      '2400'
0009  36 32 37 37 33 35         DB      '6277356 (C)COPYRIGHT IBM 1984'
      36 20 28 43 29 43
      4F 50 59 52 49 47
      48 54 20 49 42 4D
      20 31 39 38 34
0026  39 2F 31 33 2F 38         DB      '9/13/84'
      34

                            ;----- SET UP VIDEO VECTORS

002D                        L1:
002D  B6 03                     MOV     DH,3
002F  B2 DA                     MOV     DL,INPUT_STATUS
0031  EC                        IN      AL,DX
0032  B2 BA                     MOV     DL,INPUT_STATUS_B
0034  EC                        IN      AL,DX
0035  B2 C0                     MOV     DL,ATTR_WRITE
0037  B0 00                     MOV     AL,0
0039  EE                        OUT     DX,AL

                                SRLOAD  DS,0
003A  2B D2                     SUB     DX,DX
003C  8E DA                     MOV     DS,DX
```

```
003E  FA                          631     C               CLI
003F  C7 06 0040 R 0CD7 R         632     C               MOV     WORD PTR VIDEO,OFFSET COMBO_VIDEO
0045  8C 0E 0042 R                633     C               MOV     WORD PTR VIDEO+2, CS
0049  C7 06 010B R F065           634     C               MOV     WORD PTR PLANAR_VIDEO,0F065H
004F  C7 06 010A R F000           635     C               MOV     WORD PTR PLANAR_VIDEO+2,0F000H
0055  C7 06 04A8 R 010C R         636     C               MOV     WORD PTR SAVE_PTR,OFFSET SAVE_TBL
005B  8C 0E 04AA R                637     C               MOV     WORD PTR SAVE_PTR+2, CS
005F  C7 06 007C R 0000 E         638     C               MOV     WORD PTR EXT_PTR, OFFSET INT_1F_1
0065  8C 0E 007E R                639     C               MOV     WORD PTR EXT_PTR+2, CS
0069  C7 06 010C R 0000 E         640     C               MOV     WORD PTR GRX_SET, OFFSET CGDDOT
006F  8C 0E 010E R                641     C               MOV     WORD PTR GRX_SET+2, CS
0073  FB                          642     C               STI
                                  643     C
                                  644     C       ;----- POST FOR COMBO VIDEO CARD
                                  645     C
0074  C6 06 0487 R 04             646     C               MOV     INFO,00000100B
0079  E8 009B R                   647     C               CALL    RD_SWS
007C  88 1E 0488 R                648     C               MOV     INFO_3,BL
0080  E8 00CE R                   649     C               CALL    F_BTS
0083  08 06 0488 R                650     C               OR      INFO_3,AL
0087  8A 1E 0488 R                651     C               MOV     BL,INFO_3
008B  E8 00F3 R                   652     C               CALL    MK_ENV
008E  E9 0244 R                   653     C               JMP     POST
0091                              654     C       SKIP:
0091  CB                          655     C               RET
0092                              656     C       VIDEO_SETUP     ENDP
                                  657     C
                                  658     C
0092                              659     C       POR_1   PROC    NEAR
0092  EE                          660     C               OUT     DX,AL
0093  50                          661     C               PUSH    AX
0094  58                          662     C               POP     AX
0095  EC                          663     C               IN      AL,DX
0096  24 10                       664     C               AND     AL,010H
0098  D0 E8                       665     C               SHR     AL,1
009A  C3                          666     C               RET
009B                              667     C       POR_1   ENDP
                                  668     C
                                  669     C       ;----- READ THE SWITCH SETTINGS ON THE CARD
                                  670     C
009B                              671     C       RD_SWS  PROC    NEAR
                                  672     C               ASSUME  DS:ABS0
009B  B6 03                       673     C               MOV     DH,3
009D  B2 C2                       674     C               MOV     DL,MISC_OUTPUT
009F  B0 01                       675     C               MOV     AL,1
00A1  EE                          676     C               OUT     DX,AL
                                  677     C
                                  678     C       ;----- COULD BE 0,4,8,C
                                  679     C
00A2  B0 0D                       680     C               MOV     AL,0DH
00A4  E8 0092 R                   681     C               CALL    POR_1
00A7  D0 E8                       682     C               SHR     AL,1
00A9  D0 E8                       683     C               SHR     AL,1
00AB  D0 E8                       684     C               SHR     AL,1
00AD  8A D8                       685     C               MOV     BL,AL
                                  686     C
00AF  B0 09                       687     C               MOV     AL,9
00B1  E8 0092 R                   688     C               CALL    POR_1
00B4  D0 E8                       689     C               SHR     AL,1
00B6  D0 E8                       690     C               SHR     AL,1
00B8  0A D8                       691     C               OR      BL,AL
                                  692     C
00BA  B0 05                       693     C               MOV     AL,5
00BC  E8 0092 R                   694     C               CALL    POR_1
00BF  D0 E8                       695     C               SHR     AL,1
00C1  0A D8                       696     C               OR      BL,AL
                                  697     C
00C3  B0 01                       698     C               MOV     AL,1
00C5  E8 0092 R                   699     C               CALL    POR_1
00C8  0A D8                       700     C               OR      BL,AL
                                  701     C
00CA  80 E3 0F                    702     C               AND     BL,0FH
00CD  C3                          703     C               RET
00CE                              704     C       RD_SWS  ENDP
                                  705     C
                                  706     C       ;----- OBTAIN THE FEATURE BITS FROM DAUGHTER CARD
                                  707     C
00CE                              708     C       F_BTS   PROC    NEAR
00CE  B6 03                       709     C               MOV     DH,3
00D0  B2 BA                       710     C               MOV     DL,0BAH
00D2  B0 01                       711     C               MOV     AL,1
00D4  EE                          712     C               OUT     DX,AL
00D5  B2 DA                       713     C               MOV     DL,0DAH
00D7  EE                          714     C               OUT     DX,AL
00D8  B2 C2                       715     C               MOV     DL,IN_STAT_0
00DA  EC                          716     C               IN      AL,DX                   ; READ FEATURE BITS
00DB  24 60                       717     C               AND     AL,060H
00DD  D0 E8                       718     C               SHR     AL,1
00DF  8A D8                       719     C               MOV     BL,AL
00E1  B2 BA                       720     C               MOV     DL,0BAH
00E3  B0 02                       721     C               MOV     AL,2
00E5  EE                          722     C               OUT     DX,AL
00E6  B2 DA                       723     C               MOV     DL,0DAH
00E8  EE                          724     C               OUT     DX,AL
00E9  B2 C2                       725     C               MOV     DL,IN_STAT_0
00EB  EC                          726     C               IN      AL,DX                   ; READ FEATURE BITS
00EC  24 60                       727     C               AND     AL,060H
00EE  D0 E0                       728     C               SHL     AL,1
00F0  0A C3                       729     C               OR      AL,BL
00F2  C3                          730     C               RET
00F3                              731     C       F_BTS   ENDP
                                  732     C
                                  733     C       ;----- ESTABLISH THE VIDEO ENVIRONMENT, KEYED OFF OF THE SWITCHES
                                  734     C
00F3                              735     C       MK_ENV  PROC    NEAR
                                  736     C               ASSUME  DS:ABS0
00F3  2A FF                       737     C               SUB     BH,BH
00F5  80 E3 0F                    738     C               AND     BL,0FH
00F8  D1 E3                       739     C               SAL     BX,1
00FA  52                          740     C               PUSH    DX
00FB  B6 03                       741     C               MOV     DH,3
00FD  8A E6                       742     C               MOV     AH,DH
00FF  5A                          743     C               POP     DX
0100  80 E4 01                    744     C               AND     AH,1
0103  FE C4                       745     C               INC     AH
0105  F6 D4                       746     C               NOT     AH
0107  2E: FF A7 0128 R            747     C               JMP     WORD PTR CS:[BX + OFFSET T5]
                                  748     C
010C                              749     C       SAVE_TBL        LABEL   DWORD
010C  0717 R                      750     C               DW      OFFSET  VIDEO_PARMS     ; PARMS
010E  C000                        751     C               DW      0C000H                  ; PARMS
0110  0000                        752     C               DW      0                       ; PAL SAVE AREA
0112  0000                        753     C               DW      0                       ; PAL SAVE AREA
0114  0000                        754     C               DW      0                       ; ALPHA TABLES
0116  0000                        755     C               DW      0                       ; ALPHA TABLES
0118  0000                        756     C               DW      0                       ; GRAPHICS TABLES
```

```
011A  0000                    757     C               DW      0                       ; GRAPHICS TABLES
                              758     C
011C  0000                    759     C               DW      0
011E  0000                    760     C               DW      0
0120  0000                    761     C               DW      0
0122  0000                    762     C               DW      0
0124  0000                    763     C               DW      0
0126  0000                    764     C               DW      0
                              765     C
0128                          766     C  T5           LABEL   WORD
0128  0173 R                 767     C               DW      OFFSET PST_0
012A  017E R                  768     C               DW      OFFSET PST_1
012C  017E R                  769     C               DW      OFFSET PST_2
012E  0189 R                  770     C               DW      OFFSET PST_3
0130  0194 R                  771     C               DW      OFFSET PST_4
0132  01A8 R                  772     C               DW      OFFSET PST_5
0134  01BC R                  773     C               DW      OFFSET PST_6
0136  01C7 R                  774     C               DW      OFFSET PST_7
                              775     C
0138  01C7 R                  776     C               DW      OFFSET PST_8
013A  01D2 R                  777     C               DW      OFFSET PST_9
013C  01DD R                  778     C               DW      OFFSET PST_A
013E  01F1 R                  779     C               DW      OFFSET PST_B
0140  0204 R                  780     C               DW      OFFSET PST_OUT
0142  0204 R                  781     C               DW      OFFSET PST_OUT
0144  0204 R                  782     C               DW      OFFSET PST_OUT
0146  0204 R                  783     C               DW      OFFSET PST_OUT
                              784     C
0148                          785     C  ENV_X        PROC    NEAR                    ; SET 40X25 COLOR ALPHA
0148  80 26 0410 R CF         786     C               AND     EQUIP_LOW,0CFH
014D  80 0E 0410 R 10         787     C               OR      EQUIP_LOW,010H
0152  B8 0001                 788     C               MOV     AX,1H
0155  CD 10                   789     C               INT     10H
0157  C3                     790     C               RET
0158                          791     C  ENV_X        ENDP
                              792     C
0158                          793     C  ENV_0        PROC    NEAR                    ; SET 80X25 COLOR ALPHA
0158  80 26 0410 R CF         794     C               AND     EQUIP_LOW,0CFH
015D  80 0E 0410 R 20         795     C               OR      EQUIP_LOW,020H
0162  B8 0003                 796     C               MOV     AX,03H
0165  CD 10                   797     C               INT     10H
0167  C3                     798     C               RET
0168                          799     C  ENV_0        ENDP
                              800     C
0168                          801     C  ENV_3        PROC    NEAR                    ; SET MONOCHROME ALPHA
0168  80 0E 0410 R 30         802     C               OR      EQUIP_LOW,030H
016D  B8 0007                 803     C               MOV     AX,07H
0170  CD 10                   804     C               INT     10H
0172  C3                     805     C               RET
0173                          806     C  ENV_3        ENDP
                              807     C
                              808     C
0173                          809     C  PST_0:
0173  20 26 0487 R            810     C               AND     INFO,AH
0177  E8 0148 R               811     C               CALL    ENV_X
017A  E8 0168 R               812     C               CALL    ENV_3
017D  C3                      813     C               RET
017E                          814     C  PST_1:
017E                          815     C  PST_2:
017E  20 26 0487 R            816     C               AND     INFO,AH
0182  E8 0158 R               817     C               CALL    ENV_0
0185  E8 0168 R               818     C               CALL    ENV_3
0188  C3                      819     C               RET
0189                          820     C  PST_3:
0189  20 26 0487 R            821     C               AND     INFO,AH
018D  E8 0158 R               822     C               CALL    ENV_0
0190  E8 0168 R               823     C               CALL    ENV_3
0193  C3                      824     C               RET
0194                          825     C  PST_4:
0194  B6 03                   826     C               MOV     DH,3
0196  B2 C2                   827     C               MOV     DL,MISC_OUTPUT
0198  B0 00                   828     C               MOV     AL,0
019A  EE                      829     C               OUT     DX,AL
019B  F6 D4                   830     C               NOT     AH
019D  08 26 0487 R            831     C               OR      INFO,AH
01A1  E8 0168 R               832     C               CALL    ENV_3
01A4  E8 0148 R               833     C               CALL    ENV_X
01A7  C3                      834     C               RET
01A8                          835     C  PST_5:
01A8  B6 03                   836     C               MOV     DH,3
01AA  B2 C2                   837     C               MOV     DL,MISC_OUTPUT
01AC  B0 00                   838     C               MOV     AL,0
01AE  EE                      839     C               OUT     DX,AL
01AF  F6 D4                   840     C               NOT     AH
01B1  08 26 0487 R            841     C               OR      INFO,AH
01B5  E8 0168 R               842     C               CALL    ENV_3
01B8  E8 0158 R               843     C               CALL    ENV_0
01BB  C3                      844     C               RET
01BC                          845     C  PST_6:
01BC  20 26 0487 R            846     C               AND     INFO,AH
01C0  E8 0168 R               847     C               CALL    ENV_3
01C3  E8 0148 R               848     C               CALL    ENV_X
01C6  C3                      849     C               RET
01C7                          850     C  PST_7:
01C7                          851     C  PST_8:
01C7  20 26 0487 R            852     C               AND     INFO,AH
01CB  E8 0168 R               853     C               CALL    ENV_3
01CE  E8 0158 R               854     C               CALL    ENV_0
01D1  C3                      855     C               RET
01D2                          856     C  PST_9:
01D2  20 26 0487 R            857     C               AND     INFO,AH
01D6  E8 0168 R               858     C               CALL    ENV_3
01D9  E8 0158 R               859     C               CALL    ENV_0
01DC  C3                      860     C               RET
01DD                          861     C  PST_A:
01DD  B6 03                   862     C               MOV     DH,3
01DF  B2 C2                   863     C               MOV     DL,MISC_OUTPUT
01E1  B0 00                   864     C               MOV     AL,0
01E3  EE                      865     C               OUT     DX,AL
01E4  F6 D4                   866     C               NOT     AH
01E6  08 26 0487 R            867     C               OR      INFO,AH
01EA  E8 0148 R               868     C               CALL    ENV_X
01ED  E8 0168 R               869     C               CALL    ENV_3
01F0  C3                      870     C               RET
01F1                          871     C  PST_B:
01F1  B6 03                   872     C               MOV     DH,3
01F3  B2 C2                   873     C               MOV     DL,MISC_OUTPUT
01F5  B0 00                   874     C               MOV     AL,0
01F7  EE                      875     C               OUT     DX,AL
01F8  F6 D4                   876     C               NOT     AH
01FA  08 26 0487 R            877     C               OR      INFO,AH
01FE  E8 0158 R               878     C               CALL    ENV_0
0201  E8 0168 R               879     C               CALL    ENV_3
0204                          880     C  PST_OUT:
0204  C3                      881     C               RET
0205                          882     C  MK_ENV       ENDP
```

```
                                883     C
                                884     C ;--------------------------------------------------------------------------------
                                885     C ; THIS ROUTINE TESTS THE CRT CARD INTERNAL DATA BUS AND IN A LIMITED         :
                                886     C ; WAY TESTS THE CRTC VIDEO CHIP BY WRITING/READING FROM CURSOR REGISTER      :
                                887     C ; CARRY IS SET IF AN ERROR IS FOUND                                          :
                                888     C ;                                                                            :
                                889     C ; REGISTERS BX,SI,ES,DS ARE PRESERVED.                                       :
                                890     C ; REGISTERS AX,CX,DX ARE MODIFYED.                                           :
                                891     C ;--------------------------------------------------------------------------------
0205                            892     C CD_PRESENCE_TST PROC    NEAR
0205  53                        893     C         PUSH    BX                    ; SAVE BX
0206  BB 007F                  894     C         MOV     BX,07FH               ; INITIAL WORD PATTERN BYTE
0209  8B F8                    895     C         MOV     DI,BX
020B  50                        896     C         PUSH    AX                    ; SAVE PORT ADDRESS
020C  E8 022C R                 897     C         CALL    RD_CURSOR             ;
020F  8B F0                    898     C         MOV     SI,AX                 ; SAVE ORIGINAL VALUE
0211  58                        899     C         POP     AX                    ; RECOVER PORT ADDRESS
0212  50                        900     C         PUSH    AX                    ; SAVE PORT ADDRESS
0213  E8 0236 R                 901     C         CALL    WR_CURSOR             ; WRITE CURSOR
0216  58                        902     C         POP     AX                    ; RECOVER PORT ADDRESS
0217  50                        903     C         PUSH    AX                    ; SAVE PORT ADDRESS
0218  E8 022C R                 904     C         CALL    RD_CURSOR             ; READ IT BACK
021B  3B C7                    905     C         CMP     AX,DI                 ; SAME?
021D  58                        906     C         POP     AX
021E  75 03                    907     C         JNZ     NOT_PRESENT           ; EXIT IF NOT EQUAL
0220  EB 05 90                  908     C         JMP     TST_EX
0223                            909     C NOT_PRESENT:
0223  33 C0                    910     C         XOR     AX,AX                 ; SET NOT PRESENT
0225  5B                        911     C         POP     BX
0226  C3                        912     C         RET
0227                            913     C TST_EX:
0227  B8 0001                  914     C         MOV     AX,1                  ; SET PRESENT ON EXIT
022A  5B                        915     C         POP     BX                    ; RESTORE BX
022B  C3                        916     C         RET
022C                            917     C CD_PRESENCE_TST ENDP
                                918     C
                                919     C ;--------------------------------------------------------------------------------
                                920     C ; MODULE NAME  RD_CURSOR                                                     :
                                921     C ;  READ CURSOR POSITION [ADDRESS] (FROM CRTC) TO  AX                         :
                                922     C ;                                                                            :
                                923     C ; REGISTER AX IS MODIFIED.                                                   :
                                924     C ;--------------------------------------------------------------------------------
022C                            925     C RD_CURSOR       PROC NEAR
022C  52                        926     C         PUSH    DX                    ; SAVE REGS USED
022D  8B D0                    927     C         MOV     DX,AX
022F  B0 0E                    928     C         MOV     AL,C_CRSR_LOC_HGH
0231  EE                        929     C         OUT     DX,AL
0232  42                        930     C         INC     DX
0233  EC                        931     C         IN      AL,DX
                                932     C                                       ; RETURN WITH CURSOR POS IN AX
                                933     C                                       ; RESTORE REGS USED
0234  5A                        934     C         POP     DX
0235  C3                        935     C         RET
0236                            936     C RD_CURSOR       ENDP
                                937     C
                                938     C ;--------------------------------------------------------------------------------
                                939     C ; MODULE NAME  WR_CURSOR                                                     :
                                940     C ;  WRITE CURSOR POSITION [ADDRESS] (TO CRTC) WITH CONTENTS OF AX             :
                                941     C ;                                                                            :
                                942     C ; ALL REGISTERS PRESERVED                                                    :
                                943     C ;--------------------------------------------------------------------------------
0236                            944     C WR_CURSOR       PROC NEAR
                                945     C                                       ; SAVE REGS USED
0236  50                        946     C         PUSH    AX
0237  52                        947     C         PUSH    DX
0238  8B D0                    948     C         MOV     DX,AX
023A  B4 0E                    949     C         MOV     AH,C_CRSR_LOC_HGH     ; CURSOR LOCATION HIGH INDEX
023C  B0 7F                    950     C         MOV     AL,07FH               ; TEST VALUE
023E  E8 0D15 R                 951     C         CALL    OUT_DX
                                952     C                                       ; RETURN WITH CURSOR POS IN AX
                                953     C                                       ; RESTORE REGS USED
0241  5A                        954     C         POP     DX
0242  58                        955     C         POP     AX
0243  C3                        956     C         RET
0244                            957     C WR_CURSOR       ENDP
                                958     C
0244                            959     C POST:
                                960     C ;-------------------------------------------------
                                961     C ;       INITIALIZE AND START CRT CONTROLLER (6845)      :
                                962     C ;       ON COLOR GRAPHICS AND MONOCHROME CARDS          :
                                963     C ;       TEST VIDEO READ/WRITE STORAGE.                  :
                                964     C ; DESCRIPTION                                           :
                                965     C ;       RESET THE VIDEO ENABLE SIGNAL.                  :
                                966     C ;       SELECT ALPHANUMERIC MODE, 40 * 25, B & W.       :
                                967     C ;       READ/WRITE DATA PATTERNS TO STG. CHECK STG      :
                                968     C ;       ADDRESSABILITY.                                 :
                                969     C ;-------------------------------------------------
                                970     C         ASSUME  DS:ABS0,ES:ABS0
0244  E8 0CFE R                 971     C         CALL    DDS
0247  F6 06 0487 R 02           972     C         TEST    INFO,2
024C  75 12                    973     C         JNZ     COLOR_PRESENCE_TST
024E  B8 03B4                  974     C         MOV     AX,03B4H
0251  E8 0205 R                 975     C         CALL    CD_PRESENCE_TST
0254  3D 0001                  976     C         CMP     AX,1
0257  74 03                    977     C         JE      CONT1
0259  E9 0317 R                 978     C         JMP     POD14
025C                            979     C CONT1:
025C  B4 30                    980     C         MOV     AH,30H                ; MONOCHROME CARD INSTALLED
025E  EB 10                    981     C         JMP     SHORT   OVER
0260                            982     C COLOR_PRESENCE_TST:
0260  B8 03D4                  983     C         MOV     AX,03D4H
0263  E8 0205 R                 984     C         CALL    CD_PRESENCE_TST
0266  3D 0001                  985     C         CMP     AX,1
0269  74 03                    986     C         JE      CONT2
026B  E9 0317 R                 987     C         JMP     POD14
026E                            988     C CONT2:
026E  B4 20                    989     C         MOV     AH,20H                ; COLOR GRAPHICS CARD INSTALLED
0270                            990     C OVER:
0270  50                        991     C         PUSH    AX                    ; RESAVE VALUE
0271  BB B000                  992     C         MOV     BX,0B000H             ; BEG VIDEO RAM ADDR B/W CD
0274  BA 03B8                  993     C         MOV     DX,3B8H               ; MODE CONTROL B/W
0277  B9 1000                  994     C         MOV     CX,4096               ; RAM BYTE CNT FOR B/W CD
027A  B0 01                    995     C         MOV     AL,1                  ; SET MODE FOR BW CARD
027C  80 FC 30                 996     C         CMP     AH,30H                ; B/W VIDEO CARD ATTACHED?
027F  74 08                    997     C         JE      E9                    ; YES - GO TEST VIDEO STG
0281  B7 B8                    998     C         MOV     BH,0B8H               ; BEG VIDEO RAM ADDR COLOR CD
0283  B2 D8                    999     C         MOV     DL,0D8H               ; MODE CONTROL COLOR
0285  B5 40                   1000     C         MOV     CH,40H                ; RAM BYTE CNT FOR COLOR CD
0287  FE C8                   1001     C         DEC     AL                    ; SET MODE TO 0 FOR COLOR CD
0289                           1002     C E9:
0289  EE                       1003     C         OUT     DX,AL                 ; DISABLE VIDEO FOR COLOR CD
                               1004     C
028A  8B 2E 0472 R             1005     C         MOV     BP,DS:RESET_FLAG      ; POD INITIALIZED BY KBD RESET
                               1006     C
028E  81 FD 1234               1007     C         CMP     BP,1234H              ; POD INITIATED BY KBD RESET?
0292  8E C3                    1008     C         MOV     ES,BX                 ; POINT ES TO VIDEO RAM STG
```

```
0294  74 07                1009  C          JE      E10                     ; YES - SKIP VIDEO RAM TEST
0296  8E DB                1010  C          MOV     DS,BX                   ; POINT DS TO VIDEO RAM STG
                           1011  C          ASSUME  DS:NOTHING,ES:NOTHING
0298  E8 02DF R             1012  C          CALL    STGTST_CNT              ; GO TEST VIDEO R/W STG
029B  75 2E                1013  C          JNE     E17                     ; R/W STG FAILURE - BEEP SPK
                           1014  C          ;--------------------------------------------------------
                           1015  C          ;       SETUP VIDEO DATA ON SCREEN FOR VIDEO LINE TEST.        :
                           1016  C          ; DESCRIPTION                                                  :
                           1017  C          ;       ENABLE VIDEO SIGNAL AND SET MODE.                      :
                           1018  C          ;       DISPLAY A HORIZONTAL BAR ON SCREEN.                    :
                           1019  C          ;--------------------------------------------------------
029D                       1020  C          E10:
029D  58                   1021  C          POP     AX                      ; GET VIDEO SENSE SWS (AH)
029E  50                   1022  C          PUSH    AX                      ; SAVE IT
029F  B8 7020              1023  C          MOV     AX,7020H                ; WRT BLANKS IN REVERSE VIDEO
02A2  2B FF                1024  C          MOV     DI,DI                   ; SETUP STARTING LOC
02A4  B9 0028              1025  C          MOV     CX,40                   ; NO. OF BLANKS TO DISPLAY
02A7  F3/ AB               1026  C          REP     STOSW                   ; WRITE VIDEO STORAGE
                           1027  C          ;--------------------------------------------------------
                           1028  C          ;       CRT INTERFACE LINES TEST                               :
                           1029  C          ; DESCRIPTION                                                  :
                           1030  C          ;       SENSE ON/OFF TRANSITION OF THE VIDEO ENABLE            :
                           1031  C          ;       AND HORIZONTAL SYNC LINES.                             :
                           1032  C          ;--------------------------------------------------------
02A9  58                   1033  C          POP     AX                      ; GET VIDEO SENSE SW INFO
02AA  50                   1034  C          PUSH    AX                      ; SAVE IT
02AB  80 FC 30             1035  C          CMP     AH,30H                  ; B/W CARD ATTACHED?
02AE  BA 03BA              1036  C          MOV     DX,03BAH                ; SETUP ADDR OF BW STATUS PORT
02B1  74 02                1037  C          JE      E11                     ; YES - GO TEST LINES
02B3  B2 DA                1038  C          MOV     DL,0DAH                 ; COLOR CARD IS ATTACHED
02B5                       1039  C          E11:                            ; LINE_TST:
02B5  B4 08                1040  C          MOV     AH,8
02B7                       1041  C          E12:                            ; OFLOOP_CNT:
02B7  2B C9                1042  C          SUB     CX,CX
02B9                       1043  C          E13:
02B9  EC                   1044  C          IN      AL,DX                   ; READ CRT STATUS PORT
02BA  22 C4                1045  C          AND     AL,AH                   ; CHECK VIDEO/HORZ LINE
02BC  75 04                1046  C          JNZ     E14                     ; ITS ON - CHECK IF IT GOES OFF
02BE  E2 F9                1047  C          LOOP    E13                     ; LOOP TILL ON OR TIMEOUT
02C0  EB 09                1048  C          JMP     SHORT E17               ; GO PRINT ERROR MSG
02C2                       1049  C          E14:
02C2  2B C9                1050  C          SUB     CX,CX
02C4                       1051  C          E15:
02C4  EC                   1052  C          IN      AL,DX                   ; READ CRT STATUS PORT
02C5  22 C4                1053  C          AND     AL,AH                   ; CHECK VIDEO/HORZ LINE
02C7  74 0A                1054  C          JZ      E16                     ; ITS ON - CHECK NEXT LINE
02C9  E2 F9                1055  C          LOOP    E15                     ; LOOP IF OFF TILL IT GOES ON
02CB                       1056  C          E17:                            ;  CRT_ERR
02CB  BA 0102              1057  C          MOV     DX,102H
02CE  E8 06C8 R            1058  C          CALL    ERR_BEEP                ; GO BEEP SPEAKER
02D1  EB 06                1059  C          JMP     SHORT E18
02D3                       1060  C          E16:                            ; NXT_LINE
02D3  B1 03                1061  C          MOV     CL,3                    ; GET NEXT BIT TO CHECK
02D5  D2 EC                1062  C          SHR     AH,CL
02D7  75 DE                1063  C          JNZ     E12                     ; GO CHECK HORIZONTAL LINE
02D9                       1064  C          E18:                            ;  DISPLAY_CURSOR:
02D9  58                   1065  C          POP     AX                      ; GET VIDEO SENSE SWS (AH)
02DA  EB 38                1066  C          JMP     SHORT   POD14
                           1067  C
                           1068  C          ;--------------------------------------------------------------------------------
                           1069  C          ;       THIS SUBROUTINE PERFORMS A READ/WRITE STORAGE TEST ON                   :
                           1070  C          ;       A 16K BLOCK OF STORAGE.                                                :
                           1071  C          ; ENTRY REQUIREMENTS:                                                          :
                           1072  C          ;       ES = ADDRESS OF STORAGE SEGMENT BEING TESTED                           :
                           1073  C          ;       DS = ADDRESS OF STORAGE SEGMENT BEING TESTED                           :
                           1074  C          ;       WHEN ENTERING AT STGTST_CNT, CX MUST BE LOADED WITH                    :
                           1075  C          ;       THE BYTE COUNT.                                                        :
                           1076  C          ; EXIT PARAMETERS:                                                             :
                           1077  C          ;       ZERO FLAG = 0 IF STORAGE ERROR (DATA COMPARE OR PARITY CHECK.          :
                           1078  C          ;                 AL = 0 DENOTES A PARITY CHECK. ELSE AL=XOR'ED BIT            :
                           1079  C          ;                        PATTERN OF THE EXPECTED DATA PATTERN VS THE            :
                           1080  C          ;                        ACTUAL DATA READ.                                      :
                           1081  C          ;       AX,BX,CX,DX,DI, AND SI ARE ALL DESTROYED.                              :
                           1082  C          ;--------------------------------------------------------------------------------
02DC                       1083  C          STGTST  PROC    NEAR
02DC  B9 4000              1084  C          MOV     CX,4000H                ; SETUP CNT TO TEST A 16K BLK
02DF                       1085  C          STGTST_CNT:
02DF  FC                   1086  C          CLD                             ; SET DIR FLAG TO INCREMENT
02E0  8B D9                1087  C          MOV     BX,CX                   ; SAVE CNT (4K FOR VIDEO OR 16K)
02E2  B8 AAAA              1088  C          MOV     AX,0AAAAH               ; GET DATA PATTERN TO WRITE
02E5  BA FF55              1089  C          MOV     DX,0FF55H               ; SETUP OTHER DATA PATTERNS TO USE
02E8  2B FF                1090  C          SUB     DI,DI                   ; DI = OFFSET 0 RELATIVE TO ES REG
02EA  F3/ AA               1091  C          REP     STOSB                   ; WRITE STORAGE LOCATIONS
02EC                       1092  C          C3:                             ;  STG01
02EC  4F                   1093  C          DEC     DI                      ; POINT TO LAST BYTE JUST WRITTEN
02ED  FD                   1094  C          STD                             ; SET DIR FLAG TO GO BACKWARDS
02EE                       1095  C          C4:
02EE  8B F7                1096  C          MOV     SI,DI
02F0  8B CB                1097  C          MOV     CX,BX                   ; SETUP BYTE CNT
02F2                       1098  C          C5:                             ; INNER TEST LOOP
02F2  AC                   1099  C          LODSB                           ; READ OLD TEST BYTE [SI]+
02F3  32 C4                1100  C          XOR     AL,AH                   ; DATA READ AS EXPECTED ?
02F5  75 1E                1101  C          JNE     C7                      ;  NO - GO TO ERROR ROUTINE
02F7  8A C2                1102  C          MOV     AL,DL                   ; GET NEXT DATA PATTERN TO WRITE
02F9  AA                   1103  C          STOSB                           ; WRITE INTO LOCATION JUST READ
02FA  E2 F6                1104  C          LOOP    C5                      ;  DECREMENT COUNT AND LOOP CX
                           1105  C
02FC  22 E4                1106  C          AND     AH,AH                   ; ENDING 0 PATTERN WRITTEN TO STG?
02FE  74 13                1107  C          JZ      C6X                     ; YES - RETURN TO CALLER WITH AL=0
0300  8A E0                1108  C          MOV     AH,AL                   ; SETUP NEW VALUE FOR COMPARE
0302  86 F2                1109  C          XCHG    DH,DL                   ; MOVE NEXT DATA PATTERN TO DL
0304  22 E4                1110  C          AND     AH,AH                   ; READING ZERO PATTERN THIS PASS ?
0306  75 04                1111  C          JNZ     C6                      ; CONTINUE TEST SEQUENCE TILL 0
0308  8A D4                1112  C          MOV     DL,AH                   ;  ELSE SET 0 FOR END READ PATTERN
030A  EB E0                1113  C          JMP     C3                      ;  AND MAKE FINAL BACKWARDS PASS
030C                       1114  C          C6:
030C  FC                   1115  C          CLD                             ; SET DIR FLAG TO GO FORWARD
030D  47                   1116  C          INC     DI                      ; SET POINTER TO BEG LOCATION
030E  74 DE                1117  C          JZ      C4                      ; READ/WRITE FORWARD IN STG
0310  4F                   1118  C          DEC     DI                      ; ADJUST POINTER
0311  EB D9                1119  C          JMP     C3                      ; READ/WRITE BACKWARD IN STG
0313                       1120  C          C6X:
0313  B0 00                1121  C          MOV     AL,000H                 ; AL=0 DATA COMPARE OK
0315                       1122  C          C7:
0315  FC                   1123  C          CLD                             ; SET DIRECTION FLAG BACK TO INC
0316  C3                   1124  C          RET
0317                       1125  C          STGTST  ENDP
                           1126  C
                           1127  C          ;--------------------------------------------------------
                           1128  C          ;                   EGA CRT ATTACHMENT TEST             :
                           1129  C          ;                                                       :
                           1130  C          ; 1. INIT CRT TO 40X25 - BW  ****SET TO MODE****       :
                           1131  C          ; 2. CHECK FOR VERTICAL AND VIDEO ENABLES, AND CHECK    :
                           1132  C          ;    TIMING OF SAME                                     :
                           1133  C          ; 3. CHECK VERTICAL INTERRUPT                           :
                           1134  C          ; 4. CHECK RED, BLUE, GREEN, AND INTENSIFY DOTS         :
```

```
                                1135  C  ; 5. INIT TO 40X25 - COLOR/MONO ****SET TO MODE****     :
                                1136  C  ;-----------------------------------------------------
                                1137  C
                                1138  C  ;----- NOMINAL TIME IS B286H FOR 60 HZ.
                                1139  C  ;----- NOMINAL TIME IS A2FEH FOR 50 HZ.
                                1140  C
= A0AC                          1141  C  MAX_VERT_COLOR  EQU     0A0ACH                  ; MAX TIME FOR VERT/VERT
                                1142  C                                                  ;  (NOMINAL + 10%)
= C460                          1143  C  MIN_VERT_COLOR  EQU     0C460H                  ; MIN TIME FOR VERT/VERT
                                1144  C                                                  ;  (NOMINAL - 10%)
= 00C8                          1145  C  CENAB_PER_FRAME EQU     200                     ; NUM OF ENABLES PER FRAME
= 8D99                          1146  C  MAX_VERT_MONO   EQU     08D99H                  ; MAX TIME FOR VERT/VERT
                                1147  C                                                  ;  (NOMINAL + 10%)
= B862                          1148  C  MIN_VERT_MONO   EQU     0B862H                  ; MIN TIME FOR VERT/VERT
                                1149  C                                                  ;  (NOMINAL - 10%)
= 015E                          1150  C  EENAB_PER_FRAME EQU     350                     ; ENHANCED ENABLES PER FRAME
= 015E                          1151  C  MENAB_PER_FRAME EQU     350                     ; NUM OF ENABLES PER FRAME
                                1152  C
= 0043                          1153  C  TIM_CTL         EQU     043H                    ; 8253 TIMER CONTROL PORT
= 0040                          1154  C  TIMER0          EQU     040H                    ; 8253 TIMER/CNTER 0 PORT
                                1155  C
0317                            1156  C  POD14    PROC    NEAR
0317  83 EC 0A                  1157  C          SUB     SP,0AH                          ; RESERVE 5 WORDS ON STACK
031A  8B EC                     1158  C          MOV     BP,SP                           ; INIT SCRATCH PAD POINTER
                                1159  C
                                1160  C          ASSUME  DS:ABS0,ES:ABS0
031C  E8 0CFE R                 1161  C          CALL    DDS
031F  B0 30                     1162  C          MOV     AL,00110000B                    ; SET TIMER 0 TO MODE 0
                                1163  C
0321  E6 43                     1164  C          OUT     TIM_CTL,AL
0323  B0 00                     1165  C          MOV     AL,00H
0325  E6 40                     1166  C          OUT     TIMER0,AL                       ; SEND FIRST BYTE TO TIMER
0327  F6 06 0487 R 02           1167  C          TEST    INFO,2
032C  74 1F                     1168  C          JZ      COLOR_EGA_V
032E  E8 0168 R                 1169  C          CALL    ENV_3                           ; SET UP IN MONOCHROME
0331  C7 46 02 015E             1170  C          MOV     WORD PTR[BP][2],MENAB_PER_FRAME ; NUM.OF FRAMES FOR MONO
0336  C7 46 04 8D99             1171  C          MOV     WORD PTR[BP][4],MAX_VERT_MONO   ; MAX TIME FOR VERT/VERT
033B  C7 46 06 B862             1172  C          MOV     WORD PTR[BP][6],MIN_VERT_MONO   ; MIN TIME FOR VERT/VERT
0340  B2 B4                     1173  C          MOV     DL,CRTC_ADDR_B                  ; MONO CRTC REG
0342  B4 01                     1174  C          MOV     AH,C_HRZ_DSP                    ; HORIZ. TOTAL DIPLAY
0344  B0 27                     1175  C          MOV     AL,27H                          ;  TO 40 COL
0346  E8 0D15 R                 1176  C          CALL    OUT_DX                          ;
0349  B2 BA                     1177  C          MOV     DL,INPUT_STATUS_B               ; 3BA
034B  EB 2A                     1178  C          JMP     SHORT  COMMON
034D                            1179  C  COLOR_EGA_V:
034D  E8 0148 R                 1180  C          CALL    ENV_X                           ; SET UP IN 40X25 COLOR
0350  E8 0E9A R                 1181  C          CALL    BRST_DET                        ; ENHANCED MODE
0353  73 11                     1182  C          JNC     COLOR_V                         ; NO,40X25
0355  B2 D4                     1183  C          MOV     DL,CRTC_ADDR                    ; BRST MODE ONLY!
0357  B4 01                     1184  C          MOV     AH,1                            ; HRZ DSP END
0359  B0 14                     1185  C          MOV     AL,20                           ; MODIFY FOR TEST ONLY
035B  E8 0D15 R                 1186  C          CALL    OUT_DX
035E  C7 46 02 015E             1187  C          MOV     WORD PTR[BP][2],EENAB_PER_FRAME ; NUM.OF FRAMES FOR COLOR
0363  EB 06 90                  1188  C          JMP     BRST_COLOR_V
0366                            1189  C  COLOR_V:
                                1190  C
0366  C7 46 02 00C8             1191  C          MOV     WORD PTR[BP][2],CENAB_PER_FRAME ; NUM.OF FRAMES FOR COLOR
036B                            1192  C  BRST_COLOR_V:
036B  C7 46 04 A0AC             1193  C          MOV     WORD PTR[BP][4],MAX_VERT_COLOR  ; MAX TIME FOR VERT/VERT
0370  C7 46 06 C460             1194  C          MOV     WORD PTR[BP][6],MIN_VERT_COLOR  ; MIN TIME FOR VERT/VERT
0375  B2 DA                     1195  C          MOV     DL,INPUT_STATUS                 ; SET ADDRESSING TO VIDEO
                                1196  C                                                  ;  ATTR STATUS
0377                            1197  C  COMMON:
0377  B8 0500                  1198  C          MOV     AX,0500H                        ; SET TO VIDEO PAGE 0
037A  CD 10                     1199  C          INT     10H
037C  2B C9                     1200  C          SUB     CX,CX
                                1201  C
                                1202  C  ;----- LOOK FOR VERTICAL
                                1203  C
037E                            1204  C  POD14_1:
037E  EC                        1205  C          IN      AL,DX                           ; GET STATUS
037F  A8 08                     1206  C          TEST    AL,00001000B                    ; VERTICAL THERE YET?
0381  75 07                     1207  C          JNE     POD14_2                         ; CONTINUE IF IT IS
0383  E2 F9                     1208  C          LOOP    POD14_1                         ; KEEP LOOKING TILL COUNT
0385  B3 00                     1209  C          MOV     BL,00                           ;  EXHAUSTED
0387  E9 0448 R                 1210  C          JMP     POD14_ERR                       ; NO VERTICAL
                                1211  C
                                1212  C  ;----- GOT VERTICAL - START TIMER
                                1213  C
038A                            1214  C  POD14_2:
038A  B0 00                     1215  C          MOV     AL,0
038C  E6 40                     1216  C          OUT     TIMER0,AL                       ; SEND 2ND BYTE TO TIMER TO
                                1217  C                                                  ; START IT
038E  2B DB                     1218  C          SUB     BX,BX                           ; INIT. ENABLE COUNTER
                                1219  C  ;----- WAIT FOR VERTICAL TO GO AWAY
0390  33 C9                     1220  C          XOR     CX,CX
0392                            1221  C  POD14_25:
0392  EC                        1222  C          IN      AL,DX                           ; GET STATUS
0393  A8 08                     1223  C          TEST    AL,00001000B                    ; VERTICAL STILL THERE
0395  74 07                     1224  C          JZ      POD14_3                         ; CONTINUE IF IT'S GONE
0397  E2 F9                     1225  C          LOOP    POD14_25                        ; KEEP LOOKING TILL COUNT
0399  B3 01                     1226  C          MOV     BL,01H                          ;  EXHAUSTED
039B  E9 0448 R                 1227  C          JMP     POD14_ERR                       ; VERTICAL STUCK ON
                                1228  C
                                1229  C  ;----- NOW START LOOKING FOR ENABLE TRANSITIONS
                                1230  C
039E                            1231  C  POD14_3:
039E  2B C9                     1232  C          SUB     CX,CX
03A0                            1233  C  POD14_4:
03A0  EC                        1234  C          IN      AL,DX                           ; GET STATUS
03A1  A8 01                     1235  C          TEST    AL,00000001B                    ; ENABLE ON YET?
03A3  74 15                     1236  C          JE      POD14_5                         ; GO ON IF IT IS
03A5  A8 08                     1237  C          TEST    AL,00001000B                    ; VERTICAL ON AGAIN?
03A7  75 23                     1238  C          JNE     POD14_75                        ; CONTINUE IF IT IS
03A9  E2 F5                     1239  C          LOOP    POD14_4                         ; KEEP LOOKING IF NOT
03AB  B3 02                     1240  C          MOV     BL,02H
03AD  E9 0448 R                 1241  C          JMP     POD14_ERR                       ; ENABLE STUCK OFF
03B0                            1242  C  POD14_4A:
03B0  B3 03                     1243  C          MOV     BL,03H
03B2  E9 0448 R                 1244  C          JMP     POD14_ERR                       ; VERTICAL STUCK ON
03B5                            1245  C  POD14_4B:
03B5  B3 04                     1246  C          MOV     BL,04H
03B7  E9 0448 R                 1247  C          JMP     POD14_ERR                       ; ENABLE STUCK ON
                                1248  C
                                1249  C  ;----- MAKE SURE VERTICAL WENT OFF WITH ENABLE GOING ON
                                1250  C
03BA                            1251  C  POD14_5:
03BA  A8 08                     1252  C          TEST    AL,00001000B                    ; VERTICAL OFF?
03BC  75 F2                     1253  C          JNZ     POD14_4A                        ; GO ON IF IT IS
                                1254  C  ;----- NOW WAIT FOR ENABLE TO GO OFF           ;  (ERROR IF NOT)
03BE                            1255  C  POD14_6:
03BE  EC                        1256  C          IN      AL,DX                           ; GET STATUS
03BF  A8 01                     1257  C          TEST    AL,00000001B                    ; ENABLE OFF YET?
03C1  E1 FB                     1258  C          LOOPE   POD14_6                         ; KEEP LOOKING IF NOT
03C3  E3 F0                     1259  C          JCXZ    POD14_4B                        ;  YET LOW
                                1260  C  ;----- ENABLE HAS TOGGLED, BUMP COUNTER AND TEST FOR NEXT VERTICAL
```

```
03C5                                    1261    C  POD14_7:
03C5  43                                1262    C          INC     BX                              ; BUMP ENABLE COUNTER
03C6  74 04                             1263    C          JZ      POD14_75                        ; IF COUNTER WRAPS,
                                        1264    C                                                  ;  SOMETHING IS WRONG
03C8  A8 08                             1265    C          TEST    AL,00001000B                    ; DID ENABLE GO LOW
                                        1266    C                                                  ;  BECAUSE OF VERTICAL
03CA  74 D2                             1267    C          JZ      POD14_3                         ; IF NOT, LOOK FOR ANOTHER
                                        1268    C                                                  ;  ENABLE TOGGLE
                                        1269    C  ;----- HAVE HAD COMPLETE VERTICAL-VERTICAL CYCLE, NOW TEST RESULTS
03CC                                    1270    C  POD14_75:
03CC  B0 00                             1271    C          MOV     AL,00                           ; LATCH TIMER0
03CE  E6 43                             1272    C          OUT     TIM_CTL,AL
03D0  3B 5E 02                          1273    C          CMP     BX,WORD PTR[BP][2]              ; NUMBER OF ENABLES BETWEEN
                                        1274    C                                                  ;  VERTICALS O.K.?
03D3  74 04                             1275    C          JE      POD14_8
03D5  B3 05                             1276    C          MOV     BL,05H
03D7  EB 6F                             1277    C          JMP     SHORT POD14_ERR
03D9                                    1278    C  POD14_8:
03D9  E4 40                             1279    C          IN      AL,TIMER0                       ; GET TIMER VALUE LOW
03DB  8A E0                             1280    C          MOV     AH,AL                           ; SAVE IT
03DD  90                                1281    C          NOP
03DE  E4 40                             1282    C          IN      AL,TIMER0                       ; GET TIMER HIGH
03E0  86 E0                             1283    C          XCHG    AH,AL
03E2  90                                1284    C          NOP
03E3  90                                1285    C          NOP
03E4  3B 46 04                          1286    C          CMP     AX,WORD PTR[BP][4]              ; MAXIMUM VERTICAL TIMING
03E7  7D 04                             1287    C          JGE     POD14_9
03E9  B3 06                             1288    C          MOV     BL,06H
03EB  EB 5B                             1289    C          JMP     SHORT POD14_ERR
03ED                                    1290    C  POD14_9:
03ED  3B 46 06                          1291    C          CMP     AX,WORD PTR[BP][6]              ; MINIMUM VERTICAL TIMING
03F0  7E 04                             1292    C          JLE     POD14_10
03F2  B3 07                             1293    C          MOV     BL,07H
03F4  EB 52                             1294    C          JMP     SHORT   POD14_ERR
                                        1295    C
                                        1296    C  ;----- SEE IF RED, GREEN, BLUE AND INTENSIFY DOTS WORK
                                        1297    C
                                        1298    C  ;----- FIRST, SET A LINE OF REVERSE VIDEO, INTENSIFIED BLANKS INTO BUFFER
03F6                                    1299    C  POD14_10:
03F6  B8 09DB                           1300    C          MOV     AX,09DBH                        ; WRITE CHARS, BLANKS
03F9  BB 000F                           1301    C          MOV     BX,000FH                        ; PAGE 0, REVERSE VIDEO,
                                        1302    C                                                  ;  HIGH INTENSITY
03FC  B9 0050                           1303    C          MOV     CX,80                           ; 80 CHARACTERS
03FF  CD 10                             1304    C          INT     10H
0401  EC                                1305    C          IN      AL,DX
0402  52                                1306    C          PUSH    DX                              ; SAVE INPUT STATUS
0403  B2 C0                             1307    C          MOV     DL,ATTR_WRITE                   ; ATTRIBUTE ADDRESSS
0405  B4 0F                             1308    C          MOV     AH,0FH                          ; PALETTE REG 'F'
0407  B0 3F                             1309    C          MOV     AL,03FH                         ; TEST VALUE
0409  E8 0D15 R                        1310    C          CALL    OUT_DX                          ; VIDEO STATUS MUX
040C  B8 000F                           1311    C          MOV     AX,0FH                          ; START WITH BLUE DOTS
040F  5A                                1312    C          POP     DX
0410                                    1313    C  POD14_13:
0410  50                                1314    C          PUSH    AX                              ; SAVE
0411  52                                1315    C          PUSH    DX                              ; SAVE INPUT STATUS
0412  B2 C0                             1316    C          MOV     DL,ATTR_WRITE                   ; ATTRIBUTE ADDRESSS
0414  B4 32                             1317    C          MOV     AH,32H                          ; COLOR PLANE ENABLE
0416  E8 0D15 R                        1318    C          CALL    OUT_DX                          ; VIDEO STATUS MUX
0419  5A                                1319    C          POP     DX                              ; RECOVER INPUT STATUS
041A  58                                1320    C          POP     AX
041B  2B C9                             1321    C          SUB     CX,CX
                                        1322    C  ;----- SEE IF DOT COMES ON
041D                                    1323    C  POD14_14:
041D  EC                                1324    C          IN      AL,DX                           ; GET STATUS
041E  A8 30                             1325    C          TEST    AL,00110000B                    ; DOT THERE?
0420  75 09                             1326    C          JNZ     POD14_15                        ; LOOK FOR DOT TO TURN OFF
0422  E2 F9                             1327    C          LOOP    POD14_14                        ; CONTINUE TEST FOR DOT ON
0424  B3 10                             1328    C          MOV     BL,10H
0426  0A DC                             1329    C          OR      BL,AH                           ; OR IN DOT BEING TESTED
0428  EB 1E 90                          1330    C          JMP     POD14_ERR                       ; DOT NOT COMING ON
                                        1331    C  ;----- SEE IF DOT GOES OFF
042B                                    1332    C  POD14_15:
042B  2B C9                             1333    C          SUB     CX,CX
042D                                    1334    C  POD14_16:
042D  EC                                1335    C          IN      AL,DX                           ; GET STATUS
042E  A8 30                             1336    C          TEST    AL,00110000B                    ; IS DOT STILL ON?
0430  74 08                             1337    C          JE      POD14_17                        ; GO ON IF DOT OFF
0432  E2 F9                             1338    C          LOOP    POD14_16                        ; ELSE, KEEP WAITING FOR
                                        1339    C                                                  ;  DOT TO GO OFF
0434  B3 20                             1340    C          MOV     BL,20H
0436  0A DC                             1341    C          OR      BL,AH                           ; OR IN DOT BEING TESTED
0438  EB 0E                             1342    C          JMP     SHORT POD14_ERR
                                        1343    C
                                        1344    C  ;----- ADJUST TO POINT TO NEXT DOT
                                        1345    C
043A                                    1346    C  POD14_17:
043A  FE C4                             1347    C          INC     AH
043C  80 FC 30                          1348    C          CMP     AH,030H                         ; ALL 3 DOTS DONE?
043F  74 25                             1349    C          JE      POD14_18                        ; GO END
0441  80 CC 0F                          1350    C          OR      AH,0FH                          ; MAKE 0F,1F,2F
0444  8A C4                             1351    C          MOV     AL,AH
0446  EB C8                             1352    C          JMP     POD14_13                        ; GO LOOK FOR ANOTHER DOT
0448                                    1353    C  POD14_ERR:
0448  B9 0006                           1354    C          MOV     CX,6
044B  BA 0103                           1355    C          MOV     DX,0103H                        ; ONE LONG AND THREE SHORT
044E  E8 06C8 R                        1356    C          CALL    ERR_BEEP
0451  83 C4 0A                          1357    C          ADD     SP,0AH                          ; BALANCE STACK
0454  B0 36                             1358    C          MOV     AL,00110110B                    ; RE-INIT TIMER 0
0456  E6 43                             1359    C          OUT     TIM_CTL,AL
0458  2A C0                             1360    C          SUB     AL,AL
045A  E6 40                             1361    C          OUT     TIMER0,AL
045C  90                                1362    C          NOP
045D  90                                1363    C          NOP
045E  E6 40                             1364    C          OUT     TIMER0,AL
0460  BD 0001                           1365    C          MOV     BP,1
0463  E9 0091 R                        1366    C          JMP     SKIP
                                        1367    C          ASSUME  DS:ABS0
0466                                    1368    C  POD14_18:
0466  E8 0CFE R                        1369    C          CALL    DDS
0469  B8 0500                           1370    C          MOV     AX,0500H                        ; SET TO VIDEO PAGE 0
046C  CD 10                             1371    C          INT     10H
046E  B0 36                             1372    C          MOV     AL,00110110B                    ; RE-INIT TIMER 0
0470  E6 43                             1373    C          OUT     TIM_CTL,AL
0472  2A C0                             1374    C          SUB     AL,AL
0474  E6 40                             1375    C          OUT     TIMER0,AL
0476  90                                1376    C          NOP
0477  90                                1377    C          NOP
0478  E6 40                             1378    C          OUT     TIMER0,AL
047A  83 C4 0A                          1379    C          ADD     SP,0AH                          ; REMOVE SCRATCH PAD
047D  BD 0000                           1380    C          MOV     BP,0                            ; MAKE BP NON ZERO
0480                                    1381    C  POD14                ENDP
                                        1382    C
                                        1383    C  ;----- TEST STORAGE
                                        1384    C
0480                                    1385    C  MEM_TEST:
0480  1E                               1386    C          PUSH    DS
```

```
0481  E8 0CFE R               1387  C          CALL    DDS
                              1388  C          ASSUME DS:ABS0
0484  F6 06 0487 R 02         1389  C          TEST    INFO,2
0489  74 12                   1390  C          JZ      D_COLOR_M
048B  80 0E 0410 R 30         1391  C          OR      EQUIP_LOW,030H
0490  B8 000F                 1392  C          MOV     AX,0FH
0493  80 0E 0487 R 60         1393  C          OR      INFO,060H
0498  B8 000F                 1394  C          MOV     AX,0FH
049B  EB 0D                   1395  C          JMP     SHORT D_OUT_M
049D                          1396  C  D_COLOR_M:
049D  80 26 0410 R CF         1397  C          AND     EQUIP_LOW,0CFH
04A2  80 0E 0410 R 20         1398  C          OR      EQUIP_LOW,020H
04A7  B8 000E                 1399  C          MOV     AX,0EH                  ; INTERNAL COLOR MODE
04AA                          1400  C  D_OUT_M:                               ; TEST IN COLOR
04AA  CD 10                   1401  C          INT     10H
04AC  83 EC 06                1402  C          SUB     SP,6                    ; RESERVE 3 WORDS ON STACK
04AF  8B EC                   1403  C          MOV     BP,SP                   ; SET BP
04B1  B8 A000                 1404  C          MOV     AX,0A000H               ; PUT BUFFER ADDRESS IN AX
                              1405  C          ASSUME  DS:NOTHING,ES:NOTHING
04B4  8E D8                   1406  C          MOV     DS,AX                   ; SET UP SEG REGS TO POINT
04B6  8E C0                   1407  C          MOV     ES,AX                   ;  TO BUFFER AREA
04B8  C7 46 02 0000           1408  C          MOV     WORD PTR[BP][2],0       ; INITIALIZE
04BD  C7 46 04 0000           1409  C          MOV     WORD PTR[BP][4],0       ; INITIALIZE
04C2  B6 03                   1410  C          MOV     DH,3
04C4  B2 C4                   1411  C          MOV     DL,SEQ_ADDR
04C6  B8 0201                 1412  C          MOV     AX,0201H
04C9  E8 0D15 R               1413  C          CALL    OUT_DX
04CC  B2 CE                   1414  C          MOV     DL,GRAPH_ADDR           ; ADDRESS READ MAP SELECT
04CE  B8 0400                 1415  C          MOV     AX,0400H
04D1  E8 0D15 R               1416  C          CALL    OUT_DX
04D4  52                      1417  C          PUSH    DX
04D5  B2 DA                   1418  C          MOV     DL,ATTR_READ            ; SET UP ATTRIBUTE
04D7  EC                      1419  C          IN      AL,DX
04D8  B2 C0                   1420  C          MOV     DL,ATTR_WRITE           ; ATTRIBUTE WRITE ADDRESS
04DA  B8 3200                 1421  C          MOV     AX,3200H
04DD  E8 0D15 R               1422  C          CALL    OUT_DX
04E0  E8 068F R               1423  C          CALL    HOW_BIG                 ; GO FIND AMOUNT OF MEMORY
04E3  80 FC 00                1424  C          CMP     AH,0
04E6  74 03                   1425  C          JZ      AA1
04E8  E9 05CD R               1426  C          JMP     EGA_MEM_ERROR
04EB                          1427  C  AA1:
04EB  E8 05D9 R               1428  C          CALL    MEMORY_OK               ; GO TEST IT
04EE  80 FC 00                1429  C          CMP     AH,0
04F1  74 03                   1430  C          JZ      AA2
04F3  E9 05CD R               1431  C          JMP     EGA_MEM_ERROR
04F6                          1432  C  AA2:
04F6  5A                      1433  C          POP     DX
04F7  B2 C4                   1434  C          MOV     DL,SEQ_ADDR
04F9  B8 0202                 1435  C          MOV     AX,0202H
04FC  E8 0D15 R               1436  C          CALL    OUT_DX
04FF  B2 CE                   1437  C          MOV     DL,GRAPH_ADDR           ; ADDRESS OF READ MAP
0501  B8 0401                 1438  C          MOV     AX,0401H
0504  E8 0D15 R               1439  C          CALL    OUT_DX
0507  52                      1440  C          PUSH    DX
0508  B2 DA                   1441  C          MOV     DL,ATTR_READ            ; SET UP ATTRIBUTE
050A  EC                      1442  C          IN      AL,DX
050B  B2 C0                   1443  C          MOV     DL,ATTR_WRITE           ; ATTRIBUTE WRITE ADDRESS
050D  B8 3200                 1444  C          MOV     AX,3200H
0510  E8 0D15 R               1445  C          CALL    OUT_DX
0513  C7 46 04 0000           1446  C          MOV     WORD PTR [BP][4],0      ; INITIALIZE
0518  E8 068F R               1447  C          CALL    HOW_BIG                 ; GO FIND AMOUNT OF MEMORY
051B  80 FC 00                1448  C          CMP     AH,0
051E  74 03                   1449  C          JZ      AA3
0520  E9 05CD R               1450  C          JMP     EGA_MEM_ERROR
0523                          1451  C  AA3:
0523  E8 05D9 R               1452  C          CALL    MEMORY_OK               ; GO TEST IT
0526  80 FC 00                1453  C          CMP     AH,0
0529  74 03                   1454  C          JZ      AA4
052B  E9 05CD R               1455  C          JMP     EGA_MEM_ERROR
052E                          1456  C  AA4:
052E  5A                      1457  C          POP     DX
052F  B2 C4                   1458  C          MOV     DL,SEQ_ADDR
0531  B8 0204                 1459  C          MOV     AX,0204H
0534  E8 0D15 R               1460  C          CALL    OUT_DX
0537  52                      1461  C          PUSH    DX
0538  B2 CE                   1462  C          MOV     DL,GRAPH_ADDR           ; ADDRESS OF READ MAP
053A  B8 0402                 1463  C          MOV     AX,0402H
053D  E8 0D15 R               1464  C          CALL    OUT_DX
0540  B2 DA                   1465  C          MOV     DL,ATTR_READ            ; SET UP ATTRIBUTE
0542  EC                      1466  C          IN      AL,DX
0543  B2 C0                   1467  C          MOV     DL,ATTR_WRITE           ; ATTRIBUTE WRITE ADDRESS
0545  B8 3200                 1468  C          MOV     AX,3200H
0548  E8 0D15 R               1469  C          CALL    OUT_DX
054B  C7 46 04 0000           1470  C          MOV     WORD PTR[BP][4],0       ; INITIALIZE
0550  E8 068F R               1471  C          CALL    HOW_BIG                 ; GO FIND AMOUNT OF MEMORY
0553  80 FC 00                1472  C          CMP     AH,0
0556  74 03                   1473  C          JZ      AA5
0558  EB 73 90                1474  C          JMP     EGA_MEM_ERROR
055B                          1475  C  AA5:
055B  E8 05D9 R               1476  C          CALL    MEMORY_OK               ; GO TEST IT
055E  80 FC 00                1477  C          CMP     AH,0
0561  74 03                   1478  C          JZ      AA6
0563  EB 68 90                1479  C          JMP     EGA_MEM_ERROR
0566                          1480  C  AA6:
0566  5A                      1481  C          POP     DX
0567  B2 C4                   1482  C          MOV     DL,SEQ_ADDR
0569  B8 0208                 1483  C          MOV     AX,0208H
056C  E8 0D15 R               1484  C          CALL    OUT_DX
056F  B2 CE                   1485  C          MOV     DL,GRAPH_ADDR           ; ADDRESS OF READ MAP
0571  B8 0403                 1486  C          MOV     AX,0403H
0574  E8 0D15 R               1487  C          CALL    OUT_DX
0577  52                      1488  C          PUSH    DX
0578  B2 DA                   1489  C          MOV     DL,ATTR_READ            ; SET UP ATTRIBUTE
057A  EC                      1490  C          IN      AL,DX
057B  B2 C0                   1491  C          MOV     DL,ATTR_WRITE           ; ATTRIBUTE WRITE ADDRESS
057D  B8 3200                 1492  C          MOV     AX,3200H
0580  E8 0D15 R               1493  C          CALL    OUT_DX
0583  C7 46 04 0000           1494  C          MOV     WORD PTR[BP][4],0       ; INITIALIZE
0588  E8 068F R               1495  C          CALL    HOW_BIG                 ; GO FIND AMOUNT OF MEMORY
058B  80 FC 00                1496  C          CMP     AH,0
058E  75 3D                   1497  C          JNZ     EGA_MEM_ERROR
0590  E8 05D9 R               1498  C          CALL    MEMORY_OK               ; GO TEST IT
0593  80 FC 00                1499  C          CMP     AH,0
0596  75 35                   1500  C          JNZ     EGA_MEM_ERROR
0598  55                      1501  C          PUSH    BP                      ; SAVE SCRATCH PAD POINTER
0599  BD 0000                 1502  C          MOV     BP,0                    ; RESET BP FOR XT
059C                          1503  C  EGA_MEM_EXIT:
059C  5E                      1504  C          POP     SI                      ; RESTORE
059D  5A                      1505  C          POP     DX
059E  E8 0CFE R               1506  C          CALL    DDS                     ; SET DATA SEGMENT
                              1507  C          ASSUME  DS:ABS0
05A1  36: 8B 5C 02            1508  C          MOV     BX,WORD PTR SS:[SI][2]  ; GET EGA MEMORY SIZE
05A5  B1 06                   1509  C          MOV     CL,06H                  ; DIVIDE BY 64 TO GET
05A7  D3 EB                   1510  C          SHR     BX,CL                   ;  NUMBER OF 64KB BLOCKS
05A9  4B                      1511  C          DEC     BX
05AA  B1 05                   1512  C          MOV     CL,05H
```

```
05AC  D3 E3                    1513  C          SHL     BX,CL
05AE  80 E3 60                 1514  C          AND     BL,01100000B                    ; ISOLATE BITS 5 AND 6
                               1515  C
05B1  80 26 0487 R 9F          1516  C          AND     INFO,10011111B
                               1517  C
05B6  08 1E 0487 R             1518  C          OR      INFO,BL
                               1519  C
05BA  80 0E 0487 R 04          1520  C          OR      INFO,00000100B                  ; 04H  SET 3XX ACTIVE
05BF  8A 1E 0488 R             1521  C          MOV     BL,INFO_3
05C3  E8 00F3 R                1522  C          CALL    MK_ENV
05C6  83 C4 06                 1523  C          ADD     SP,6                            ; RESTORE STACK
05C9  1F                       1524  C          POP     DS
05CA  E9 0091 R                1525  C          JMP     SKIP                            ; GO TO END
05CD                           1526  C  EGA_MEM_ERROR:
05CD  BA 0103                  1527  C          MOV     DX,0103H                        ; ONE LONG AND THREE SHORT
05D0  E8 06C8 R                1528  C          CALL    ERR_BEEP
05D3  55                       1529  C          PUSH    BP                              ; SAVE SCRATCH PAD POINTER
05D4  BD 0001                  1530  C          MOV     BP,1                            ; INDICATE ERROR FOR XT
05D7  EB C3                    1531  C          JMP     EGA_MEM_EXIT
                               1532  C
                               1533  C  ;----- THIS ROUTINE FINDS AMOUNT OF MEMORY GOOD
                               1534  C
05D9                           1535  C  MEMORY_OK       PROC    NEAR
05D9  BB A000                  1536  C          MOV     BX,0A000H                       ; SET PTR. TO BUFFER SEG
05DC  8E DB                    1537  C          MOV     DS,BX                           ; SET SEG.REG.
05DE  8E C3                    1538  C          MOV     ES,BX
05E0  8B 46 04                 1539  C          MOV     AX,WORD PTR[BP][4]              ; SET COUNT FOR 32K WORDS
05E3  8A E8                    1540  C          MOV     CH,AL                           ; SET AMOUNT OF BUFFER
05E5  2A C9                    1541  C          SUB     CL,CL                           ;  TO BE TESTED
05E7  D1 E1                    1542  C          SHL     CX,1                            ; MULTIPLY BY TWO
05E9  E8 05FB R                1543  C          CALL    PODSTG
05EC  80 FC 00                 1544  C          CMP     AH,0                            ; TEST FOR ERROR
05EF  75 09                    1545  C          JNZ     MEMORY_OK_ERR                   ; IF ERROR GO PRINT IT
05F1                           1546  C  MEMORY_OK_EX:
05F1  8B 46 04                 1547  C          MOV     AX,WORD PTR[BP][4]              ; AMOUNT OF MEMORY FOUND
05F4  01 46 02                 1548  C          ADD     WORD PTR[BP][2],AX              ; AMOUNT OF MEMORY GOOD
05F7  B8 0000                  1549  C          MOV     AX,0
05FA                           1550  C  MEMORY_OK_ERR:
05FA  C3                       1551  C          RET
05FB                           1552  C  MEMORY_OK       ENDP
                               1553  C
                               1554  C  ;--------------------------------------------------------------------
                               1555  C  ; THIS ROUTINE PERFORMS A READ/WRITE TEST ON A BLOCK OF STORAGE  :
                               1556  C  ; (MAX. SIZE = 32KW). IF "WARM START", FILL BLOCK WITH 0000 AND  :
                               1557  C  ; RETURN.                                                        :
                               1558  C  ; ON ENTRY:                                                     :
                               1559  C  ;   ES = ADDRESS OF STORAGE TO BE TESTED                        :
                               1560  C  ;   DS = ADDRESS OF STORAGE TO BE TESTED                        :
                               1561  C  ;   CX = WORD COUNT OF STORAGE BLOCK TO BE TESTED               :
                               1562  C  ;        (MAX. = 8000H (32K WORDS))                             :
                               1563  C  ; ON EXIT:                                                      :
                               1564  C  ;   ZERO FLAG = OFF IF STORAGE ERROR                           :
                               1565  C  ; AX,BX,CX,DX,DI,SI ARE ALL DESTROYED.                         :
                               1566  C  ;--------------------------------------------------------------------
05FB                           1567  C  PODSTG  PROC    NEAR
05FB  55                       1568  C          PUSH    BP
05FC  FC                       1569  C          CLD                                     ; SET DIR TO INCREMENT
05FD  2B FF                    1570  C          SUB     DI,DI                           ; SET DI=0000 REL TO START
                               1571  C                                                  ;  OF SEGMENT
05FF  2B C0                    1572  C          SUB     AX,AX                           ; INITIAL DATA PATTERN FOR
                               1573  C                                                  ;  00-FF TEST
0601  E8 0CFE R                1574  C          CALL    DDS
                               1575  C          ASSUME  DS:ABS0
0604  8B 1E 0472 R             1576  C          MOV     BX,DS:RESET_FLAG                ; WARM START?
0608  81 FB 1234               1577  C          CMP     BX,1234H
060C  8C C2                    1578  C          MOV     DX,ES
060E  8E DA                    1579  C          MOV     DS,DX                           ; RESTORE DS
0610  74 62                    1580  C          JE      PODSTG_5                        ; GO DO FILL WITH 0000
                               1581  C                                                  ;  IF WARM START
0612  81 FB 4321               1582  C          CMP     BX,4321H                        ; DCP WARM START?
0616  74 5C                    1583  C          JE      PODSTG_5                        ; DO FILL IF SO
0618                           1584  C  PODSTG_1:
0618  88 05                    1585  C          MOV     [DI],AL                         ; WRITE TEST DATA
061A  8A 05                    1586  C          MOV     AL,[DI]                         ; GET IT BACK
061C  32 C4                    1587  C          XOR     AL,AH                           ; COMPARE TO EXPECTED
061E  75 40                    1588  C          JNZ     PODSTG_ERRO                     ; ERROR EXIT IF MISCOMPARE
0620  FE C4                    1589  C          INC     AH                              ; FORM NEW DATA PATTERN
0622  8A C4                    1590  C          MOV     AL,AH
0624  75 F2                    1591  C          JNZ     PODSTG_1                        ; LOOP TILL ALL 256 DATA
                               1592  C                                                  ;  PATTERNS DONE
0626  8B E9                    1593  C          MOV     BP,CX                           ; SAVE WORD COUNT
0628  B8 AA55                  1594  C          MOV     AX,0AA55H                       ; LOAD DATA PATTERN
062B  8B D8                    1595  C          MOV     BX,AX
062D  BA 55AA                  1596  C          MOV     DX,055AAH                       ; LOAD OTHER DATA PATTERN
0630  F3/ AB                   1597  C          REP     STOSW                           ; FILL WORDS FROM LOW TO
                               1598  C                                                  ;  HIGH WITH AAAA
0632  4F                       1599  C          DEC     DI                              ; POINT TO LAST WORD
0633  4F                       1600  C          DEC     DI                              ;  WRITTEN
0634  FD                       1601  C          STD                                     ; SET DIR FLAG TO GO DOWN
0635  8B F7                    1602  C          MOV     SI,DI                           ; SET INDEX REGS. EQUAL
0637  8B CD                    1603  C          MOV     CX,BP                           ; RECOVER WORD COUNT
0639                           1604  C  PODSTG_2:
0639  AD                       1605  C          LODSW                                   ; GO FROM HIGH TO LOW
063A  33 C3                    1606  C          XOR     AX,BX                           ; GET WORD FROM MEMORY
063C  75 22                    1607  C          JNZ     PODSTG_ERRO                     ; EQUAL WHAT S/B THERE?
063E  8B C2                    1608  C          MOV     AX,DX                           ; GO ERROR EXIT IF NOT
0640  AB                       1609  C          STOSW                                   ; GET 55 DATA PATTERN AND
0641  E2 F6                    1610  C          LOOP    PODSTG_2                        ;  STORE IN LOC JUST READ
0643  8B CD                    1611  C          MOV     CX,BP                           ; LOOP TILL ALL BYTES DONE
0645  FC                       1612  C          CLD                                     ; RECOVER WORD COUNT
0646  46                       1613  C          INC     SI                              ; BACK TO INCREMENT
0647  46                       1614  C          INC     SI                              ; ADJUST PTRS
0648  8B FE                    1615  C          MOV     DI,SI
064A                           1616  C  PODSTG_3:                                      ; LOW TO HIGH DOING WORDS
064A  AD                       1617  C          LODSW                                   ; GET A WORD
064B  33 C2                    1618  C          XOR     AX,DX                           ; SHOULD COMPARE TO DX
064D  75 11                    1619  C          JNZ     PODSTG_ERRO                     ; GO ERROR IF NOT
064F  AB                       1620  C          STOSW                                   ; WRITE 0000 BACK TO LOC
                               1621  C                                                  ;  JUST READ
0650  E2 F8                    1622  C          LOOP    PODSTG_3                        ; LOOP TILL DONE
                               1623  C
0652  FD                       1624  C          STD                                     ; BACK TO DECREMENT
0653  4E                       1625  C          DEC     SI                              ; ADJUST POINTER DOWN TO
                               1626  C                                                  ;  LAST WORD WRITTEN
0654  4E                       1627  C          DEC     SI
0655  8B CD                    1628  C          MOV     CX,BP                           ; GET WORD COUNT
0657                           1629  C  PODSTG_4:
0657  AD                       1630  C          LODSW                                   ; GET WORD
0658  0B C0                    1631  C          OR      AX,AX                           ; = TO 0000
065A  75 04                    1632  C          JNZ     PODSTG_ERRO                     ; ERROR IF NOT
065C  E2 F9                    1633  C          LOOP    PODSTG_4                        ; LOOP TILL DONE
065E  EB 11                    1634  C          JMP     SHORT PODSTG_ERR2
0660                           1635  C  PODSTG_ERRO:
0660  8B C8                    1636  C          MOV     CX,AX                           ; SAVE BITS IN ERROR
0662  32 E4                    1637  C          XOR     AH,AH
0664  0A ED                    1638  C          OR      CH,CH                           ; HIGH BYTE ERROR?
```

```
0666  74 02                1639     C          JZ      PODSTG_ERR1
0668  B4 01                1640     C          MOV     AH,1                    ; SET HIGH BYTE ERROR
066A                       1641     C  PODSTG_ERR1:
066A  0A C9                1642     C          OR      CL,CL                   ; LOW BYTE ERROR?
066C  74 03                1643     C          JZ      PODSTG_ERR2
066E  80 C4 02             1644     C          ADD     AH,2
0671                       1645     C  PODSTG_ERR2:
0671  5D                   1646     C          POP     BP
0672  FC                   1647     C          CLD                             ; SET DIR FLAG BACK TO INC
0673  C3                   1648     C          RET                             ; RETURN TO CALLER
0674                       1649     C  PODSTG_5:                               ; SIMPLE FILL WITH 0000 ON
                           1650     C                                         ;  WARM-START
0674  50                   1651     C          PUSH    AX                      ; SAVE
0675  52                   1652     C          PUSH    DX                      ; SAVE VALUE
0676  B6 03                1653     C          MOV     DH,3
0678  B2 C4                1654     C          MOV     DL,SEQ_ADDR             ; SEQ_ADDR  REGISTER
067A  B8 020F              1655     C          MOV     AX,020FH
067D  E8 0D15 R            1656     C          CALL    OUT_DX                  ; DO IT
0680  5A                   1657     C          POP     DX                      ; RESTORE
0681  58                   1658     C          POP     AX                      ; RESTORE
0682  F3/ AB                1659     C          REP     STOSW
0684  E8 0CFE R            1660     C          CALL    DDS
                           1661     C          ASSUME  DS:ABS0
0687  89 1E 0472 R          1662     C          MOV     DS:RESET_FLAG,BX
068B  8E DA                1663     C          MOV     DS,DX                   ; RESTORE DS
068D  EB E2                1664     C          JMP     PODSTG_ERR2             ; AND EXIT
068F                       1665     C  PODSTG  ENDP
                           1666     C
                           1667     C  ;----- DETERMINE SIZE OF BUFFER
                           1668     C
068F                       1669     C  HOW_BIG          PROC NEAR
068F  8C DA                1670     C          MOV     DX,DS                   ; SET PNTR TO BUFFER LOC
0691  2B DB                1671     C          SUB     BX,BX                   ; BASIC COUNT OF 00K
0693                       1672     C  FILL_LOOP:
0693  8E C2                1673     C          MOV     ES,DX                   ; SET SEG. REG
0695  2B FF                1674     C          SUB     DI,DI
0697  B8 AA55              1675     C          MOV     AX,0AA55H               ; TEST PATTERN
069A  8B C8                1676     C          MOV     CX,AX
069C  26: 89 05            1677     C          MOV     ES:[DI],AX              ; SEND TO MEMORY
069F  B0 0F                1678     C          MOV     AL,0FH                  ; PUT SOMETHING IN AL
06A1  26: 8B 05            1679     C          MOV     AX,ES:[DI]              ; GET PATTERN FROM MEMORY
06A4  33 C1                1680     C          XOR     AX,CX                   ; COMPARE PATTERNS
06A6  75 14                1681     C          JNZ     HOW_BIG_END             ; GO END IF NO COMPARE
06A8  B9 2000              1682     C          MOV     CX,2000H                ; SET COUNT FOR 8K WORDS
06AB  F3/ AB               1683     C  REP     STOSW                           ; FILL 8K WORDS
06AD  81 C2 0400           1684     C          ADD     DX,0400H                ; POINT TO NEXT 16K BLOCK
06B1  83 C3 10             1685     C          ADD     BX,16                   ; BUMP COUNT BY 16KB
06B4  80 FE B0             1686     C          CMP     DH,0B0H
06B7  75 DA                1687     C          JNZ     FILL_LOOP               ; AREA YET ?(B0000H)
06B9  EB 01 90             1688     C          JMP     HOW_BIG_END
06BC                       1689     C  HOW_BIG_END:
06BC  80 FE A0             1690     C          CMP     DH,0A0H                 ; 1ST 16KB OK
06BF  74 06                1691     C          JZ      HB_ERROR_EXIT
06C1                       1692     C  RESUME:
06C1  01 5E 04             1693     C          ADD     WORD PTR[BP][4],BX      ; SAVE BUFFER FOUND
06C4  B8 0000              1694     C          MOV     AX,0
06C7                       1695     C  HB_ERROR_EXIT:
06C7  C3                   1696     C          RET     ,
06C8                       1697     C  HOW_BIG          ENDP
                           1698     C
                           1699     C  ;-----------------------------------
                           1700     C  ;SUBROUTINES FOR POWER ON DIAGNOSTICS  :
                           1701     C  ;-------------------------------------------------------------------------
                           1702     C  ;THIS PROCEDURE WILL ISSUE ONE LONG TONE (3 SEC) AND ONE OR      :
                           1703     C  ;MORE SHORT TONES (1 SEC) TO INDICATE A FAILURE ON THE PLANAR    :
                           1704     C  ;BOARD ,A BAD RAM MODULE,OR A PROBLEM WITH THE CRT.              :
                           1705     C  ;ENTRY REQUIREMENTS:                                             :
                           1706     C  ;       DH=NUMBER OF LONG TONES TO BEEP                          :
                           1707     C  ;       DL=NUMBER OF SHORT TONES TO BEEP.                        :
                           1708     C  ;-------------------------------------------------------------------------
06C8                       1709     C  ERR_BEEP         PROC    NEAR
06C8  9C                   1710     C          PUSHF                           ; SAVE FLAGS
06C9  FA                   1711     C          CLI                             ; DISABLE SYSTEM INTS
06CA  1E                   1712     C          PUSH    DS
06CB  E8 0CFE R            1713     C          CALL    DDS
                           1714     C          ASSUME  DS:ABS0
06CE  0A F6                1715     C          OR      DH,DH                   ; ANY LONG TONES TO BEEP
06D0  74 0B                1716     C          JZ      G3                      ; NO, DO THE SHORT ONES
06D2                       1717     C  G1:                                     ; LONG BEEP
06D2  B3 06                1718     C          MOV     BL,6                    ; COUNTER FOR BEEPS
06D4  E8 0D20 R            1719     C          CALL    BEEP                    ; DO THE BEEP
06D7                       1720     C  G2:
06D7  E2 FE                1721     C          LOOP    G2                      ; DELAY BETWEEN BEEPS
06D9  FE CE                1722     C          DEC     DH                      ; ANY MORE TO DO
06DB  75 F5                1723     C          JNZ     G1                      ; DO IT
06DD                       1724     C  G3:
06DD  B3 01                1725     C          MOV     BL,1                    ; COUNTER FOR A SHORT BEEP
06DF  E8 0D20 R            1726     C          CALL    BEEP                    ; DO IT
06E2                       1727     C  G4:
06E2  E2 FE                1728     C          LOOP    G4                      ; DELAY BETWEEN BEEPS
06E4  FE CA                1729     C          DEC     DL                      ; DONE WITH SHORT BEEPS
06E6  75 F5                1730     C          JNZ     G3                      ; DO MORE
06E8                       1731     C  G5:
06E8  E2 FE                1732     C          LOOP G5                         ; DELAY BEFORE RETURN
06EA                       1733     C  G6:
06EA  E2 FE                1734     C          LOOP G6
06EC  1F                   1735     C          POP     DS                      ; RESTORE CONTENTS OF DS
06ED  9D                   1736     C          POPF                            ; RESTORE FLAGS
06EE  C3                   1737     C          RET
06EF                       1738     C  ERR_BEEP         ENDP
                           1739     C
                           1740     C          SUBTTL
                           1741
                           1742
06EF                       1743        T2      LABEL   WORD
06EF  0EB3 R               1744                DW      OFFSET  AH0             ; MODE SET
06F1  10EF R               1745                DW      OFFSET  AH1             ; SET CURSOR TYPE
06F3  1157 R               1746                DW      OFFSET  AH2             ; SET CURSOR POSITION
06F5  1186 R               1747                DW      OFFSET  AH3             ; READ CURSOR POSITION
06F7  119D R               1748                DW      OFFSET  AH4             ; READ LIGHT PEN POSITION
06F9  12A4 R               1749                DW      OFFSET  AH5             ; ACTIVE DISPLAY PAGE
06FB  150E R               1750                DW      OFFSET  AH6             ; SCROLL DOWN
06FD  15B0 R               1751                DW      OFFSET  AH7             ; SCROLL UP
06FF  17D2 R               1752                DW      OFFSET  AH8             ; READ CHAR/ATTRIBUTE
0701  1899 R               1753                DW      OFFSET  AH9             ; WRITE CHAR/ATTRIBUTE
0703  18DD R               1754                DW      OFFSET  AHA             ; WRITE CHARACTER ONLY
0705  1A75 R               1755                DW      OFFSET  AHB             ; SET COLOR PALETTE
0707  1BCB R               1756                DW      OFFSET  AHC             ; WRITE DOT
0709  1C9F R               1757                DW      OFFSET  AHD             ; READ DOT
070B  1D01 R               1758                DW      OFFSET  AHE             ; WRITE TTY
070D  1D85 R               1759                DW      OFFSET  AHF             ; CURRENT VIDEO STATE
070F  1DC5 R               1760                DW      OFFSET  AH10            ; SET PALETTE REGISTERS
0711  1F98 R               1761                DW      OFFSET  AH11            ; CHAR GENERATOR ROUTINE
0713  20BF R               1762                DW      OFFSET  AH12            ; ALTERNATE SELECT
0715  2118 R               1763                DW      OFFSET  AH13            ; WRITE STRING
= 0028                     1764        T2L     EQU     $-T2
```

```
                                1765
                                1766      C             INCLUDE         VPARMS.INC
                                1767      C             SUBTTL  VPARMS.INC
                                1768      C             PAGE
0717                            1769      C     VIDEO_PARMS       LABEL   BYTE
                                1770      C
                                1771      C     ; STRUCTURE OF THIS TABLE
                                1772      C     ;
                                1773      C     ;       COLUMNS, ROWS, PELS PER CHARACTER
                                1774      C     ;       PAGE LENGTH
                                1775      C     ;       SEQUENCER PARAMETERS
                                1776      C     ;       MISCELLANEOUS REGISTER
                                1777      C     ;       CRTC PARAMETERS
                                1778      C     ;       ATTRIBUTE PARAMETERS
                                1779      C     ;       GRAPHICS PARAMETERS
                                1780      C
= 0000                          1781      C     BASE_1  EQU     $ - VIDEO_PARMS
0717                            1782      C     BASE_1_L        LABEL   BYTE
                                1783      C
                                1784      C     ;----- DEFAULT MODES
                                1785      C
                                1786      C     ;--0--
0717  28 18 08                  1787      C             DB      40D,24D,08D
071A  0800                      1788      C             DW      00800H
                                1789      C
= 0005                          1790      C     TFS_LEN EQU     $ - BASE_1_L
                                1791      C
071C                            1792      C     SEQ_PARMS       LABEL   BYTE
071C  0B 03 00 00 03            1793      C             DB      00BH,003H,000H,003H
= 0004                          1794      C     M1      EQU     $ - SEQ_PARMS
                                1795      C
0720  23                        1796      C             DB      023H
                                1797      C
0721                            1798      C     CRT_PARMS       LABEL   BYTE
0721  37 27 2D 37 31 15         1799      C             DB      037H,027H,02DH,037H,031H,015H
0727  04 11 00 07 06 07         1800      C             DB      004H,011H,000H,007H,006H,007H
072D  00 00 00 00 E1 24         1801      C             DB      000H,000H,000H,000H,0E1H,024H
0733  C7 14 08 E0 F0 A3         1802      C             DB      0C7H,014H,008H,0E0H,0F0H,0A3H
0739  FF                        1803      C             DB      0FFH
= 0019                          1804      C     M4      EQU     $-CRT_PARMS
                                1805      C
= 0023                          1806      C     LN_4    EQU     $ - BASE_1_L
                                1807      C
073A                            1808      C     ATTR_PARMS      LABEL   BYTE
073A  00 01 02 03 04 05         1809      C             DB      000H,001H,002H,003H,004H,005H
0740  06 07 10 11 12 13         1810      C             DB      006H,007H,010H,011H,012H,013H
0746  14 15 16 17 08 00         1811      C             DB      014H,015H,016H,017H,008H,000H
074C  0F 00                     1812      C             DB      00FH,000H
= 0014                          1813      C     M5      EQU     $-ATTR_PARMS
                                1814      C
= 0037                          1815      C     LN_2    EQU     $ - BASE_1_L
074E                            1816      C     GRAPH_PARMS     LABEL   BYTE
074E  00 00 00 00 00 10         1817      C             DB      000H,000H,000H,000H,000H,010H
0754  0E 00 FF                  1818      C             DB      00EH,000H,0FFH
= 0009                          1819      C     M6      EQU     $-GRAPH_PARMS
                                1820      C
= 0040                          1821      C     M_TBL_LEN       EQU     $ - BASE_1_L
                                1822      C
                                1823      C     ;--1--
0757  28 18 08                  1824      C             DB      40D,24D,08D
075A  0800                      1825      C             DW      00800H
                                1826      C
075C  08 03 00 03               1827      C             DB      008H,003H,000H,003H
                                1828      C
0760  23                        1829      C             DB      023H
                                1830      C
0761  37 27 2D 37 31 15         1831      C             DB      037H,027H,02DH,037H,031H,015H
0767  04 11 00 07 06 07         1832      C             DB      004H,011H,000H,007H,006H,007H
076D  00 00 00 00 E1 24         1833      C             DB      000H,000H,000H,000H,0E1H,024H
0773  C7 14 08 E0 F0 A3         1834      C             DB      0C7H,014H,008H,0E0H,0F0H,0A3H
0779  FF                        1835      C             DB      0FFH
                                1836      C
077A  00 01 02 03 04 05         1837      C             DB      000H,001H,002H,003H,004H,005H
0780  06 07 10 11 12 13         1838      C             DB      006H,007H,010H,011H,012H,013H
0786  14 15 16 17 08 00         1839      C             DB      014H,015H,016H,017H,008H,000H
078C  0F 00                     1840      C             DB      00FH,000H
                                1841      C
078E  00 00 00 00 00 10         1842      C             DB      000H,000H,000H,000H,000H,010H
0794  0E 00 FF                  1843      C             DB      00EH,000H,0FFH
                                1844      C
                                1845      C     ;--2--
0797  50 18 08                  1846      C             DB      80D,24D,08D
079A  1000                      1847      C             DW      01000H
                                1848      C
079C  01 03 00 03               1849      C             DB      001H,003H,000H,003H
                                1850      C
07A0  23                        1851      C             DB      023H
                                1852      C
07A1  70 4F 5C 2F 5F 07         1853      C             DB      070H,04FH,05CH,02FH,05FH,007H
07A7  04 11 00 07 06 07         1854      C             DB      004H,011H,000H,007H,006H,007H
07AD  00 00 00 00 E1 24         1855      C             DB      000H,000H,000H,000H,0E1H,024H
07B3  C7 28 08 E0 F0 A3         1856      C             DB      0C7H,028H,008H,0E0H,0F0H,0A3H
07B9  FF                        1857      C             DB      0FFH
                                1858      C
07BA  00 01 02 03 04 05         1859      C             DB      000H,001H,002H,003H,004H,005H
07C0  06 07 10 11 12 13         1860      C             DB      006H,007H,010H,011H,012H,013H
07C6  14 15 16 17 08 00         1861      C             DB      014H,015H,016H,017H,008H,000H
07CC  0F 00                     1862      C             DB      00FH,000H
                                1863      C
07CE  00 00 00 00 00 10         1864      C             DB      000H,000H,000H,000H,000H,010H
07D4  0E 00 FF                  1865      C             DB      00EH,000H,0FFH
                                1866      C
                                1867      C     ;--3--
07D7  50 18 08                  1868      C             DB      80D,24D,08D
07DA  1000                      1869      C             DW      01000H
                                1870      C
07DC  01 03 00 03               1871      C             DB      001H,003H,000H,003H
                                1872      C
07E0  23                        1873      C             DB      023H
                                1874      C
07E1  70 4F 5C 2F 5F 07         1875      C             DB      070H,04FH,05CH,02FH,05FH,007H
07E7  04 11 00 07 06 07         1876      C             DB      004H,011H,000H,007H,006H,007H
07ED  00 00 00 00 E1 24         1877      C             DB      000H,000H,000H,000H,0E1H,024H
07F3  C7 28 08 E0 F0 A3         1878      C             DB      0C7H,028H,008H,0E0H,0F0H,0A3H
07F9  FF                        1879      C             DB      0FFH
                                1880      C
07FA  00 01 02 03 04 05         1881      C             DB      000H,001H,002H,003H,004H,005H
0800  06 07 10 11 12 13         1882      C             DB      006H,007H,010H,011H,012H,013H
0806  14 15 16 17 08 00         1883      C             DB      014H,015H,016H,017H,008H,000H
080C  0F 00                     1884      C             DB      00FH,000H
                                1885      C
080E  00 00 00 00 00 10         1886      C             DB      000H,000H,000H,000H,000H,010H
0814  0E 00 FF                  1887      C             DB      00EH,000H,0FFH
                                1888      C
                                1889      C     ;--4--
0817  28 18 08                  1890      C             DB      40D,24D,08D
```

```
081A  4000                        1891  C           DW      04000H
                                  1892  C
081C  0B 03 00 02                 1893  C           DB      00BH,003H,000H,002H
                                  1894  C
0820  23                         1895  C           DB      023H
                                  1896  C
0821  37 27 2D 37 30 14           1897  C           DB      037H,027H,02DH,037H,030H,014H
0827  04 11 00 01 00 00          1898  C           DB      004H,011H,000H,001H,000H,000H
082D  00 00 00 00 E1 24           1899  C           DB      000H,000H,000H,000H,0E1H,024H
0833  C7 14 00 E0 F0 A2           1900  C           DB      0C7H,014H,000H,0E0H,0F0H,0A2H
0839  FF                          1901  C           DB      0FFH
                                  1902  C
083A  00 13 15 17 02 04           1903  C           DB      000H,013H,015H,017H,002H,004H
0840  06 07 10 11 12 13           1904  C           DB      006H,007H,010H,011H,012H,013H
0846  14 15 16 17 01 00           1905  C           DB      014H,015H,016H,017H,001H,000H
084C  03 00                       1906  C           DB      003H,000H
                                  1907  C
084E  00 00 00 00 00 30           1908  C           DB      000H,000H,000H,000H,000H,030H
0854  0F 00 FF                    1909  C           DB      00FH,000H,0FFH
                                  1910  C
                                  1911  C ;--5--
0857  28 18 08                    1912  C           DB      40D,24D,08D
085A  4000                        1913  C           DW      04000H
                                  1914  C
085C  0B 03 00 02                 1915  C           DB      00BH,003H,000H,002H
                                  1916  C
0860  23                         1917  C           DB      023H
                                  1918  C
0861  37 27 2D 37 30 14           1919  C           DB      037H,027H,02DH,037H,030H,014H
0867  04 11 00 01 00 00          1920  C           DB      004H,011H,000H,001H,000H,000H
086D  00 00 00 00 E1 24           1921  C           DB      000H,000H,000H,000H,0E1H,024H
0873  C7 14 00 E0 F0 A2           1922  C           DB      0C7H,014H,000H,0E0H,0F0H,0A2H
0879  FF                          1923  C           DB      0FFH
                                  1924  C
087A  00 13 15 17 02 04           1925  C           DB      000H,013H,015H,017H,002H,004H
0880  06 07 10 11 12 13           1926  C           DB      006H,007H,010H,011H,012H,013H
0886  14 15 16 17 01 00           1927  C           DB      014H,015H,016H,017H,001H,000H
088C  03 00                       1928  C           DB      003H,000H
                                  1929  C
088E  00 00 00 00 00 30           1930  C           DB      000H,000H,000H,000H,000H,030H
0894  0F 00 FF                    1931  C           DB      00FH,000H,0FFH
                                  1932  C
                                  1933  C ;--6--
0897  50 18 08                    1934  C           DB      80D,24D,08D
089A  4000                        1935  C           DW      04000H
                                  1936  C
089C  01 01 00 06                 1937  C           DB      001H,001H,000H,006H
                                  1938  C
08A0  23                         1939  C           DB      023H
                                  1940  C
08A1  70 4F 59 2D 5E 06           1941  C           DB      070H,04FH,059H,02DH,05EH,006H
08A7  04 11 00 01 00 00          1942  C           DB      004H,011H,000H,001H,000H,000H
08AD  00 00 00 00 E0 23           1943  C           DB      000H,000H,000H,000H,0E0H,023H
08B3  C7 28 00 DF EF C2           1944  C           DB      0C7H,028H,000H,0DFH,0EFH,0C2H
08B9  FF                          1945  C           DB      0FFH
                                  1946  C
08BA  00 17 17 17 17 17           1947  C           DB      000H,017H,017H,017H,017H,017H
08C0  17 17 17 17 17 17           1948  C           DB      017H,017H,017H,017H,017H,017H
08C6  17 17 17 17 01 00           1949  C           DB      017H,017H,017H,017H,001H,000H
08CC  01 00                       1950  C           DB      001H,000H
                                  1951  C
08CE  00 00 00 00 00 00           1952  C           DB      000H,000H,000H,000H,000H,000H
08D4  0D 00 FF                    1953  C           DB      00DH,000H,0FFH
                                  1954  C
                                  1955  C ;--7--
08D7  50 18 0E                    1956  C           DB      80D,24D,14D
08DA  1000                        1957  C           DW      01000H
                                  1958  C
08DC  00 03 00 03                 1959  C           DB      000H,003H,000H,003H
                                  1960  C
08E0  A6                          1961  C           DB      0A6H
                                  1962  C
08E1  60 4F 56 3A 51 60           1963  C           DB      060H,04FH,056H,03AH,051H,060H
08E7  70 1F 00 0D 0B 0C           1964  C           DB      070H,01FH,000H,00DH,00BH,00CH
08ED  00 00 00 00 5E 2E           1965  C           DB      000H,000H,000H,000H,05EH,02EH
08F3  5D 28 0D 5E 6E A3           1966  C           DB      05DH,028H,00DH,05EH,06EH,0A3H
08F9  FF                          1967  C           DB      0FFH
                                  1968  C
08FA  00 08 08 08 08 08           1969  C           DB      000H,008H,008H,008H,008H,008H
0900  08 08 10 18 18 18           1970  C           DB      008H,008H,010H,018H,018H,018H
0906  18 18 18 18 0E 00           1971  C           DB      018H,018H,018H,018H,00EH,000H
090C  0F 08                       1972  C           DB      00FH,008H
                                  1973  C
090E  00 00 00 00 00 10           1974  C           DB      000H,000H,000H,000H,000H,010H
0914  0A 00 FF                    1975  C           DB      00AH,000H,0FFH
                                  1976  C
                                  1977  C ;--8--
0917  28 18 08                    1978  C           DB      40D,24D,08D
091A  4000                        1979  C           DW      04000H
                                  1980  C
091C  00 00 00 03                 1981  C           DB      000H,000H,000H,003H
                                  1982  C
0920  23                         1983  C           DB      023H
                                  1984  C
0921  37 27 2D 37 31 15           1985  C           DB      037H,027H,02DH,037H,031H,015H
0927  04 11 00 07 06 07          1986  C           DB      004H,011H,000H,007H,006H,007H
092D  00 00 00 00 E1 24           1987  C           DB      000H,000H,000H,000H,0E1H,024H
0933  C7 14 08 E0 F0 A3           1988  C           DB      0C7H,014H,008H,0E0H,0F0H,0A3H
0939  FF                          1989  C           DB      0FFH
                                  1990  C
093A  00 01 02 03 04 05           1991  C           DB      000H,001H,002H,003H,004H,005H
0940  06 07 10 11 12 13           1992  C           DB      006H,007H,010H,011H,012H,013H
0946  14 15 16 17 08 00           1993  C           DB      014H,015H,016H,017H,008H,000H
094C  0F 00                       1994  C           DB      00FH,000H
                                  1995  C
094E  00 00 00 00 00 10           1996  C           DB      000H,000H,000H,000H,000H,010H
0954  0E 00 FF                    1997  C           DB      00EH,000H,0FFH
                                  1998  C
                                  1999  C ;--9--
0957  28 18 08                    2000  C           DB      40D,24D,08D
095A  4000                        2001  C           DW      04000H
                                  2002  C
095C  00 00 00 03                 2003  C           DB      000H,000H,000H,003H
                                  2004  C
0960  23                         2005  C           DB      023H
                                  2006  C
0961  37 27 2D 37 31 15           2007  C           DB      037H,027H,02DH,037H,031H,015H
0967  04 11 00 07 06 07          2008  C           DB      004H,011H,000H,007H,006H,007H
096D  00 00 00 00 E1 24           2009  C           DB      000H,000H,000H,000H,0E1H,024H
0973  C7 14 08 E0 F0 A3           2010  C           DB      0C7H,014H,008H,0E0H,0F0H,0A3H
0979  FF                          2011  C           DB      0FFH
                                  2012  C
097A  00 01 02 03 04 05           2013  C           DB      000H,001H,002H,003H,004H,005H
0980  06 07 10 11 12 13           2014  C           DB      006H,007H,010H,011H,012H,013H
0986  14 15 16 17 08 00           2015  C           DB      014H,015H,016H,017H,008H,000H
098C  0F 00                       2016  C           DB      00FH,000H
```

```
                                        2017    C
098E  00 00 00 00 00 00 10              2018    C               DB      000H,000H,000H,000H,000H,010H
0994  0E 00 FF                          2019    C               DB      00EH,000H,0FFH
                                        2020    C
                                        2021    C       ;--A--
0997  28 18 08                          2022    C               DB      40D,24D,08D
099A  4000                              2023    C               DW      04000H
                                        2024    C
099C  00 00 00 03                       2025    C               DB      000H,000H,000H,003H
                                        2026    C
09A0  23                                2027    C               DB      023H
                                        2028    C
09A1  37 27 2D 37 31 15                 2029    C               DB      037H,027H,02DH,037H,031H,015H
09A7  04 11 00 07 06 07                 2030    C               DB      004H,011H,000H,007H,006H,007H
09AD  00 00 00 00 E1 24                 2031    C               DB      000H,000H,000H,000H,0E1H,024H
09B3  C7 14 08 E0 F0 A3                 2032    C               DB      0C7H,014H,008H,0E0H,0F0H,0A3H
09B9  FF                                2033    C               DB      0FFH
                                        2034    C
09BA  00 01 02 03 04 05                 2035    C               DB      000H,001H,002H,003H,004H,005H
09C0  06 07 10 11 12 13                 2036    C               DB      006H,007H,010H,011H,012H,013H
09C6  14 15 16 17 08 00                 2037    C               DB      014H,015H,016H,017H,008H,000H
09CC  0F 00                             2038    C               DB      00FH,000H
                                        2039    C
09CE  00 00 00 00 00 10                 2040    C               DB      000H,000H,000H,000H,000H,010H
09D4  0E 00 FF                          2041    C               DB      00EH,000H,0FFH
                                        2042    C
                                        2043    C       ;--B--
09D7  50 18 08                          2044    C               DB      80D,24D,08D
09DA  1000                              2045    C               DW      01000H
                                        2046    C
09DC  01 04 00 07                       2047    C               DB      001H,004H,000H,007H
                                        2048    C
09E0  23                                2049    C               DB      023H
                                        2050    C
09E1  70 4F 5C 2F 5F 07                 2051    C               DB      070H,04FH,05CH,02FH,05FH,007H
09E7  04 11 00 07 06 07                 2052    C               DB      004H,011H,000H,007H,006H,007H
09ED  00 00 00 00 E1 24                 2053    C               DB      000H,000H,000H,000H,0E1H,024H
09F3  C7 28 08 E0 F0 A3                 2054    C               DB      0C7H,028H,008H,0E0H,0F0H,0A3H
09F9  FF                                2055    C               DB      0FFH
                                        2056    C
09FA  00 00 00 00 00 00                 2057    C               DB      000H,000H,000H,000H,000H,000H
0A00  00 00 00 00 00 00                 2058    C               DB      000H,000H,000H,000H,000H,000H
0A06  00 00 00 00 00 00                 2059    C               DB      000H,000H,000H,000H,000H,000H
0A0C  0F 00                             2060    C               DB      00FH,000H
                                        2061    C
0A0E  00 00 00 00 00 00                 2062    C               DB      000H,000H,000H,000H,000H,000H
0A14  04 00 FF                          2063    C               DB      004H,000H,0FFH
                                        2064    C       ;--C--
0A17  50 18 0E                          2065    C               DB      80D,24D,14D
0A1A  1000                              2066    C               DW      01000H
                                        2067    C
0A1C  00 04 00 07                       2068    C               DB      000H,004H,000H,007H
                                        2069    C
0A20  A6                                2070    C               DB      0A6H
                                        2071    C
0A21  60 4F 56 3A 51 60                 2072    C               DB      060H,04FH,056H,03AH,051H,060H
0A27  70 1F 00 0D 0B 0C                 2073    C               DB      070H,01FH,000H,00DH,00BH,00CH
0A2D  00 00 00 00 5E 2E                 2074    C               DB      000H,000H,000H,000H,05EH,02EH
0A33  5D 28 0D 5E 6E A3                 2075    C               DB      05DH,028H,00DH,05EH,06EH,0A3H
0A39  FF                                2076    C               DB      0FFH
                                        2077    C
0A3A  00 00 00 00 00 00                 2078    C               DB      000H,000H,000H,000H,000H,000H
0A40  00 00 00 00 00 00                 2079    C               DB      000H,000H,000H,000H,000H,000H
0A46  00 00 00 00 0E 00                 2080    C               DB      000H,000H,000H,000H,00EH,000H
0A4C  0F 08                             2081    C               DB      00FH,008H
                                        2082    C
0A4E  00 00 00 00 00 00                 2083    C               DB      000H,000H,000H,000H,000H,000H
0A54  04 00 FF                          2084    C               DB      004H,000H,0FFH
                                        2085    C       ;--D--
0A57  28 18 08                          2086    C               DB      40D,24D,08D
0A5A  2000                              2087    C               DW      02000H
                                        2088    C
0A5C  0B 0F 00 06                       2089    C               DB      00BH,00FH,000H,006H
                                        2090    C
0A60  23                                2091    C               DB      023H
                                        2092    C
0A61  37 27 2D 37 30 14                 2093    C               DB      037H,027H,02DH,037H,030H,014H
0A67  04 11 00 00 00 00                 2094    C               DB      004H,011H,000H,000H,000H,000H
0A6D  00 00 00 00 E1 24                 2095    C               DB      000H,000H,000H,000H,0E1H,024H
0A73  C7 14 00 E0 F0 E3                 2096    C               DB      0C7H,014H,000H,0E0H,0F0H,0E3H
0A79  FF                                2097    C               DB      0FFH
                                        2098    C
0A7A  00 01 02 03 04 05                 2099    C               DB      000H,001H,002H,003H,004H,005H
0A80  06 07 10 11 12 13                 2100    C               DB      006H,007H,010H,011H,012H,013H
0A86  14 15 16 17 01 00                 2101    C               DB      014H,015H,016H,017H,001H,000H
0A8C  0F 00                             2102    C               DB      00FH,000H
                                        2103    C
0A8E  00 00 00 00 00 00                 2104    C               DB      000H,000H,000H,000H,000H,000H
0A94  05 0F FF                          2105    C               DB      005H,00FH,0FFH
                                        2106    C       ;--E--
0A97  50 18 08                          2107    C               DB      80D,24D,08D
0A9A  4000                              2108    C               DW      04000H
                                        2109    C
0A9C  01 0F 00 06                       2110    C               DB      001H,00FH,000H,006H
                                        2111    C
0AA0  23                                2112    C               DB      023H
                                        2113    C
0AA1  70 4F 59 2D 5E 06                 2114    C               DB      070H,04FH,059H,02DH,05EH,006H
0AA7  04 11 00 00 00 00                 2115    C               DB      004H,011H,000H,000H,000H,000H
0AAD  00 00 00 00 E0 23                 2116    C               DB      000H,000H,000H,000H,0E0H,023H
0AB3  C7 28 00 DF EF E3                 2117    C               DB      0C7H,028H,000H,0DFH,0EFH,0E3H
0AB9  FF                                2118    C               DB      0FFH
                                        2119    C
0ABA  00 01 02 03 04 05                 2120    C               DB      000H,001H,002H,003H,004H,005H
0AC0  06 07 10 11 12 13                 2121    C               DB      006H,007H,010H,011H,012H,013H
0AC6  14 15 16 17 01 00                 2122    C               DB      014H,015H,016H,017H,001H,000H
0ACC  0F 00                             2123    C               DB      00FH,000H
                                        2124    C
0ACE  00 00 00 00 00 00                 2125    C               DB      000H,000H,000H,000H,000H,000H
0AD4  05 0F FF                          2126    C               DB      005H,00FH,0FFH
                                        2127    C       ;--F--
0AD7  50 18 0E                          2128    C               DB      80D,24D,14D
0ADA  8000                              2129    C               DW      08000H
                                        2130    C
0ADC  05 0F 00 00                       2131    C               DB      005H,00FH,000H,000H
                                        2132    C
0AE0  A2                                2133    C               DB      0A2H
                                        2134    C
0AE1  60 4F 56 1A 50 E0                 2135    C               DB      060H,04FH,056H,01AH,050H,0E0H
0AE7  70 1F 00 00 00 00                 2136    C               DB      070H,01FH,000H,000H,000H,000H
0AED  00 00 00 00 5E 2E                 2137    C               DB      000H,000H,000H,000H,05EH,02EH
0AF3  5D 14 0D 5E 6E 8B                 2138    C               DB      05DH,014H,00DH,05EH,06EH,08BH
0AF9  FF                                2139    C               DB      0FFH
                                        2140    C
0AFA  00 08 00 00 18 18                 2141    C               DB      000H,008H,000H,000H,018H,018H
0B00  00 00 00 08 00 00                 2142    C               DB      000H,000H,000H,008H,000H,000H
```

```
0B06  00 18 00 00 0B 00          2143  C               DB      000H,018H,000H,000H,00BH,000H
0B0C  05 00                      2144  C               DB      005H,000H
                                 2145  C
0B0E  00 00 00 00 00 10          2146  C               DB      000H,000H,000H,000H,000H,010H
0B14  07 0F FF                   2147  C               DB      007H,00FH,0FFH
                                 2148  C       ;-10--
0B17  50 18 0E                   2149  C               DB      80D,24D,14D
0B1A  8000                       2150  C               DW      08000H
                                 2151  C
0B1C  05 0F 00 00                2152  C               DB      005H,00FH,000H,000H
                                 2153  C
0B20  A7                         2154  C               DB      0A7H
                                 2155  C
0B21  5B 4F 53 17 50 BA          2156  C               DB      05BH,04FH,053H,017H,050H,0BAH
0B27  6C 1F 00 00 00 00          2157  C               DB      06CH,01FH,000H,000H,000H,000H
0B2D  00 00 00 00 5E 2B          2158  C               DB      000H,000H,000H,000H,05EH,02BH
0B33  5D 14 0F 5F 0A 8B          2159  C               DB      05DH,014H,00FH,05FH,00AH,08BH
0B39  FF                         2160  C               DB      0FFH
                                 2161  C
0B3A  00 01 00 00 04 07          2162  C               DB      000H,001H,000H,000H,004H,007H
0B40  00 00 00 01 00 00          2163  C               DB      000H,000H,000H,001H,000H,000H
0B46  04 07 00 00 01 00          2164  C               DB      004H,007H,000H,000H,001H,000H
0B4C  05 00                      2165  C               DB      005H,000H
                                 2166  C
0B4E  00 00 00 00 00 10          2167  C               DB      000H,000H,000H,000H,000H,010H
0B54  07 0F FF                   2168  C               DB      007H,00FH,0FFH
                                 2169  C
= 0440                           2170  C       BASE_2  EQU     $ - VIDEO_PARMS
                                 2171  C
                                 2172  C       ;-----   > 16K MODE VALUES
                                 2173  C
                                 2174  C       ;--F--
0B57  50 18 0E                   2175  C               DB      80D,24D,14D
0B5A  8000                       2176  C               DW      08000H
                                 2177  C
0B5C  01 0F 00 06                2178  C               DB      001H,00FH,000H,006H
                                 2179  C
0B60  A2                         2180  C               DB      0A2H
                                 2181  C
0B61  60 4F 56 3A 50 60          2182  C               DB      060H,04FH,056H,03AH,050H,060H
0B67  70 1F 00 00 00 00          2183  C               DB      070H,01FH,000H,000H,000H,000H
0B6D  00 00 00 00 5E 2E          2184  C               DB      000H,000H,000H,000H,05EH,02EH
0B73  5D 28 0D 5E 6E E3          2185  C               DB      05DH,028H,00DH,05EH,06EH,0E3H
0B79  FF                         2186  C               DB      0FFH
                                 2187  C
0B7A  00 08 00 00 18 18          2188  C               DB      000H,008H,000H,000H,018H,018H
0B80  00 00 00 08 00 00          2189  C               DB      000H,000H,000H,008H,000H,000H
0B86  00 18 00 00 0B 00          2190  C               DB      000H,018H,000H,000H,00BH,000H
0B8C  05 00                      2191  C               DB      005H,000H
                                 2192  C
0B8E  00 00 00 00 00 00          2193  C               DB      000H,000H,000H,000H,000H,000H
0B94  05 0F FF                   2194  C               DB      005H,00FH,0FFH
                                 2195  C
                                 2196  C       ;-10--
0B97  50 18 0E                   2197  C               DB      80D,24D,14D
0B9A  8000                       2198  C               DW      08000H
                                 2199  C
0B9C  01 0F 00 06                2200  C               DB      001H,00FH,000H,006H
                                 2201  C
0BA0  A7                         2202  C               DB      0A7H
                                 2203  C
0BA1  5B 4F 53 37 52 00          2204  C               DB      05BH,04FH,053H,037H,052H,000H
0BA7  6C 1F 00 00 00 00          2205  C               DB      06CH,01FH,000H,000H,000H,000H
0BAD  00 00 00 00 5E 2B          2206  C               DB      000H,000H,000H,000H,05EH,02BH
0BB3  5D 28 0F 5F 0A E3          2207  C               DB      05DH,028H,00FH,05FH,00AH,0E3H
0BB9  FF                         2208  C               DB      0FFH
                                 2209  C
0BBA  00 01 02 03 04 05          2210  C               DB      000H,001H,002H,003H,004H,005H
0BC0  14 07 38 39 3A 3B          2211  C               DB      014H,007H,038H,039H,03AH,03BH
0BC6  3C 3D 3E 3F 01 00          2212  C               DB      03CH,03DH,03EH,03FH,001H,000H
0BCC  0F 00                      2213  C               DB      00FH,000H
                                 2214  C
0BCE  00 00 00 00 00 00          2215  C               DB      000H,000H,000H,000H,000H,000H
0BD4  05 0F FF                   2216  C               DB      005H,00FH,0FFH
                                 2217  C
                                 2218  C
= 04C0                           2219  C       BASE_3  EQU     $ - VIDEO_PARMS
                                 2220  C
                                 2221  C       ;----- HI RES ALTERNATE VALUES
                                 2222  C
                                 2223  C       ;--0--
0BD7  28 18 0E                   2224  C               DB      40D,24D,14D
0BDA  0800                       2225  C               DW      00800H
                                 2226  C
0BDC  0B 03 00 03                2227  C               DB      00BH,003H,000H,003H
                                 2228  C
0BE0  A7                         2229  C               DB      0A7H
                                 2230  C
0BE1  2D 27 28 2D 28 6D          2231  C               DB      02DH,027H,02BH,02DH,028H,06DH
0BE7  6C 1F 00 0D 06 07          2232  C               DB      06CH,01FH,000H,00DH,006H,007H
0BED  00 00 00 00 5E 2B          2233  C               DB      000H,000H,000H,000H,05EH,02BH
0BF3  5D 14 0F 5E 0A A3          2234  C               DB      05DH,014H,00FH,05EH,00AH,0A3H
0BF9  FF                         2235  C               DB      0FFH
                                 2236  C
0BFA  00 01 02 03 04 05          2237  C               DB      000H,001H,002H,003H,004H,005H
0C00  14 07 38 39 3A 3B          2238  C               DB      014H,007H,038H,039H,03AH,03BH
0C06  3C 3D 3E 3F 08 00          2239  C               DB      03CH,03DH,03EH,03FH,008H,000H
0C0C  0F 00                      2240  C               DB      00FH,000H
                                 2241  C
0C0E  00 00 00 00 00 10          2242  C               DB      000H,000H,000H,000H,000H,010H
0C14  0E 00 FF                   2243  C               DB      00EH,000H,0FFH
                                 2244  C
                                 2245  C       ;--1--
0C17  28 18 0E                   2246  C               DB      40D,24D,14D
0C1A  0800                       2247  C               DW      00800H
                                 2248  C
0C1C  0B 03 00 03                2249  C               DB      00BH,003H,000H,003H
                                 2250  C
0C20  A7                         2251  C               DB      0A7H
                                 2252  C
0C21  2D 27 28 2D 28 6D          2253  C               DB      02DH,027H,02BH,02DH,028H,06DH
0C27  6C 1F 00 0D 06 07          2254  C               DB      06CH,01FH,000H,00DH,006H,007H
0C2D  00 00 00 00 5E 2B          2255  C               DB      000H,000H,000H,000H,05EH,02BH
0C33  5D 14 0F 5E 0A A3          2256  C               DB      05DH,014H,00FH,05EH,00AH,0A3H
0C39  FF                         2257  C               DB      0FFH
                                 2258  C
0C3A  00 01 02 03 04 05          2259  C               DB      000H,001H,002H,003H,004H,005H
0C40  14 07 38 39 3A 3B          2260  C               DB      014H,007H,038H,039H,03AH,03BH
0C46  3C 3D 3E 3F 08 00          2261  C               DB      03CH,03DH,03EH,03FH,008H,000H
0C4C  0F 00                      2262  C               DB      00FH,000H
                                 2263  C
0C4E  00 00 00 00 00 10          2264  C               DB      000H,000H,000H,000H,000H,010H
0C54  0E 00 FF                   2265  C               DB      00EH,000H,0FFH
                                 2266  C
                                 2267  C       ;--2--
0C57  50 18 0E                   2268  C               DB      80D,24D,14D
```

```
0C5A  1000                    2269  C         DW      01000H
                              2270  C
0C5C  01 03 00 03             2271  C         DB      001H,003H,000H,003H
                              2272  C
0C60  A7                      2273  C         DB      0A7H
                              2274  C
0C61  5B 4F 53 37 51 5B       2275  C         DB      05BH,04FH,053H,037H,051H,05BH
0C67  6C 1F 00 0D 06 07       2276  C         DB      06CH,01FH,000H,00DH,006H,007H
0C6D  00 00 00 00 5E 2B       2277  C         DB      000H,000H,000H,000H,05EH,02BH
0C73  5D 28 0F 5E 0A A3       2278  C         DB      05DH,028H,00FH,05EH,00AH,0A3H
0C79  FF                      2279  C         DB      0FFH
                              2280  C
0C7A  00 01 02 03 04 05       2281  C         DB      000H,001H,002H,003H,004H,005H
0C80  14 07 38 39 3A 3B       2282  C         DB      014H,007H,038H,039H,03AH,03BH
0C86  3C 3D 3E 3F 08 00       2283  C         DB      03CH,03DH,03EH,03FH,008H,000H
0C8C  0F 00                   2284  C         DB      00FH,000H
                              2285  C
0C8E  00 00 00 00 00 10       2286  C         DB      000H,000H,000H,000H,000H,010H
0C94  0E 00 FF                2287  C         DB      00EH,000H,0FFH
                              2288  C
                              2289  C  ;--3--
0C97  50 18 0E                2290  C         DB      80D,24D,14D
0C9A  1000                    2291  C         DW      01000H
                              2292  C
0C9C  01 03 00 03             2293  C         DB      001H,003H,000H,003H
                              2294  C
0CA0  A7                      2295  C         DB      0A7H
                              2296  C
0CA1  5B 4F 53 37 51 5B       2297  C         DB      05BH,04FH,053H,037H,051H,05BH
0CA7  6C 1F 00 0D 06 07       2298  C         DB      06CH,01FH,000H,00DH,006H,007H
0CAD  00 00 00 00 5E 2B       2299  C         DB      000H,000H,000H,000H,05EH,02BH
0CB3  5D 28 0F 5E 0A A3       2300  C         DB      05DH,028H,00FH,05EH,00AH,0A3H
0CB9  FF                      2301  C         DB      0FFH
                              2302  C
0CBA  00 01 02 03 04 05       2303  C         DB      000H,001H,002H,003H,004H,005H
0CC0  14 07 38 39 3A 3B       2304  C         DB      014H,007H,038H,039H,03AH,03BH
0CC6  3C 3D 3E 3F 08 00       2305  C         DB      03CH,03DH,03EH,03FH,008H,000H
0CCC  0F 00                   2306  C         DB      00FH,000H
                              2307  C
0CCE  00 00 00 00 00 10       2308  C         DB      000H,000H,000H,000H,000H,010H
0CD4  0E 00 FF                2309  C         DB      00EH,000H,0FFH
                              2310  C
                              2311  C
                              2312  C         SUBTTL
                              2313
                              2314      ;----- VECTOR INTO <AH> SPECIFIED FUNCTION
                              2315
0CD7                          2316      COMBO_VIDEO     PROC    NEAR
0CD7  FB                      2317              STI                             ; INTERRUPTS ON
0CD8  FC                      2318              CLD                             ; SET DIRECTION FORWARD
0CD9  55                      2319              PUSH    BP                      ; SAVE THE REGISTER SET
0CDA  06                      2320              PUSH    ES
0CDB  1E                      2321              PUSH    DS
0CDC  52                      2322              PUSH    DX
0CDD  51                      2323              PUSH    CX
0CDE  53                      2324              PUSH    BX
0CDF  56                      2325              PUSH    SI
0CE0  57                      2326              PUSH    DI
                              2327
0CE1  50                      2328              PUSH    AX                      ; SAVE AX VALUE
0CE2  8A C4                   2329              MOV     AL,AH                   ; GET INTO LOW BYTE
0CE4  32 E4                   2330              XOR     AH,AH                   ; ZERO TO HIGH BYTE
0CE6  D1 E0                   2331              SAL     AX,1                    ; * 2 FOR TABLE LOOKUP
0CE8  8B F0                   2332              MOV     SI,AX                   ; PUT INTO SI FOR BRANCH
0CEA  3D 0028                 2333              CMP     AX,T2L                  ; TEST FOR WITHIN RANGE
0CED  72 06                   2334              JB      M2                      ; BRANCH AROUND BRANCH
0CEF  58                      2335              POP     AX                      ; RECOVER REGISTER
0CF0  CD 42                   2336              INT     42H                     ; PASS UNRECOGNIZED CALL
0CF2  E9 219E R               2337              JMP     V_RET                   ; RETURN TO CALLER
0CF5                          2338      M2:
                              2339              ASSUME  DS:ABS0
0CF5  E8 0CFE R               2340              CALL    DDS
0CF8  58                      2341              POP     AX                      ; RECOVER
0CF9  2E: FF A4 06EF R        2342              JMP     WORD PTR CS:[SI + OFFSET T2]    ; JMP TO AH=0 THRU AH=XX
                              2343
                              2344      ;----- UTILITY ROUTINES
                              2345
                              2346      ;----- SET DS TO THE DATA SEGMENT
                              2347
0CFE                          2348      DDS     PROC    NEAR
0CFE  50                      2349              PUSH    AX                      ; SAVE REGISTER
0CFF  2B C0                   2350              SUB     AX,AX
0D01  8E D8                   2351              MOV     DS,AX
0D03  58                      2352              POP     AX                      ; RESTORE REGISTER
0D04  C3                      2353              RET
0D05                          2354      DDS     ENDP
                              2355
0D05                          2356      WHAT_BASE       PROC    NEAR
                              2357              ASSUME  DS:ABS0
0D05  1E                      2358              PUSH    DS                      ; SAVE DATA SEGMENT
0D06  E8 0CFE R               2359              CALL    DDS                     ; GET LOW MEMORY SEGMENT
0D09  8B 16 0463 R            2360              MOV     DX,ADDR_6845            ; GET CRTC ADDRESS
0D0D  80 E2 F0                2361              AND     DL,0F0H                 ; STRIP OFF LOW NIBBLE
0D10  80 CA 0A                2362              OR      DL,0AH                  ; SET TO STATUS REGISTER
0D13  1F                      2363              POP     DS
0D14  C3                      2364              RET
0D15                          2365      WHAT_BASE       ENDP
                              2366
0D15                          2367      OUT_DX  PROC    NEAR                    ; AH=INDEX,AL=DATA,DX=PORT
0D15  86 C4                   2368              XCHG    AL,AH                   ; GET INDEX VALUE
0D17  EE                      2369              OUT     DX,AL                   ; SET INDEX REG
0D18  42                      2370              INC     DX                      ; SET DX TO DATA REG
0D19  86 C4                   2371              XCHG    AL,AH                   ; GET DATA VALUE
0D1B  EE                      2372              OUT     DX,AL                   ; SET DATA REG
0D1C  4A                      2373              DEC     DX                      ; SET DX BACK TO INDEX
0D1D  C3                      2374              RET
0D1E                          2375      OUT_DX  ENDP
                              2376
                              2377      ;----- ROUTINE TO SOUND BEEPER
                              2378
0D1E                          2379      BP_1    PROC    NEAR
0D1E  EE                      2380              OUT     DX,AL
0D1F  C3                      2381              RET
0D20                          2382      BP_1    ENDP
                              2383
0D20                          2384      BEEP    PROC    NEAR
0D20  52                      2385              PUSH    DX
0D21  BA 0043                 2386              MOV     DX,TIMER+3
0D24  B0 B6                   2387              MOV     AL,10110110B            ; SEL TIM 2,LSB,MSB,BINARY
0D26  E8 0D1E R               2388              CALL    BP_1                    ; WRITE THE TIMER MODE REG
0D29  B8 0533                 2389              MOV     AX,533H                 ; DIVISOR FOR 1000 HZ
0D2C  4A                      2390              DEC     DX
0D2D  E8 0D1E R               2391              CALL    BP_1                    ; WRITE TIMER 2 CNT - LSB
0D30  8A C4                   2392              MOV     AL,AH
0D32  E8 0D1E R               2393              CALL    BP_1                    ; WRITE TIMER 2 CNT - MSB
0D35  BA 0061                 2394              MOV     DX,PORT_B
```

```
0D3B  EC                      2395          IN      AL,DX                   ; GET SETTING OF PORT
0D39  8A E0                   2396          MOV     AH,AL                   ; SAVE THAT SETTING
0D3B  0C 03                   2397          OR      AL,03                   ; TURN SPEAKER ON
0D3D  E8 0D1E R               2398          CALL    BP_1
0D40  2B C9                   2399          SUB     CX,CX                   ; SET CNT TO WAIT 500 MS
0D42                          2400    G7:
0D42  E2 FE                   2401          LOOP    G7                      ; DELAY BEFORE TURNING OFF
0D44  FE CB                   2402          DEC     BL                      ; DELAY CNT EXPIRED?
0D46  75 FA                   2403          JNZ     G7                      ; NO-CONTINUE BEEPING SPK
0D48  8A C4                   2404          MOV     AL,AH                   ; RECOVER VALUE OF PORT
0D4A  E8 0D1E R               2405          CALL    BP_1
0D4D  5A                      2406          POP     DX
0D4E  C3                      2407          RET                             ; RETURN TO CALLER
0D4F                          2408    BEEP  ENDP
                              2409
                              2410    ;----- FIND THE PARAMETER TABLE VECTOR IN THE SAVE TABLE
                              2411
0D4F                          2412    SET_BASE        PROC    NEAR
                              2413            ASSUME  DS:ABS0
0D4F  E8 0CFE R               2414            CALL    DDS
0D52  C4 1E 04A8 R            2415            LES     BX,SAVE_PTR             ; GET PTR TP PTR TABLE
0D56  26: C4 1F               2416            LES     BX,DWORD PTR ES:[BX]    ; GET PARAMETER PTR
0D59  C3                      2417            RET
0D5A                          2418    SET_BASE        ENDP
                              2419
                              2420    ;----- ESTABLISH ADDRESSING TO THE CORRECT MODE TABLE ENTRY
                              2421
0D5A                          2422    MAKE_BASE       PROC    NEAR
                              2423            ASSUME  DS:ABS0
0D5A  51                      2424            PUSH    CX
0D5B  52                      2425            PUSH    DX
0D5C  E8 0D4F R               2426            CALL    SET_BASE                ; GET PARM TBL PTR
0D5F  8A 26 0449 R            2427            MOV     AH,CRT_MODE
0D63  F6 06 0487 R 60         2428            TEST    INFO,060H               ; TEST FOR BASE CARD
0D68  74 18                   2429            JZ      B_M_1                   ; MIN MEMORY
                              2430
                              2431    ;----- WE HAVE A MEMORY EXPANSION OPTION HERE
                              2432
0D6A  80 FC 0F                2433            CMP     AH,0FH
0D6D  75 07                   2434            JNE     B_M_2
0D6F  81 C3 0440              2435            ADD     BX,BASE_2 - BASE_1
0D73  EB 33 90                2436            JMP     B_M_OUT
0D76                          2437    B_M_2:
0D76  80 FC 10                2438            CMP     AH,010H
0D79  75 07                   2439            JNE     B_M_1
0D7B  81 C3 0480              2440            ADD     BX,BASE_2 + M_TBL_LEN - BASE_1
0D7F  EB 27 90                2441            JMP     B_M_OUT
0D82                          2442    B_M_1:
0D82  80 FC 03                2443            CMP     AH,03H
0D85  77 14                   2444            JA      B_M_3                   ; SKIP ENHANCED PORTION
                              2445
                              2446    ;----- CHECK THE SWITCH SETTING FOR ENHANCEMENT
                              2447
0D87  A0 0488 R               2448            MOV     AL,INFO_3
0D8A  24 0F                   2449            AND     AL,0FH
0D8C  3C 03                   2450            CMP     AL,03H                  ; SECONDARY EMULATE SETTING
0D8E  74 07                   2451            JE      BRS
0D90  3C 09                   2452            CMP     AL,09H                  ; PRIMARY EMULATE SETTING
0D92  74 03                   2453            JE      BRS
0D94  EB 05 90                2454            JMP     B_M_3
                              2455
                              2456    ;----- WE WILL PERFORM ENHANCEMENT
                              2457
0D97                          2458    BRS:
0D97  81 C3 04C0              2459            ADD     BX,BASE_3 - BASE_1      ; VECTOR TO ENHANCEMENT TBL
0D9B                          2460    B_M_3:
0D9B  8A 0E 0449 R            2461            MOV     CL,CRT_MODE
0D9F  2A ED                   2462            SUB     CH,CH
0DA1  E3 05                   2463            JCXZ    B_M_4
                              2464
                              2465    ;----- THIS LOOP WILL MOVE THE PTR TO THE INDIVIDUAL MODE ENTRY
                              2466
0DA3                          2467    B_M_5:
0DA3  83 C3 40                2468            ADD     BX,M_TBL_LEN            ; LENGTH OF ONE MODE ENTRY
0DA6  E2 FB                   2469            LOOP    B_M_5
0DA8                          2470    B_M_4:
0DA8                          2471    B_M_OUT:
0DA8  5A                      2472            POP     DX
0DA9  59                      2473            POP     CX
0DAA  C3                      2474            RET
0DAB                          2475    MAKE_BASE       ENDP
                              2476
                              2477    ;----- PROGRAM THE EGA REGISTERS FROM THE PARAMETER TABLE
                              2478
0DAB                          2479    SET_REGS        PROC    NEAR
                              2480            ASSUME  DS:ABS0,ES:NOTHING
                              2481
                              2482    ;----- PROGRAM THE SEQUENCER
                              2483
0DAB  E8 0D5A R               2484            CALL    MAKE_BASE               ; GET TABLE PTR
0DAE  83 C3 05                2485            ADD     BX,TFS_LEN              ; MODE TO SEQUENCER PARMS
0DB1  B6 03                   2486            MOV     DH,3
0DB3  B2 C4                   2487            MOV     DL,SEQ_ADDR
0DB5  B8 0001                 2488            MOV     AX,0001H                ; RESET SEQUENCER
0DB8  FA                      2489            CLI                             ; DISABLE INTERRUPTS
0DB9  E8 0D15 R               2490            CALL    OUT_DX
0DBC  26: 8A 07               2491            MOV     AL,ES:[BX]              ; GET SEQUENCER VALUE
0DBF  FE C4                   2492            INC     AH                      ; NEXT INDEX
0DC1  E8 0D15 R               2493            CALL    OUT_DX                  ; SET IT
0DC4                          2494    D1:
0DC4  FE C4                   2495            INC     AH                      ; NEXT INDEX REGISTER
0DC6  43                      2496            INC     BX                      ; NEXT TABLE ENTRY
0DC7  26: 8A 07               2497            MOV     AL,ES:[BX]
0DCA  E8 0D15 R               2498            CALL    OUT_DX
0DCD  80 FC 05                2499            CMP     AH,R1+1
0DD0  72 F2                   2500            JB      D1
                              2501
0DD2  26: 8A 07               2502            MOV     AL,ES:[BX]
0DD5  43                      2503            INC     BX
0DD6  B2 C2                   2504            MOV     DL,MISC_OUTPUT
0DD8  EE                      2505            OUT     DX,AL
0DD9  B2 C4                   2506            MOV     DL,SEQ_ADDR
0DDB  B8 0003                 2507            MOV     AX,0003H
0DDE  E8 0D15 R               2508            CALL    OUT_DX                  ; START SEQUENCER
0DE1  FB                      2509            STI                             ; ENABLE INTERRUPTS
                              2510
                              2511    ;----- PROGRAM THE CRT CONTROLLER
                              2512
0DE2  8B 16 0463 R            2513            MOV     DX,ADDR_6845            ; CRTC INDEX REGISTER
0DE6  2A E4                   2514            SUB     AH,AH                   ; COUNTER
0DE8                          2515    X1:
0DE8  26: 8A 07               2516            MOV     AL,ES:[BX]              ; GET VALUE FROM TABLE
0DEB  E8 0D15 R               2517            CALL    OUT_DX                  ; SET CRTC REGISTER
0DEE  43                      2518            INC     BX                      ; NEXT TABLE ENTRY
0DEF  FE C4                   2519            INC     AH                      ; NEXT INDEX VALUE
0DF1  80 FC 19                2520            CMP     AH,M4                   ; TEST REGISTER COUNT
```

```
0DF4  72 F2                2521                JB      X1                      ; DO THE REST
0DF6  26: 8B 47 F1         2522                MOV     AX,ES:[BX][-0FH]        ; GET CURSOR MODE
0DFA  86 E0                2523                XCHG    AH,AL
0DFC  A3 0460 R            2524                MOV     CURSOR_MODE,AX          ; SET LOW RAM VALUE
                           2525
                           2526        ;----- PROGRAM THE ATTRIBUTE CHIP
                           2527
0DFF  8B F3                2528                MOV     SI,BX
0E01  E8 0D05 R            2529                CALL    WHAT_BASE
0E04  EC                   2530                IN      AL,DX
0E05  B2 C0                2531                MOV     DL,ATTR_WRITE
0E07  2A E4                2532                SUB     AH,AH                   ; INDEX COUNTER
0E09                       2533        D3:
0E09  26: 8A 07            2534                MOV     AL,ES:[BX]              ; GET DATA VALUE
0E0C  86 E0                2535                XCHG    AH,AL
0E0E  EE                   2536                OUT     DX,AL
0E0F  86 E0                2537                XCHG    AH,AL
0E11  EE                   2538                OUT     DX,AL
0E12  43                   2539                INC     BX                      ; NEXT DATA VALUE
0E13  FE C4                2540                INC     AH                      ; NEXT INDEX VALUE
0E15  80 FC 14             2541                CMP     AH,M5                   ; TEST REGISTER COUNT
0E18  72 EF                2542                JB      D3                      ; DO THE REST
                           2543
0E1A  B0 00                2544                MOV     AL,0
0E1C  EE                   2545                OUT     DX,AL
                           2546
                           2547        ;----- CHECK IF PALETTE REGISTER VALUES ARE TO BE SAVED
                           2548
0E1D  1E                   2549                PUSH    DS
0E1E  06                   2550                PUSH    ES
0E1F  C4 3E 04A8 R         2551                LES     DI,SAVE_PTR             ; GET TABLE PTR
0E23  26: C4 7D 04         2552                LES     DI,DWORD PTR ES:[DI][4] ; GET PALETTE PTR
0E27  8C C0                2553                MOV     AX,ES
0E29  0B C7                2554                OR      AX,DI
0E2B  74 09                2555                JZ      SAVE_OUT                ; IF ZERO, NO SAVE OCCURS
                           2556
                           2557        ;----- STORE AWAY THE PALETTE VALUES IN RAM SAVE AREA
                           2558
0E2D  1F                   2559                POP     DS
0E2E  1E                   2560                PUSH    DS
0E2F  B9 0010              2561                MOV     CX,16D
0E32  F3/ A4               2562        REP     MOVSB                           ; SAVE THE PALETTE REGS
0E34  46                   2563                INC     SI
0E35  A4                   2564                MOVSB                           ; SAVE THE OVERSCAN REG
0E36                       2565        SAVE_OUT:
0E36  07                   2566                POP     ES
0E37  1F                   2567                POP     DS
                           2568
                           2569        ;----- PROGRAM THE GRAPHICS CHIPS
                           2570
0E38  B2 CC                2571                MOV     DL,GRAPH_1_POS
0E3A  B0 00                2572                MOV     AL,0
0E3C  EE                   2573                OUT     DX,AL
0E3D  B2 CA                2574                MOV     DL,GRAPH_2_POS
0E3F  B0 01                2575                MOV     AL,1
0E41  EE                   2576                OUT     DX,AL
0E42  B2 CE                2577                MOV     DL,GRAPH_ADDR
0E44  2A E4                2578                SUB     AH,AH
0E46                       2579        D4:
0E46  26: 8A 07            2580                MOV     AL,ES:[BX]              ; PARAMETER BYTE
0E49  E8 0D15 R            2581                CALL    OUT_DX                  ; SET IT
0E4C  43                   2582                INC     BX                      ; NEXT BYTE
0E4D  FE C4                2583                INC     AH                      ; NEXT REGISTER
0E4F  80 FC 09             2584                CMP     AH,M6
0E52  72 F2                2585                JB      D4                      ; CONTINUE
0E54  C3                   2586                RET
0E55                       2587        SET_REGS        ENDP
                           2588
                           2589        ;----- MODE SET REGEN CLEAR ROUTINE
                           2590
0E55                       2591        BLANK   PROC    NEAR                    ; FILL REGEN WITH BLANKS
                           2592                ASSUME  DS:ABS0,ES:NOTHING
0E55  A0 0487 R            2593                MOV     AL,INFO                 ; SEE IF BLANK IS TO OCCUR
0E58  A8 80                2594                TEST    AL,080H                 ; MODE SET HIGH BIT
0E5A  75 39                2595                JNZ     OUT_1                   ; SKIP BLANK FOR REGEN
0E5C  BA B800              2596                MOV     DX,0B800H               ; COLOR MODE REGEN ADDRESS
0E5F  A0 0449 R            2597                MOV     AL,CRT_MODE             ; CURRENT MODE SET
0E62  3C 06                2598                CMP     AL,6                    ; 0-6 ARE COLOR MODES
0E64  76 0A                2599                JBE     CG0
0E66  BA B000              2600                MOV     DX,0B000H               ; MONOCHROME REGEN ADDRESS
0E69  3C 07                2601                CMP     AL,7                    ; MONOCHROME MODE
0E6B  74 03                2602                JE      CG0
0E6D  BA A000              2603                MOV     DX,0A000H               ; REMAINING MODES
0E70                       2604        CG0:
0E70  BB 0720              2605                MOV     BX,0720H                ; ALPHA BLANK VALUE
0E73  3C 04                2606                CMP     AL,4                    ; ALPHAMODES 0-3
0E75  72 06                2607                JB      WW1
0E77  3C 07                2608                CMP     AL,7                    ; ALPHA MODE
0E79  74 02                2609                JE      WW1
0E7B  2B DB                2610                SUB     BX,BX                   ; GRAPHICS BLANK VALUE
0E7D                       2611        WW1:
                           2612                SRLOAD  ES                      ; SET THE REGEN SEGMENT
0E7D  8E C2                2613        +       MOV     ES,DX
0E7F  8B 0E 044C R         2614                MOV     CX,CRT_LEN
0E83  E3 10                2615                JCXZ    OUT_1
0E85  B9 8000              2616                MOV     CX,08000H
0E88  80 FE A0             2617                CMP     DH,0A0H
0E8B  74 02                2618                JE      N_BA
0E8D  B5 40                2619                MOV     CH,040H
0E8F                       2620        N_BA:
0E8F  8B C3                2621                MOV     AX,BX                   ; BLANK VALUE
0E91  2B FF                2622                SUB     DI,DI                   ; CLEAR POINTER
0E93  F3/ AB               2623                REP     STOSW                   ; CLEAR THE PAGE
0E95                       2624        OUT_1:
0E95  C3                   2625                RET                             ; RETURN TO CALLER
0E96                       2626        BLANK   ENDP
                           2627
0E96                       2628        PH_5    PROC    NEAR
0E96  E8 1DB7 R            2629                CALL    PAL_ON
0E99  C3                   2630                RET
0E9A                       2631        PH_5    ENDP
                           2632
                           2633        ;----- SEE IF WE ARE TO SUPPORT 640 X 350 ON A 640 X 200 MODE
                           2634
0E9A                       2635        BRST_DET        PROC    NEAR
                           2636                ASSUME  DS:ABS0
0E9A  50                   2637                PUSH    AX
0E9B  1E                   2638                PUSH    DS
0E9C  E8 0CFE R            2639                CALL    DDS
0E9F  A0 0488 R            2640                MOV     AL,INFO_3
0EA2  1F                   2641                POP     DS
0EA3  24 0F                2642                AND     AL,0FH
0EA5  3C 03                2643                CMP     AL,03H                  ; EMULATE MODE
0EA7  74 07                2644                JE      B_YES
0EA9  3C 09                2645                CMP     AL,09H                  ; EMULATE MODE
0EAB  74 03                2646                JE      B_YES
```

```
0EAD  58                        2647            POP     AX
0EAE  F8                        2648            CLC
0EAF  C3                        2649            RET
0EB0                            2650    B_YES:
0EB0  58                        2651            POP     AX
0EB1  F9                        2652            STC
0EB2  C3                        2653            RET
0EB3                            2654    BRST_DET        ENDP
                                2655
                                2656    ;----- MODE SET
                                2657
0EB3                            2658    AHO:
                                2659            ASSUME  DS:ABS0
0EB3  FA                        2660            CLI
0EB4  C7 06 010C R 0000 E       2661            MOV     WORD PTR GRX_SET, OFFSET CGDDOT
0EBA  8C 0E 010E R              2662            MOV     WORD PTR GRX_SET+2, CS
0EBE  FB                        2663            STI
0EBF  80 26 0487 R F3           2664            AND     INFO,11110011B                  ; TURN OFF RETRACE BIT
                                2665                                                    ;  EGA ACTIVE BIT
0EC4  50                        2666            PUSH    AX                              ; SAVE
0EC5  F6 06 0487 R 02           2667            TEST    INFO,2
0ECA  74 2C                     2668            JZ      ST_1                    ; THERE IS NO MONOCHROME
0ECC  A1 0410 R                 2669            MOV     AX,EQUIP_FLAG           ; THERE IS A MONOCHROME
0ECF  24 30                     2670            AND     AL,030H                 ; CHECK THE EQUIPMENT FLAG
0ED1  3C 30                     2671            CMP     AL,030H                 ;  FOR MONOCHROME CALL
0ED3  74 48                     2672            JE      ST_2                    ; IT IS A MONOCHROME CALL
                                2673
                                2674    ;----- FALL THROUGH => REGULAR COLOR CARD SETUP
                                2675
0ED5  C6 06 0484 R 18           2676            MOV     ROWS,024D
0EDA  C7 06 0485 R 0008         2677            MOV     POINTS,8
0EE0  58                        2678            POP     AX                              ; RECOVER
0EE1  80 0E 0487 R 08           2679            OR      INFO,00001000B                  ; EGA NOT ACTIVE
0EE6  3C 01                     2680            CMP     AL,1
0EE8  76 09                     2681            JBE     ST_7                    ; WAIT FOR RETRACE ON
0EEA  3C 04                     2682            CMP     AL,4                    ; MODES 2,3 ONLY
0EEC  73 05                     2683            JAE     ST_7
0EEE  80 0E 0487 R 04           2684            OR      INFO,00000100B          ; DO RETRACE
0EF3                            2685    ST_7:
0EF3  CD 42                     2686            INT     42H                     ; OTHER ADAPTER MODE CALL
0EF5  E9 219E R                 2687            JMP     V_RET                   ; BACK TO CALLER
                                2688
                                2689    ;----- AT THIS POINT THERE IS NO MONOCHROME ATTACHED TO THE ADAPTER
                                2690
0EF8                            2691    ST_1:
0EF8  A1 0410 R                 2692            MOV     AX,EQUIP_FLAG           ; TEST THE EQUIPMENT FLAG
0EFB  24 30                     2693            AND     AL,030H                 ;  TO SEE IF THIS IS A
0EFD  3C 30                     2694            CMP     AL,030H                 ;  MONOCHROME SETUP CALL
0EFF  75 40                     2695            JNE     ST_3                    ; MUST BE COLOR TO CARD
                                2696
                                2697    ;----- FALL THROUGH => REGULAR MONOCHROME CARD SETUP
                                2698
0F01  C6 06 0484 R 18           2699            MOV     ROWS,024D
0F06  C7 06 0485 R 000E         2700            MOV     POINTS,014D
0F0C  58                        2701            POP     AX                              ; RECOVER
0F0D  CD 42                     2702            INT     42H                     ; OTHER ADAPTER MODE CALL
0F0F  C7 06 0460 R 0B0C         2703            MOV     CURSOR_MODE,0B0CH       ; FIX PLANAR VALUE
0F15  80 0E 0487 R 08           2704            OR      INFO,8                  ; THE EGA IS NOT ACTIVE
0F1A  E9 219E R                 2705            JMP     V_RET                   ; BACK TO CALLER
                                2706
                                2707    ;----- MONOCHROME SETUP TO THE ADAPTER
                                2708
0F1D                            2709    ST_2:
0F1D  58                        2710            POP     AX                              ; RECOVER
0F1E  50                        2711            PUSH    AX                              ; SAVE
0F1F  B6 03                     2712            MOV     DH,3
0F21  24 80                     2713            AND     AL,080H                 ; PICK OFF THE CLEAR BIT
0F23  80 26 0487 R 7F           2714            AND     INFO,07FH               ; MASK OFF THE OTHER BITS
0F28  08 06 0487 R              2715            OR      INFO,AL                 ; SAVE REGEN CLEAR BIT
0F2C  58                        2716            POP     AX                      ; RECOVER TRUE CALL VALUE
0F2D  24 7F                     2717            AND     AL,07FH                 ; ALREADY DEALT WITH D7
0F2F  3C 0F                     2718            CMP     AL,0FH                  ; A MONOCHROME MODE
0F31  74 02                     2719            JE      ST_2A                   ; DO THIS MODE
0F33  B0 07                     2720            MOV     AL,7                    ; REGULAR MONOCHROME
0F35                            2721    ST_2A:
0F35  A2 0449 R                 2722            MOV     CRT_MODE,AL             ; SAVE MODE VALUE
0F38  B2 B4                     2723            MOV     DL,0B4H                 ; IT IS 3-B-X
0F3A  89 16 0463 R              2724            MOV     ADDR_6845,DX            ; SAVE CRTC ADDRESS
0F3E  EB 1C 90                  2725            JMP     QQ1                     ; CONTINUE THE MODE SET
                                2726
                                2727    ;----- COLOR SETUP TO THE ADAPTER
                                2728
0F41                            2729    ST_3:
0F41  58                        2730            POP     AX                              ; RECOVER PARAMETER VALUE
0F42  50                        2731            PUSH    AX                              ; SAVE IT
0F43  B6 03                     2732            MOV     DH,3
0F45  24 80                     2733            AND     AL,080H                 ; ISOLATE REGEN CLEAR BIT
0F47  80 26 0487 R 7F           2734            AND     INFO,07FH               ; PREPARE INFO BYTE
0F4C  08 06 0487 R              2735            OR      INFO,AL                 ; SET IT, OR NOT
0F50  58                        2736            POP     AX                      ; RECOVER TRUE MODE CALL
0F51  24 7F                     2737            AND     AL,07FH                 ; DONE WITH D7
0F53  A2 0449 R                 2738            MOV     CRT_MODE,AL             ; SAVE THIS MODE
0F56  B2 D4                     2739            MOV     DL,0D4H                 ; 3-D-X
0F58  89 16 0463 R              2740            MOV     ADDR_6845,DX            ; SAVE CRTC ADDRESS
0F5C                            2741    QQ1:
0F5C  C7 06 044E R 0000         2742            MOV     CRT_START,0             ; SAVE START ADDRESS
0F62  C6 06 0462 R 00           2743            MOV     ACTIVE_PAGE,0           ; RESET PAGE VALUE TO ZERO
                                2744            ASSUME  ES:NOTHING
0F67  B9 0008                   2745            MOV     CX,8                    ; 8 PAGES OF CURSOR VALUES
0F6A  BF 0450 R                 2746            MOV     DI,OFFSET CURSOR_POSN   ; OFFSET
0F6D  1E                        2747            PUSH    DS                      ; ESTABLISH
0F6E  07                        2748            POP     ES                      ;  ADDRESSING
0F6F  2B C0                     2749            SUB     AX,AX                   ; 0 THOSE CURSOR LOCATIONS
0F71  F3/ AB                    2750            REP     STOSW                   ; CLEAR OUT SAVED VALUES
                                2751
0F73  E8 0D5A R                 2752            CALL    MAKE_BASE
                                2753
0F76  26: 8A 07                 2754            MOV     AL,ES:[BX]              ; GET COLUMN COUNT
0F79  2A E4                     2755            SUB     AH,AH                   ; ZERO HIGH BYTE
0F7B  A3 044A R                 2756            MOV     CRT_COLS,AX             ; STORE COLUMN VALUE
                                2757
0F7E  26: 8A 47 01              2758            MOV     AL,ES:[BX][1]           ; GET ROW VALUE
0F82  A2 0484 R                 2759            MOV     ROWS,AL                 ; STORE ROW VALUE
                                2760
0F85  26: 8A 47 02              2761            MOV     AL,ES:[BX][2]           ; GET THE BYTES/CHAR
0F89  2A E4                     2762            SUB     AH,AH                   ; ZERO HIGH BYTE
0F8B  A3 0485 R                 2763            MOV     POINTS,AX               ; STORE BYTES/CHAR
                                2764
0F8E  26: 8B 47 03              2765            MOV     AX,ES:[BX][3]           ; GET PAGE SIZE
0F92  A3 044C R                 2766            MOV     CRT_LEN,AX              ; STORE PAGE LENGTH
                                2767
0F95  2B DB                     2768            SUB     BX,BX                   ; ZERO
0F97  B0 01                     2769            MOV     AL,1                    ; MONOCHROME ALPHA CHAR GEN
0F99  8A 26 0449 R              2770            MOV     AH,CRT_MODE             ; GET CURRENT MODE
0F9D  80 FC 07                  2771            CMP     AH,7                    ; IS IT MONOCHROME
0FA0  74 0C                     2772            JE      ENTRY_2                 ; 9X14 FONT
```

```
0FA2  80 FC 03                2773                    CMP     AH,03H
0FA5  77 35                   2774                    JA      ENTRY_1
                              2775
0FA7  E8 0E9A R               2776                    CALL    BRST_DET
0FAA  72 02                   2777                    JC      ENTRY_2
                              2778
0FAC  B0 02                   2779                    MOV     AL,2                    ; COLOR ALPHA CHAR GEN
0FAE                          2780            ENTRY_2:
0FAE  E8 1EAE R               2781                    CALL    CH_GEN                  ; LOAD ALPHA CHAR GEN
0FB1  E8 0CFE R               2782                    CALL    DDS
0FB4  8A 26 0449 R            2783                    MOV     AH,CRT_MODE             ; GET CURRENT MODE
0FB8  80 FC 07                2784                    CMP     AH,7                    ; IS IT MONOCHROME
0FBB  74 03                   2785                    JE      FDG_IT                  ; 9X14 FONT
0FBD  EB 1D 90                2786                    JMP     ENTRY_1
0FC0                          2787            FDG_IT:
0FC0  BD 0000 E               2788                    MOV     BP,OFFSET CGMN_FDG      ; TABLE POINTER
0FC3  BB 0E00                 2789                    MOV     BX,0E00H                ; 14 BYTES PER CHAR
0FC6                          2790            FDG:
0FC6  0E                      2791                    PUSH    CS                      ; GET THE ROM SEGMENT
0FC7  07                      2792                    POP     ES                      ;  INTO ES
0FC8  26: 8B 56 00            2793                    MOV     DX,ES:[BP]              ; GET THE CHAR HEX CODE
0FCC  0B D2                   2794                    OR      DX,DX                   ; ZERO = NO MORE CHARS
0FCE  74 0C                   2795                    JZ      ENTRY_1                 ; NO MORE
0FD0  B9 0001                 2796                    MOV     CX,1                    ; DO ONE CHAR AT A TIME
0FD3  45                      2797                    INC     BP                      ; MOVE TO FIRST CODE POINT
0FD4  E8 1EF6 R               2798                    CALL    DO_MAP2                 ; STORE THE CODE POINT
0FD7  83 C5 0E                2799                    ADD     BP,014D                 ; ADJUST BP TO NEXT CODE
0FDA  EB EA                   2800                    JMP     FDG                     ; DO ANOTHER
0FDC                          2801            ENTRY_1:
0FDC  E8 0DAB R               2802                    CALL    SET_REGS
0FDF  E8 0E55 R               2803                    CALL    BLANK                   ; CLEAR OUT THE BUFFER
0FE2  E8 0E96 R               2804                    CALL    PH_5
                              2805
                              2806                    ASSUME  DS:ABSO
0FE5  E8 0CFE R               2807                    CALL    DDS
0FE8  80 3E 0449 R 0F         2808                    CMP     CRT_MODE,0FH
0FED  72 06                   2809                    JB      MS_1
0FEF  C7 06 010C R 0000 E     2810                    MOV     WORD PTR GRX_SET , OFFSET CGMN
0FF5                          2811            MS_1:
0FF5  80 3E 0449 R 07         2812                    CMP     CRT_MODE,7
0FFA  77 09                   2813                    JA      SAVE_GRPH
0FFC  74 4B                   2814                    JE      SAVE_ALPH
0FFE  80 3E 0449 R 03         2815                    CMP     CRT_MODE,3
1003  76 44                   2816                    JBE     SAVE_ALPH
1005                          2817            SAVE_GRPH:
1005  C4 1E 04A8 R            2818                    LES     BX,SAVE_PTR
1009  83 C3 0C                2819                    ADD     BX,0CH
100C  26: C4 1F               2820                    LES     BX,DWORD PTR ES:[BX]
100F  8C C0                   2821                    MOV     AX,ES
1011  0B C3                   2822                    OR      AX,BX
1013  74 32                   2823                    JZ      J4J                     ; JMP AHO_DONE
1015  BE 0007                 2824                    MOV     SI,07H
1018                          2825            SG_1:
1018  26: 8A 00               2826                    MOV     AL,ES:[BX][SI]
101B  3C FF                   2827                    CMP     AL,0FFH
101D  74 7A                   2828                    JE      AHO_DONE
101F  3A 06 0449 R            2829                    CMP     AL,CRT_MODE
1023  74 03                   2830                    JE      SG_2
1025  46                      2831                    INC     SI
1026  EB F0                   2832                    JMP     SG_1
1028                          2833            SG_2:
1028  FA                      2834                    CLI
1029  26: 8A 07               2835                    MOV     AL,BYTE PTR ES:[BX]
102C  FE C8                   2836                    DEC     AL
102E  A2 0484 R               2837                    MOV     ROWS,AL
1031  26: 8B 47 01            2838                    MOV     AX,WORD PTR ES:[BX][1]
1035  A3 0485 R               2839                    MOV     POINTS,AX
1038  26: 8B 47 03            2840                    MOV     AX,WORD PTR ES:[BX][3]
103C  A3 010C R               2841                    MOV     WORD PTR GRX_SET,AX
103F  26: 8B 47 05            2842                    MOV     AX,WORD PTR ES:[BX][5]
1043  A3 010E R               2843                    MOV     WORD PTR GRX_SET + 2,AX
1046  FB                      2844                    STI
1047                          2845            J4J:
1047  EB 50                   2846                    JMP     SHORT AHO_DONE
1049                          2847            SAVE_ALPH:
1049  C4 1E 04A8 R            2848                    LES     BX,SAVE_PTR
104D  83 C3 08                2849                    ADD     BX,08H
1050  26: C4 1F               2850                    LES     BX,DWORD PTR ES:[BX]
1053  8C C0                   2851                    MOV     AX,ES
1055  0B C3                   2852                    OR      AX,BX
1057  74 40                   2853                    JZ      AHO_DONE
1059  BE 000B                 2854                    MOV     SI,0BH
105C                          2855            SA_1:
105C  26: 8A 00               2856                    MOV     AL,ES:[BX][SI]
105F  3C FF                   2857                    CMP     AL,0FFH
1061  74 36                   2858                    JE      AHO_DONE
1063  3A 06 0449 R            2859                    CMP     AL,CRT_MODE
1067  74 03                   2860                    JE      SA_2
1069  46                      2861                    INC     SI
106A  EB F0                   2862                    JMP     SA_1
106C                          2863            SA_2:
106C  26: 8A 27               2864                    MOV     AH,ES:[BX]
106F  26: 8A 47 01            2865                    MOV     AL,ES:[BX][1]
1073  26: 8B 4F 02            2866                    MOV     CX,ES:[BX][2]
1077  26: 8B 57 04            2867                    MOV     DX,ES:[BX][4]
107B  26: 8B 4F 06            2868                    MOV     BP,ES:[BX][6]
107F  26: 8E 47 08            2869                    MOV     ES,ES:[BX][8]
1083  53                      2870                    PUSH    BX
1084  8B D8                   2871                    MOV     BX,AX
1086  B8 1110                 2872                    MOV     AX,1110H
1089  CD 10                   2873                    INT     10H
108B  5B                      2874                    POP     BX
108C  26: 8A 47 0A            2875                    MOV     AL,ES:[BX][0AH]
1090  3C FF                   2876                    CMP     AL,0FFH
1092  74 05                   2877                    JE      AHO_DONE
1094  FE C8                   2878                    DEC     AL
1096  A2 0484 R               2879                    MOV     ROWS,AL
                              2880
                              2881            ;----- SET THE LOW RAM VALUES FOR COMPATIBILITY (3D8 AND 3D9 SAVE BYTES)
                              2882
1099                          2883            AHO_DONE:
1099  E8 0CFE R               2884                    CALL    DDS
109C  80 3E 0449 R 07         2885                    CMP     CRT_MODE,7
10A1  77 1E                   2886                    JA      DNDCS
10A3  BB 10C8 R               2887                    MOV     BX,OFFSET COMPAT_MODE
10A6  A0 0449 R               2888                    MOV     AL,CRT_MODE
10A9  2A E4                   2889                    SUB     AH,AH
10AB  03 D8                   2890                    ADD     BX,AX
10AD  2E: 8A 07               2891                    MOV     AL,CS:[BX]
10B0  A2 0465 R               2892                    MOV     CRT_MODE_SET,AL
10B3  B0 30                   2893                    MOV     AL,030H
10B5  80 3E 0449 R 06         2894                    CMP     CRT_MODE,6
10BA  75 02                   2895                    JNE     DO_PAL
10BC  B0 3F                   2896                    MOV     AL,03FH
10BE                          2897            DO_PAL:
10BE  A2 0466 R               2898                    MOV     CRT_PALETTE,AL
```

```
10C1                            2899    ONDCS:
10C1  EB 0E 0460 R              2900            MOV     CX,CURSOR_MODE
10C5  EB 28 90                  2901            JMP     AH1
                                2902
10C8                            2903    COMPAT_MODE     LABEL   BYTE
10C8  2C 28 2D 29 2A 2E         2904            DB      02CH,028H,02DH,029H,02AH,02EH
10CE  1E 29                     2905            DB      01EH,029H
                                2906
                                2907 C          INCLUDE V1-5.INC
                                2908 C          SUBTTL V1-5.INC
                                2909 C          PAGE
                                2910 C
10D0                            2911 C  CALC_CURSOR     PROC    NEAR
                                2912 C          ASSUME  DS:ABS0
10D0  80 FD 00                  2913 C          CMP     CH,0                    ; CHECK FOR FULL HEIGHT
10D3  75 04                     2914 C          JNE     CC_1                    ; NORMAL CHECK
10D5  FE C1                     2915 C          INC     CL                      ; ADJUST END VALUE
10D7  EB 0A                     2916 C          JMP     SHORT   CALC_OUT
10D9                            2917 C  CC_1:
10D9  FE C1                     2918 C          INC     CL                      ; ADJUST FOR EGA REGISTERS
10DB  3A 0E 0485 R              2919 C          CMP     CL,BYTE PTR POINTS      ; WILL IT WRAP
10DF  72 02                     2920 C          JB      CALC_OUT                ; NO, ITS OK
10E1  2A C9                     2921 C          SUB     CL,CL                   ; EGA METHOD FOR CURSOR END
10E3                            2922 C  CALC_OUT:
10E3  51                        2923 C          PUSH    CX                      ; SAVE CURSOR TYPE VALUE
10E4  2A CD                     2924 C          SUB     CL,CH                   ; END - START
10E6  80 F9 10                  2925 C          CMP     CL,010H                 ; LOW NIBBLE EQUAL
10E9  59                        2926 C          POP     CX                      ; RESTORE
10EA  75 02                     2927 C          JNE     COMP_4
10EC  FE C1                     2928 C          INC     CL                      ; ADD 1 FOR CORRECT CURSOR
10EE                            2929 C  COMP_4:
10EE  C3                        2930 C          RET                             ; BACK TO CALLER
10EF                            2931 C  CALC_CURSOR     ENDP
                                2932 C
                                2933 C  ;--------------------------------------------------------
                                2934 C  ; SET_CTYPE     SET CURSOR TYPE                         :
                                2935 C  ;       THIS ROUTINE SETS THE CURSOR VALUE              :
                                2936 C  ; INPUT                                                 :
                                2937 C  ;       (CX) HAS CURSOR VALUE CH-START LINE, CL-STOP LINE
                                2938 C  ; OUTPUT                                                :
                                2939 C  ;       NONE                                            :
                                2940 C  ;--------------------------------------------------------
= 0004                          2941 C          CUT_OFF         EQU     4
10EF                            2942 C  AH1:
                                2943 C          ASSUME  DS:ABS0
10EF  B4 0A                     2944 C          MOV     AH,C_CRSR_START         ; CRTC REG FOR CURSOR SET
10F1  89 0E 0460 R              2945 C          MOV     CURSOR_MODE,CX          ; SAVE IN DATA AREA
10F5  F6 06 0487 R 08           2946 C          TEST    INFO,8                  ; EGA ACTIVE BIT
10FA  75 33                     2947 C          JNZ     DO_SET                  ; 0=EGA, 1=OLD CARDS
                                2948 C
                                2949 C  ;----- THIS SECTION WILL EMULATE CURSOR OFF ON THE EGA
                                2950 C
10FC  8A C5                     2951 C          MOV     AL,CH                   ; GET START VALUE
10FE  24 60                     2952 C          AND     AL,060H                 ; TURN OFF CURSOR ?
1100  3C 20                     2953 C          CMP     AL,020H                 ; TEST THE BITS
1102  75 05                     2954 C          JNE     AH1_A                   ; SKIP CURSOR OFF
1104  B9 1E00                   2955 C          MOV     CX,01E00H               ; EMULATE CURSOR OFF
1107  EB 26                     2956 C          JMP     SHORT DO_SET
                                2957 C
                                2958 C  ;----- THIS SECTION : ADJUST THE CURSOR AND TEST FOR ENHANCED OPERATION
                                2959 C
1109                            2960 C  AH1_A:
1109  F6 06 0487 R 01           2961 C          TEST    INFO,1                  ; CURSOR EMULATE BIT
110E  75 1F                     2962 C          JNZ     DO_SET                  ; 0=EMULATE, 1=VALUE AS-IS
1110  80 3E 0449 R 03           2963 C          CMP     CRT_MODE,3              ; POSSIBLE EMULATION
1115  77 15                     2964 C          JA      AH1_S                   ; NO, SET THE CURSOR TYPE
1117  E8 0E9A R                 2965 C          CALL    BRST_DET                ; SEE IF EMULATE MODE
111A  73 10                     2966 C          JNC     AH1_S                   ; NOT EMULATING
111C  80 FD 04                  2967 C          CMP     CH,CUT_OFF              ; TEST START
111F  76 03                     2968 C          JBE     AH1_B                   ; SKIP ADJUST
1121  80 C5 05                  2969 C          ADD     CH,5                    ; ADJUST
1124                            2970 C  AH1_B:
1124  80 F9 04                  2971 C          CMP     CL,CUT_OFF              ; TEST END
1127  76 03                     2972 C          JBE     AH1_S                   ; SKIP ADJUST
1129  80 C1 05                  2973 C          ADD     CL,5
112C                            2974 C  AH1_S:
112C  E8 10D0 R                 2975 C          CALL    CALC_CURSOR             ; ADJUST END REGISTER
112F                            2976 C  DO_SET:
112F  E8 1135 R                 2977 C          CALL    M16                     ; OUTPUT CX REG
1132  E9 219E R                 2978 C          JMP     V_RET                   ; RETURN TO CALLER
                                2979 C
                                2980 C  ;----- THIS ROUTINE OUTPUTS THE CX REGISTER TO THE CRTC REGS NAMED IN AH
                                2981 C
1135                            2982 C  M16:
1135  8B 16 0463 R              2983 C          MOV     DX,ADDR_6845            ; ADDRESS REGISTER
1139  8A C5                     2984 C          MOV     AL,CH                   ; DATA
113B  E8 0D15 R                 2985 C          CALL    OUT_DX                  ; OUTPUT THE VALUE
113E  FE C4                     2986 C          INC     AH                      ; NEXT REGISTER
1140  8A C1                     2987 C          MOV     AL,CL                   ; SECOND DATA VALUE
1142  E8 0D15 R                 2988 C          CALL    OUT_DX                  ; OUTPUT THE VALUE
1145  C3                        2989 C          RET                             ; ALL DONE
                                2990 C
                                2991 C  ;--------------------------------------------------------
                                2992 C  ; POSITION                                              :
                                2993 C  ;       THIS SERVICE ROUTINE CALCULATES THE REGEN BUFFER :
                                2994 C  ;       ADDRESS OF A CHARACTER IN THE ALPHA MODE         :
                                2995 C  ; INPUT                                                 :
                                2996 C  ;       AX = ROW, COLUMN POSITION                       :
                                2997 C  ; OUTPUT                                                :
                                2998 C  ;       AX = OFFSET OF CHAR POSITION IN REGEN BUFFER     :
                                2999 C  ;--------------------------------------------------------
1146                            3000 C  POSITION        PROC    NEAR
1146  53                        3001 C          PUSH    BX                      ; SAVE REGISTER
1147  8B D8                     3002 C          MOV     BX,AX
1149  8A C4                     3003 C          MOV     AL,AH                   ; ROWS TO AL
114B  F6 26 044A R              3004 C          MUL     BYTE PTR CRT_COLS       ; DETERMINE BYTES TO ROW
114F  32 FF                     3005 C          XOR     BH,BH                   ; ZERO OUT
1151  03 C3                     3006 C          ADD     AX,BX                   ; ADD IN COLUMN VALUE
1153  D1 E0                     3007 C          SAL     AX,1                    ; * 2 FOR ATTRIBUTE BYTES
1155  5B                        3008 C          POP     BX                      ; RESTORE REGISTER
1156  C3                        3009 C          RET
1157                            3010 C  POSITION        ENDP
                                3011 C
                                3012 C  ;--------------------------------------------------------
                                3013 C  ; SET_CPOS       SET CURSOR POSITION                    :
                                3014 C  ;       THIS ROUTINE SETS THE CURRENT CURSOR POSITION TO THE
                                3015 C  ;       NEW X-Y VALUES PASSED                           :
                                3016 C  ; INPUT                                                 :
                                3017 C  ;       DX - ROW,COLUMN OF NEW CURSOR                   :
                                3018 C  ;       BH - DISPLAY PAGE OF CURSOR                     :
                                3019 C  ; OUTPUT                                                :
                                3020 C  ;       CURSOR IS SET AT CRTC IF DISPLAY PAGE IS CURRENT
                                3021 C  ;       DISPLAY                                         :
                                3022 C  ;--------------------------------------------------------
1157                            3023 C  AH2:
1157  E8 115D R                 3024 C          CALL    SET_CPOS
```

```
115A  E9 219E R                 3025     C          JMP     V_RET
                                3026     C
115D                            3027     C  SET_CPOS:
115D  8A CF                     3028     C          MOV     CL,BH
115F  32 ED                     3029     C          XOR     CH,CH                   ; ESTABLISH LOOP COUNT
1161  D1 E1                     3030     C          SAL     CX,1                    ; WORD OFFSET
1163  8B F1                     3031     C          MOV     SI,CX                   ; USE INDEX REGISTER
1165  89 94 0450 R              3032     C          MOV     [SI+OFFSET CURSOR_POSN],DX  ; SAVE THE POINTER
1169  38 3E 0462 R              3033     C          CMP     ACTIVE_PAGE,BH
116D  75 05                     3034     C          JNZ     M17                     ; SET_CPOS_RETURN
116F  8B C2                     3035     C          MOV     AX,DX                   ; GET ROW/COLUMN TO AX
1171  E8 1175 R                 3036     C          CALL    M18                     ; CURSOR_SET
1174                            3037     C  M17:                                    ; SET_CPOS_RETURN
1174  C3                       3038     C          RET
                                3039     C
                                3040     C  ;----- SET CURSOR POSITION, AX HAS ROW/COLUMN FOR CURSOR
                                3041     C
1175                            3042     C  M18     PROC    NEAR
1175  E8 1146 R                 3043     C          CALL    POSITION                ; DETERMINE LOC IN REGEN
1178  8B C8                     3044     C          MOV     CX,AX
117A  03 0E 044E R              3045     C          ADD     CX,CRT_START            ; ADD IN THE START ADDR
                                3046     C                                          ;  FOR THIS PAGE
117E  D1 F9                     3047     C          SAR     CX,1                    ; / 2 FOR CHAR ONLY COUNT
1180  B4 0E                     3048     C          MOV     AH,C_CRSR_LOC_HGH       ; REGISTER NUMBER FOR CURSOR
1182  E8 1135 R                 3049     C          CALL    M16                     ; SET VALUE TO CRTC
1185  C3                       3050     C          RET
1186                            3051     C  M18     ENDP
                                3052     C
                                3053     C  ;--------------------------------------------------------
                                3054     C  ; READ_CURSOR                                           :
                                3055     C  ;       THIS ROUTINE READS THE CURRENT CURSOR VALUE FROM :
                                3056     C  ;       MEMORY AND SENDS IT BACK TO THE CALLER          :
                                3057     C  ; INPUT                                                 :
                                3058     C  ;       BH - PAGE OF CURSOR                             :
                                3059     C  ; OUTPUT                                                :
                                3060     C  ;       DX - ROW, COLUMN OF THE CURRENT CURSOR POSITION :
                                3061     C  ;       CX - CURRENT CURSOR MODE                        :
                                3062     C  ;--------------------------------------------------------
1186                            3063     C  AH3:
1186  8A DF                     3064     C          MOV     BL,BH                   ; PAGE VALUE
1188  32 FF                     3065     C          XOR     BH,BH                   ; ZERO UPPER BYTE
118A  D1 E3                     3066     C          SAL     BX,1                    ; WORD OFFSET
118C  8B 97 0450 R              3067     C          MOV     DX,[BX + OFFSET CURSOR_POSN]  ; GET CURSOR FOR THIS PAGE
1190  8B 0E 0460 R              3068     C          MOV     CX,CURSOR_MODE          ; GET THE CURSOR MODE
1194  5F                       3069     C          POP     DI
1195  5E                       3070     C          POP     SI
1196  5B                       3071     C          POP     BX
1197  58                       3072     C          POP     AX                      ; DISCARD CX
1198  58                       3073     C          POP     AX                      ; DISCARD DX
1199  1F                       3074     C          POP     DS
119A  07                       3075     C          POP     ES
119B  5D                       3076     C          POP     BP
119C  CF                       3077     C          IRET
                                3078     C
                                3079     C  ;----- READ LIGHT PEN POSITION
                                3080     C
119D                            3081     C  AH4:
119D  A0 0449 R                 3082     C          MOV     AL,CRT_MODE
11A0  3C 07                     3083     C          CMP     AL,07H
11A2  77 37                     3084     C          JA      READ_LPEN
                                3085     C
11A4  F6 06 0487 R 02           3086     C          TEST    INFO,2
11A9  74 07                     3087     C          JZ      EGA_IS_COLOR
                                3088     C
                                3089     C  ;----- MONOCHROME HERE (MONOC BIT 1)
                                3090     C
11AB  3C 07                     3091     C          CMP     AL,07H
11AD  74 2C                     3092     C          JE      READ_LPEN
11AF  EB 05 90                  3093     C          JMP     OLD_LP
                                3094     C
                                3095     C  ;----- EGA IS COLOR HERE (MONOC BIT 0)
                                3096     C
11B2                            3097     C  EGA_IS_COLOR:
11B2  3C 06                     3098     C          CMP     AL,06H
11B4  76 25                     3099     C          JBE     READ_LPEN
11B6                            3100     C  OLD_LP:
11B6  CD 42                     3101     C          INT     42H                     ; CALL EXISTING CODE
11B8  5F                       3102     C          POP     DI
11B9  5E                       3103     C          POP     SI
11BA  83 C4 06                  3104     C          ADD     SP,6                    ; DISCARD SAVED BX,CX,DX
11BD  1F                       3105     C          POP     DS
11BE  07                       3106     C          POP     ES
11BF  5D                       3107     C          POP     BP
11C0  CF                       3108     C          IRET
                                3109     C
                                3110     C  ;--------------------------------------------------------
                                3111     C  ; LIGHT PEN                                             :
                                3112     C  ;       THIS ROUTINE TESTS THE LIGHT PEN SWITCH AND THE LIGHT  :
                                3113     C  ;       PEN TRIGGER.  IF BOTH ARE SET, THE LOCATION OF THE LIGHT :
                                3114     C  ;       PEN IS DETERMINED.  OTHERWISE, A RETURN WITH NO :
                                3115     C  ;       INFORMATION IS MADE.                            :
                                3116     C  ; ON EXIT                                               :
                                3117     C  ;       (AH) = 0 IF NO LIGHT PEN INFORMATION IS AVAILABLE :
                                3118     C  ;              BX,CX,DX ARE DESTROYED                   :
                                3119     C  ;       (AH) = 1  IF LIGHT PEN IS AVAILABLE             :
                                3120     C  ;                 (DH,DL) = ROW,COLUMN OF CURRENT LIGHT PEN :
                                3121     C  ;                           POSITION                    :
                                3122     C  ;                 (CH) = RASTER POSITION (OLD MODES)    :
                                3123     C  ;                 (CX) = RASTER POSITION (NEW MODES)    :
                                3124     C  ;                 (BX) = BEST GUESS AT PIXEL HORIZONTAL POSITION :
                                3125     C  ;--------------------------------------------------------
                                3126     C          ASSUME  CS:CODE,DS:ABS0
                                3127     C  ;----- SUBTRACT_TABLE
11C1                            3128     C  V1      LABEL   BYTE
11C1  06 06 07 07 05 05         3129     C          DB      006H,006H,007H,007H,005H,005H   ; 0-5
11C7  04 05 00 00 00 00         3130     C          DB      004H,005H,000H,000H,000H,000H   ; 6-B
11CD  00 05 06 04 04 04         3131     C          DB      000H,005H,006H,004H,004H,004H   ; C-11
11D3  04 06 06 04 07 04         3132     C          DB      004H,006H,006H,004H,007H,004H   ; 12-17
11D9  07 04                     3133     C          DB      007H,004H                       ; 18-19
                                3134     C
11DB                            3135     C  READ_LPEN       PROC    NEAR
                                3136     C
                                3137     C  ;----- WAIT FOR LIGHT PEN TO BE DEPRESSED
                                3138     C
11DB  8B 16 0463 R              3139     C          MOV     DX,ADDR_6845            ; GET BASE ADDRESS OF 6845
11DF  83 C2 06                  3140     C          ADD     DX,6                    ; POINT TO STATUS REGISTER
11E2  EC                        3141     C          IN      AL,DX                   ; GET STATUS REGISTER
11E3  A8 04                     3142     C          TEST    AL,4                    ; TEST LIGHT PEN SWITCH
11E5  B4 00                     3143     C          MOV     AH,0                    ; SET NO LIGHT PEN RETURN
11E7  74 03                     3144     C          JZ      V9                      ;  CODE
11E9  E9 1291 R                 3145     C          JMP     V6                      ; NOT SET, RETURN
                                3146     C
                                3147     C  ;----- NOW TEST FOR LIGHT PEN TRIGGER
                                3148     C
11EC                            3149     C  V9:
11EC  A8 02                     3150     C          TEST    AL,2                    ; TEST LIGHT PEN TRIGGER
```

```
11EE  75 03                    3151  C          JNZ     V7A                     ; RETURN WITHOUT RESETTING
                               3152  C                                          ;  TRIGGER
11F0  E9 129B R                3153  C          JMP     V7                      ; EXIT LIGHT PEN ROUTINE
                               3154  C
                               3155  C  ;----- TRIGGER HAS BEEN SET, READ THE VALUE IN
                               3156  C
11F3                           3157  C  V7A:
11F3  B4 10                    3158  C          MOV     AH,16                   ; LIGHT PEN REGISTERS
                               3159  C
                               3160  C  ;----- INPUT REGS POINTED TO BY AH, AND CONVERT TO ROW COLUMN IN DX
                               3161  C
11F5  8B 16 0463 R             3162  C          MOV     DX,ADDR_6845            ; ADDRESS REGISTER
11F9  8A C4                    3163  C          MOV     AL,AH                   ; REGISTER TO READ
11FB  EE                       3164  C          OUT     DX,AL                   ; SET IT UP
11FC  42                       3165  C          INC     DX                      ; DATA REGISTER
11FD  50                       3166  C          PUSH    AX
11FE  EC                       3167  C          IN      AL,DX                   ; GET THE VALUE
11FF  8A E8                    3168  C          MOV     CH,AL                   ; SAVE IN CX
1201  58                       3169  C          POP     AX
1202  4A                       3170  C          DEC     DX                      ; ADDRESS REGISTER
1203  FE C4                    3171  C          INC     AH
1205  8A C4                    3172  C          MOV     AL,AH                   ; SECOND DATA REGISTER
1207  EE                       3173  C          OUT     DX,AL
1208  42                       3174  C          INC     DX                      ; POINT TO DATA REGISTER
1209  EC                       3175  C          IN      AL,DX                   ; GET THE 2ND DATA VALUE
120A  8A E5                    3176  C          MOV     AH,CH                   ; AX HAS INPUT VALUE
                               3177  C
                               3178  C  ;----- AX HAS THE VALUE READ IN FROM THE 6845
                               3179  C
120C  8A 1E 0449 R             3180  C          MOV     BL,CRT_MODE
1210  2A FF                    3181  C          SUB     BH,BH                   ; MODE VALUE TO BX
1212  2E: 8A 9F 11C1 R         3182  C          MOV     BL,CS:V1[BX]            ; AMOUNT TO SUBTRACT
1217  2B C3                    3183  C          SUB     AX,BX                   ; TAKE IT AWAY
1219  8B 1E 044E R             3184  C          MOV     BX,CRT_START            ; SCREEN ADDRESS
121D  D1 EB                    3185  C          SHR     BX,1                    ; DIVIDE BY 2
121F  2B C3                    3186  C          SUB     AX,BX                   ; ADJUST TO ZERO START
1221  79 02                    3187  C          JNS     V2                      ; IF POSITIVE, GET MODE
1223  2B C0                    3188  C          SUB     AX,AX                   ; <0 PLAYS AS 0
                               3189  C
                               3190  C  ;----- DETERMINE MODE OF OPERATION
                               3191  C
1225                           3192  C  V2:                                     ; DETERMINE_MODE
1225  B1 03                    3193  C          MOV     CL,3                    ; SET *8 SHIFT COUNT
1227  80 3E 0449 R 04          3194  C          CMP     CRT_MODE,4              ; GRAPHICS OR ALPHA
122C  72 4D                    3195  C          JB      V4                      ; ALPHA_PEN
122E  80 3E 0449 R 07          3196  C          CMP     CRT_MODE,7
1233  74 46                    3197  C          JE      V4                      ; ALPHA_PEN
                               3198  C
1235  80 3E 0449 R 06          3199  C          CMP     CRT_MODE,06H
123A  77 28                    3200  C          JA      V8
123C  75 02                    3201  C          JNE     V8X
123E  D1 E8                    3202  C          SHR     AX,1
                               3203  C
                               3204  C  ;----- OLD GRAPHICS MODES
                               3205  C
1240                           3206  C  V8X:
1240  B2 28                    3207  C          MOV     DL,40                   ; DIVISOR FOR GRAPHICS
1242  F6 F2                    3208  C          DIV     DL                      ; ROW(AL) AND COLUMN(AH)
                               3209  C                                          ;  AL RANGE 0-99,
                               3210  C                                          ;  AH RANGE 0-39
                               3211  C  ;----- DETERMINE GRAPHIC ROW POSITION
                               3212  C
1244  8A E8                    3213  C          MOV     CH,AL                   ; SAVE ROW VALUE IN CH
1246  02 ED                    3214  C          ADD     CH,CH                   ; *2 FOR EVEN/ODD FIELD
1248  8A DC                    3215  C          MOV     BL,AH                   ; COLUMN VALUE TO BX
124A  2A FF                    3216  C          SUB     BH,BH                   ; *8 FOR MEDIUM RES
124C  80 3E 0449 R 06          3217  C          CMP     CRT_MODE,6              ; MEDIUM OR HIGH RES
1251  75 04                    3218  C          JNE     V3                      ; NOT_HIGH_RES
1253  B1 04                    3219  C          MOV     CL,4                    ; SHIFT VALUE FOR HIGH RES
1255  D0 E4                    3220  C          SAL     AH,1                    ; COLUMN VALUE *2 FOR HIGH RES
1257                           3221  C  V3:                                     ; NOT_HIGH_RES
1257  D3 E3                    3222  C          SHL     BX,CL                   ; *16 FOR HIGH RES
                               3223  C
                               3224  C  ;----- DETERMINE ALPHA CHAR POSITION
                               3225  C
1259  8A D4                    3226  C          MOV     DL,AH                   ; COLUMN VALUE FOR RETURN
125B  8A F0                    3227  C          MOV     DH,AL                   ; ROW VALUE
125D  D0 EE                    3228  C          SHR     DH,1                    ; DIVIDE BY 4
125F  D0 EE                    3229  C          SHR     DH,1                    ;  FOR VALUE IN 0-24 RANGE
1261  EB 2C 90                 3230  C          JMP     V5                      ; LIGHT_PEN_RETURN_SET
1264                           3231  C  V8:
                               3232  C
                               3233  C  ;----- NEW GRAPHICS MODES
                               3234  C
1264  99                       3235  C          CWD                             ; PREPARE TO DIVIDE
1265  F7 36 044A R             3236  C          DIV     CRT_COLS                ; AX = ROW, DX = COLUMN
1269  8B DA                    3237  C          MOV     BX,DX                   ; SAVE REMAINDER
126B  D3 E3                    3238  C          SAL     BX,CL                   ; PEL COLUMN
126D  8B C8                    3239  C          MOV     CX,AX                   ; PEL ROW
126F  52                       3240  C          PUSH    DX                      ; SAVE FROM DIVIDE
1270  99                       3241  C          CWD                             ; PREPARE TO DIVIDE
1271  F7 36 0485 R             3242  C          DIV     POINTS                  ; DIVIDE BY BYTES/CHAR
1275  5A                       3243  C          POP     DX                      ; RECOVER
1276  8A F0                    3244  C          MOV     DH,AL                   ; CHARACTER ROW
1278  EB 15 90                 3245  C          JMP     V5
                               3246  C
                               3247  C  ;----- ALPHA MODE ON LIGHT PEN
                               3248  C
127B                           3249  C  V4:                                     ; ALPHA_PEN
127B  F6 36 044A R             3250  C          DIV     BYTE PTR CRT_COLS       ; ROW,COLUMN VALUE
127F  8A F0                    3251  C          MOV     DH,AL                   ; ROWS TO DH
1281  8A D4                    3252  C          MOV     DL,AH                   ; COLS TO DL
1283  8A DC                    3253  C          MOV     BL,AH                   ; COLUMN VALUE
1285  32 FF                    3254  C          XOR     BH,BH                   ;  TO BX
1287  D3 E3                    3255  C          SAL     BX,CL
1289  F6 26 0485 R             3256  C          MUL     BYTE PTR POINTS
128D  8B C8                    3257  C          MOV     CX,AX
128F                           3258  C  V5:                                     ; LIGHT_PEN_RETURN_SET
128F  B4 01                    3259  C          MOV     AH,1                    ; INDICATE EVERTHING SET
1291                           3260  C  V6:                                     ; LIGHT_PEN_RETURN
1291  52                       3261  C          PUSH    DX                      ; SAVE RETURN VALUE
                               3262  C                                          ;  (IN CASE)
1292  8B 16 0463 R             3263  C          MOV     DX,ADDR_6845            ; GET BASE ADDRESS
1296  83 C2 07                 3264  C          ADD     DX,7                    ; POINT TO RESET PARM
1299  EE                       3265  C          OUT     DX,AL                   ; ADDRESS, NOT DATA,
                               3266  C                                          ;  IS IMPORTANT
129A  5A                       3267  C          POP     DX                      ; RECOVER VALUE
129B                           3268  C  V7:                                     ; RETURN_NO_RESET
129B  5F                       3269  C          POP     DI
129C  5E                       3270  C          POP     SI
129D  83 C4 06                 3271  C          ADD     SP,6                    ; DISCARD SAVED BX,CX,DX
12A0  1F                       3272  C          POP     DS
12A1  07                       3273  C          POP     ES
12A2  5D                       3274  C          POP     BP
12A3  CF                       3275  C          IRET
12A4                           3276  C  READ_LPEN       ENDP
```

```
                        3277    C
                        3278    C ;--------------------------------------------------------
                        3279    C ; ACT_DISP_PAGE          SELECT ACTIVE DISPLAY PAGE      :
                        3280    C ;       THIS ROUTINE SETS THE ACTIVE DISPLAY PAGE, ALLOWING :
                        3281    C ;       FOR MULTIPLE PAGES OF DISPLAYED VIDEO.          :
                        3282    C ; INPUT                                                 :
                        3283    C ;       AL HAS THE NEW ACTIVE DISPLAY PAGE              :
                        3284    C ; OUTPUT                                                :
                        3285    C ;       THE CRTC IS RESET TO DISPLAY THAT PAGE          :
                        3286    C ;--------------------------------------------------------
12A4                    3287    C AH5:
12A4  A2 0462 R         3288    C         MOV     ACTIVE_PAGE,AL                  ; SAVE ACTIVE PAGE VALUE
12A7  8B 0E 044C R      3289    C         MOV     CX,CRT_LEN                      ; GET SAVED LENGTH OF
                        3290    C                                                 ;  REGEN BUFFER
12AB  98                3291    C         CBW                                     ; CONVERT AL TO WORD
12AC  50                3292    C         PUSH    AX                              ; SAVE PAGE VALUE
12AD  F7 E1             3293    C         MUL     CX                              ; DISPLAY PAGE TIMES
                        3294    C                                                 ;  REGEN LENGTH
12AF  A3 044E R         3295    C         MOV     CRT_START,AX                    ; SAVE START ADDRESS FOR
                        3296    C                                                 ;  LATER REQUIREMENTS
12B2  8B C8             3297    C         MOV     CX,AX                           ; START ADDRESS TO CX
12B4  8A 1E 0449 R      3298    C         MOV     BL,CRT_MODE
12B8  80 FB 07          3299    C         CMP     BL,7                            ; DO NOT DIVIDE BY TWO
12BB  77 02             3300    C         JA      ADP_1
12BD                    3301    C ADP_2:
12BD  D1 F9             3302    C         SAR     CX,1                            ; / 2 FOR CRTC HANDLING
12BF                    3303    C ADP_1:
12BF  B4 0C             3304    C         MOV     AH,C_STRT_HGH                   ; REG FOR START ADDRESS
12C1  E8 1135 R         3305    C         CALL    M16
12C4  5B                3306    C         POP     BX                              ; RECOVER PAGE VALUE
12C5  D1 E3             3307    C         SAL     BX,1                            ; *2 FOR WORD OFFSET
12C7  8B 87 0450 R      3308    C         MOV     AX,[BX + OFFSET CURSOR_POSN]    ; GET CURSOR FOR THIS PAGE
12CB  E8 1175 R         3309    C         CALL    M18                             ; SET THE CURSOR POSITION
12CE  E9 219E R         3310    C         JMP     V_RET
                        3311    C
                        3312    C         SUBTTL
                        3313
                        3314    C         INCLUDE VSCROLL.INC
                        3315    C         SUBTTL  VSCROLL.INC
                        3316    C         PAGE
                        3317    C
12D1                    3318    C FLTA    PROC    NEAR                            ; CHECK FOR SCROLL COUNT
12D1  50                3319    C         PUSH    AX
12D2  8A E6             3320    C         MOV     AH,DH                           ; LOWER ROW
12D4  2A E5             3321    C         SUB     AH,CH                           ; UPPER ROW
12D6  FE C4             3322    C         INC     AH                              ; NUMBER TO SCROLL
12D8  3A E0             3323    C         CMP     AH,AL                           ; SAME AS REQUESTED
12DA  58                3324    C         POP     AX
12DB  75 02             3325    C         JNE     LTA
12DD  2A C0             3326    C         SUB     AL,AL                           ; YES, SET TO 0 FOR BLANK
12DF                    3327    C LTA:
12DF  C3                3328    C         RET
12E0                    3329    C FLTA    ENDP
                        3330    C
12E0                    3331    C CRANK   PROC    NEAR                            ; MOVE ROWS OF PELS UP
12E0  53                3332    C         PUSH    BX
                        3333    C         ASSUME  DS:ABS0
12E1  1E                3334    C         PUSH    DS                              ; SAVE DATA SEGMENT
12E2  E8 0CFE R         3335    C         CALL    DDS                             ; SET DATA SEGMENT
12E5  8B 1E 044A R      3336    C         MOV     BX,CRT_COLS
12E9  1F                3337    C         POP     DS
12EA                    3338    C CRANK_A:
12EA  51                3339    C         PUSH    CX                              ; SAVE MOVE COUNT
12EB  8A CA             3340    C         MOV     CL,DL                           ; COLUMN COUNT
12ED  2A ED             3341    C         SUB     CH,CH                           ; CLEAR HIGH BYTE
12EF  56                3342    C         PUSH    SI                              ; SAVE POINTERS
12F0  57                3343    C         PUSH    DI
12F1  F3/ A4            3344    C         REP     MOVSB                           ; MOVE THAT ROW
12F3  5F                3345    C         POP     DI                              ; RECOVER POINTERS
12F4  5E                3346    C         POP     SI
12F5  03 F3             3347    C         ADD     SI,BX                           ; NEXT ROW
12F7  03 FB             3348    C         ADD     DI,BX                           ; NEXT ROW
12F9  59                3349    C         POP     CX                              ; RECOVER ROW COUNT
12FA  E2 EE             3350    C         LOOP    CRANK_A                         ; DO MORE
12FC  5B                3351    C         POP     BX
12FD  C3                3352    C         RET                                     ; RETURN TO CALLER
12FE                    3353    C CRANK   ENDP
                        3354    C
12FE                    3355    C CRANK_4 PROC    NEAR                            ; MOVE ROWS OF PELS DOWN
12FE  53                3356    C         PUSH    BX
                        3357    C         ASSUME  DS:ABS0
12FF  1E                3358    C         PUSH    DS                              ; SAVE DATA SEGMENT
1300  E8 0CFE R         3359    C         CALL    DDS                             ; SET DATA SEGMENT
1303  8B 1E 044A R      3360    C         MOV     BX,CRT_COLS
1307  1F                3361    C         POP     DS
1308                    3362    C CRANK_B:
1308  51                3363    C         PUSH    CX                              ; SAVE MOVE COUNT
1309  8A CA             3364    C         MOV     CL,DL                           ; COLUMN COUNT
130B  2A ED             3365    C         SUB     CH,CH                           ; CLEAR HIGH BYTE
130D  56                3366    C         PUSH    SI                              ; SAVE POINTERS
130E  57                3367    C         PUSH    DI
130F  F3/ A4            3368    C         REP     MOVSB                           ; MOVE THAT ROW
1311  5F                3369    C         POP     DI                              ; RECOVER POINTERS
1312  5E                3370    C         POP     SI
1313  2B F3             3371    C         SUB     SI,BX                           ; NEXT ROW
1315  2B FB             3372    C         SUB     DI,BX                           ; NEXT ROW
1317  59                3373    C         POP     CX                              ; RECOVER ROW COUNT
1318  E2 EE             3374    C         LOOP    CRANK_B                         ; DO MORE
131A  5B                3375    C         POP     BX
131B  C3                3376    C         RET                                     ; RETURN TO CALLER
131C                    3377    C CRANK_4 ENDP
                        3378    C
131C                    3379    C PART_1  PROC    NEAR                            ; FILL ROW AFTER SCROLL
131C  52                3380    C         PUSH    DX
131D  B6 03             3381    C         MOV     DH,3
131F  B2 C4             3382    C         MOV     DL,SEQ_ADDR                     ; SEQUENCER
1321  B8 020F           3383    C         MOV     AX,020FH                        ; MAP MASK
1324  E8 0D15 R         3384    C         CALL    OUT_DX                          ; ALL MAPS ON
1327  5A                3385    C         POP     DX
1328  2B C0             3386    C         SUB     AX,AX                           ; ZERO
132A  8A CA             3387    C         MOV     CL,DL                           ; COLUMN COUNT
132C  2A ED             3388    C         SUB     CH,CH
132E  57                3389    C         PUSH    DI                              ; SAVE POINTER
132F  F3/ AA            3390    C         REP     STOSB                           ; CLEAR ONE ROW OF PELS
1331  5F                3391    C         POP     DI                              ; RECOVER POINTER
1332  8A C6             3392    C         MOV     AL,DH                           ; GET COLOR VALUE
1334  52                3393    C         PUSH    DX
1335  B6 03             3394    C         MOV     DH,3
1337  B2 C4             3395    C         MOV     DL,SEQ_ADDR                     ; SEQUENCER
1339  B4 02             3396    C         MOV     AH,02H                          ; MAP MASK
133B  E8 0D15 R         3397    C         CALL    OUT_DX                          ; SET THE COLOR
133E  5A                3398    C         POP     DX
133F  B0 FF             3399    C         MOV     AL,0FFH                         ; ALL BITS ON
1341  8A CA             3400    C         MOV     CL,DL                           ; COLUMN COUNT
1343  57                3401    C         PUSH    DI                              ; SAVE POINTER
1344  F3/ AA            3402    C         REP     STOSB                           ; TURN ON THOSE BITS IN
```

```
                                3403     C                                              ;  ENABLED PLANES
1346  5F                        3404     C                      POP     DI              ; RECOVER POINTER
1347  C3                        3405     C                      RET                     ; RETURN TO CALLER
1348                            3406     C  PART_1              ENDP
                                3407     C
1348                            3408     C  PART_2              PROC    NEAR
1348  B6 03                     3409     C                      MOV     DH,3
134A  B2 C4                     3410     C                      MOV     DL,SEQ_ADDR     ; SEQUENCER
134C  B8 020F                   3411     C                      MOV     AX,020FH        ; MAP MASK, ALL MAPS
134F  E8 0D15 R                 3412     C                      CALL    OUT_DX          ; ENABLE THE MAPS
1352  C3                        3413     C                      RET                     ; RETURN TO CALLER
1353                            3414     C  PART_2              ENDP
                                3415     C
1353                            3416     C  BLNK_3              PROC    NEAR            ; BLANK FOR SCROLL UP
1353  1E                        3417     C                      PUSH    DS              ; SAVE DATA SEGMENT
                                3418     C                      ASSUME  DS:ABS0
1354  E8 0CFE R                 3419     C                      CALL    DDS             ; GET LOW MEMORY SEGMENT
1357  8A F7                     3420     C                      MOV     DH,BH           ; ATTRIBUTE FOR BLANK LINE
1359  2A FF                     3421     C                      SUB     BH,BH           ; CLEAR HIGH BYTE
135B  50                        3422     C                      PUSH    AX              ; SAVE
135C  52                        3423     C                      PUSH    DX              ; SAVE BECAUSE OF MULTIPLY
135D  8B C3                     3424     C                      MOV     AX,BX           ; ROW COUNT
135F  F7 26 0485 R              3425     C                      MUL     POINTS          ; CHARACTER HEIGHT
1363  8B D8                     3426     C                      MOV     BX,AX           ; NET VALUE TO BX
1365  5A                        3427     C                      POP     DX              ; RECOVER
1366  58                        3428     C                      POP     AX
                                3429     C
1367  1F                        3430     C                      POP     DS
                                3431     C                      ASSUME  DS:NOTHING
1368                            3432     C  S13:
1368  E8 131C R                 3433     C                      CALL    PART_1          ; BLANK OUT ROW WITH COLOR
                                3434     C                      ASSUME  DS:ABS0
136B  1E                        3435     C                      PUSH    DS              ; SAVE SEGMENT
136C  E8 0CFE R                 3436     C                      CALL    DDS             ; LOW MEMORY SEGMENT
136F  03 3E 044A R              3437     C                      ADD     DI,CRT_COLS     ; NEXT ROW
1373  1F                        3438     C                      POP     DS              ; RECOVER
1374  4B                        3439     C                      DEC     BX              ; NEXT
1375  75 F1                     3440     C                      JNZ     S13             ; DO MORE
1377  E8 1348 R                 3441     C                      CALL    PART_2
137A  C3                        3442     C                      RET                     ; RETURN TO CALLER
137B                            3443     C  BLNK_3              ENDP
                                3444     C
137B                            3445     C  BLNK_4              PROC    NEAR            ; BLANK FOR SCROLL DOWN
137B  1E                        3446     C                      PUSH    DS              ; SAVE DATA SEGMENT
                                3447     C                      ASSUME  DS:ABS0
137C  E8 0CFE R                 3448     C                      CALL    DDS             ; GET LOW MEMORY SEGMENT
137F  8A F7                     3449     C                      MOV     DH,BH           ; ATTRIBUTE FOR BLANK LINE
1381  2A FF                     3450     C                      SUB     BH,BH           ; CLEAR HIGH BYTE
1383  50                        3451     C                      PUSH    AX              ; SAVE
1384  52                        3452     C                      PUSH    DX              ; SAVE BECAUSE OF MULTIPLY
1385  8B C3                     3453     C                      MOV     AX,BX           ; ROW COUNT
1387  F7 26 0485 R              3454     C                      MUL     POINTS          ; CHARACTER HEIGHT
138B  8B D8                     3455     C                      MOV     BX,AX           ; NET VALUE TO BX
138D  5A                        3456     C                      POP     DX              ; RECOVER
138E  58                        3457     C                      POP     AX
                                3458     C
138F  1F                        3459     C                      POP     DS
                                3460     C                      ASSUME  DS:NOTHING
1390                            3461     C  S13_4:
1390  E8 131C R                 3462     C                      CALL    PART_1          ; BLANK OUT ROW WITH COLOR
                                3463     C                      ASSUME  DS:ABS0
1393  1E                        3464     C                      PUSH    DS              ; SAVE SEGMENT
1394  E8 0CFE R                 3465     C                      CALL    DDS             ; LOW MEMORY SEGMENT
1397  2B 3E 044A R              3466     C                      SUB     DI,CRT_COLS     ; NEXT ROW
139B  1F                        3467     C                      POP     DS              ; RECOVER
139C  4B                        3468     C                      DEC     BX              ; NEXT
139D  75 F1                     3469     C                      JNZ     S13_4           ; DO MORE
139F  E8 1348 R                 3470     C                      CALL    PART_2
13A2  C3                        3471     C                      RET                     ; RETURN TO CALLER
13A3                            3472     C  BLNK_4              ENDP
                                3473     C
                                3474     C  ;--------------------------------------------------------
                                3475     C  ; SCROLL UP                                            :
                                3476     C  ;       THIS ROUTINE MOVES A BLOCK OF CHARACTERS UP     :
                                3477     C  ;       ON THE SCREEN                                   :
                                3478     C  ; INPUT                                                :
                                3479     C  ;       (AH) = CURRENT CRT MODE                         :
                                3480     C  ;       (AL) = NUMBER OF ROWS TO SCROLL                 :
                                3481     C  ;       (CX) = ROW/COLUMN OF UPPER LEFT CORNER          :
                                3482     C  ;       (DX) = ROW/COLUMN OF LOWER RIGHT CORNER         :
                                3483     C  ;       (BH) = ATTRIBUTE TO BE USED ON BLANKED LINE     :
                                3484     C  ;       (DS) = DATA SEGMENT                             :
                                3485     C  ;       (ES) = REGEN BUFFER SEGMENT                     :
                                3486     C  ; OUTPUT                                               :
                                3487     C  ;       NONE -- THE REGEN BUFFER IS MODIFIED            :
                                3488     C  ;--------------------------------------------------------
                                3489     C                      ASSUME  CS:CODE,DS:ABS0,ES:NOTHING
13A3                            3490     C  SCROLL_UP           PROC    NEAR
13A3  8A D8                     3491     C                      MOV     BL,AL           ; SAVE LINE COUNT IN BL
13A5  E8 16EB R                 3492     C                      CALL    MK_ES
13A8  80 FC 04                  3493     C                      CMP     AH,4            ; TEST FOR GRAPHICS MODE
13AB  72 08                     3494     C                      JB      N1              ; HANDLE SEPERATELY
13AD  80 FC 07                  3495     C                      CMP     AH,7            ; TEST FOR BW CARD
13B0  74 03                     3496     C                      JE      N1
13B2  E9 1474 R                 3497     C                      JMP     GRAPHICS_UP
13B5                            3498     C  N1:                                         ; UP_CONTINUE
13B5  53                        3499     C                      PUSH    BX              ; SAVE FILL ATTR IN BH
13B6  8B C1                     3500     C                      MOV     AX,CX           ; UPPER LEFT POSITION
13B8  E8 13F2 R                 3501     C                      CALL    SCROLL_POSITION ; DO SETUP FOR SCROLL
13BB  74 31                     3502     C                      JZ      N7              ; BLANK_FIELD
13BD  03 F0                     3503     C                      ADD     SI,AX           ; FROM ADDRESS
13BF  8A E6                     3504     C                      MOV     AH,DH           ; # ROWS IN BLOCK
13C1  2A E3                     3505     C                      SUB     AH,BL           ; # ROWS TO BE MOVED
13C3                            3506     C  N2:                                         ; ROW_LOOP
13C3  E8 1432 R                 3507     C                      CALL    N10             ; MOVE ONE ROW
13C6  03 F5                     3508     C                      ADD     SI,BP
13C8  03 FD                     3509     C                      ADD     DI,BP           ; NEXT LINE IN BLOCK
13CA  FE CC                     3510     C                      DEC     AH              ; COUNT OF LINES TO MOVE
13CC  75 F5                     3511     C                      JNZ     N2              ; ROW_LOOP
13CE                            3512     C  N3:                                         ; CLEAR_ENTRY
13CE  58                        3513     C                      POP     AX              ; RECOVER ATTRIBUTE IN AH
13CF  B0 20                     3514     C                      MOV     AL,' '          ; FILL WITH BLANKS
13D1                            3515     C  N4:                                         ; CLEAR_LOOP
13D1  E8 143B R                 3516     C                      CALL    N11             ; CLEAR THE ROW
13D4  03 FD                     3517     C                      ADD     DI,BP           ; POINT TO NEXT LINE
13D6  FE CB                     3518     C                      DEC     BL              ; LINES TO SCROLL
13D8  75 F7                     3519     C                      JNZ     N4              ; CLEAR_LOOP
13DA                            3520     C  N5:                                         ; SCROLL_END
13DA  E8 0CFE R                 3521     C                      CALL    DDS
13DD  80 3E 0449 R 07           3522     C                      CMP     CRT_MODE,7      ; IS THIS THE B/W CARD
13E2  74 07                     3523     C                      JE      N6              ; SKIP THE MODE RESET
13E4  A0 0465 R                 3524     C                      MOV     AL,CRT_MODE_SET ; GET THE MODE SET
13E7  BA 03D8                   3525     C                      MOV     DX,03D8H        ; ALWAYS SET COLOR CARD
13EA  EE                        3526     C                      OUT     DX,AL
13EB                            3527     C  N6:                                         ; VIDEO_RET_HERE
13EB  E9 219E R                 3528     C                      JMP     V_RET
```

```
13EE                    3529     C  N7:                                             ; BLANK_FIELD
13EE  8A DE             3530     C          MOV     BL,DH                        ; GET ROW COUNT
13F0  EB DC             3531     C          JMP     N3                           ; GO CLEAR THAT AREA
13F2                    3532     C  SCROLL_UP       ENDP
                        3533     C
                        3534     C  ;----- HANDLE COMMON SCROLL SET UP HERE
                        3535     C
13F2                    3536     C  SCROLL_POSITION PROC    NEAR
13F2  F6 06 0487 R 04   3537     C          TEST    INFO,4
13F7  74 12             3538     C          JZ      N9
                        3539     C
                        3540     C  ;----- 80X25 COLOR CARD SCROLL
                        3541     C
13F9  52                3542     C          PUSH    DX
13FA  B6 03             3543     C          MOV     DH,3
13FC  B2 DA             3544     C          MOV     DL,0DAH                      ; COLOR CARD HERE
13FE  50                3545     C          PUSH    AX
13FF                    3546     C  N8:                                          ; WAIT_DISP_ENABLE
13FF  EC                3547     C          IN      AL,DX
1400  A8 08             3548     C          TEST    AL,8                         ; WAIT FOR VERT RETRACE
1402  74 FB             3549     C          JZ      N8                           ; WAIT_DISP_ENABLE
1404  B0 25             3550     C          MOV     AL,25H
1406  B2 D8             3551     C          MOV     DL,0D8H                      ; DX=3D8
1408  EE                3552     C          OUT     DX,AL                        ; TURN OFF VIDEO
1409  58                3553     C          POP     AX                           ;  DURING VERTICAL RETRACE
140A  5A                3554     C          POP     DX
140B                    3555     C  N9:
140B  E8 1146 R         3556     C          CALL    POSITION                     ; CONVERT TO REGEN POINTER
140E  03 06 044E R      3557     C          ADD     AX,CRT_START                 ; OFFSET OF ACTIVE PAGE
1412  8B F8             3558     C          MOV     DI,AX                        ; TO ADDRESS FOR SCROLL
1414  8B F0             3559     C          MOV     SI,AX                        ; FROM ADDRESS FOR SCROLL
1416  2B D1             3560     C          SUB     DX,CX                        ; DX = #ROWS, #COLS
1418  FE C6             3561     C          INC     DH
141A  FE C2             3562     C          INC     DL                           ; INCREMENT FOR 0 ORIGIN
141C  32 ED             3563     C          XOR     CH,CH                        ; ZERO HIGH BYTE OF COUNT
141E  8B 2E 044A R      3564     C          MOV     BP,CRT_COLS                  ; NUM OF COLS IN DISPLAY
1422  03 ED             3565     C          ADD     BP,BP                        ; TIMES 2 FOR ATTR BYTE
1424  8A C3             3566     C          MOV     AL,BL                        ; GET LINE COUNT
1426  F6 26 044A R      3567     C          MUL     BYTE PTR CRT_COLS            ; OFFSET TO FROM ADDRESS
142A  03 C0             3568     C          ADD     AX,AX                        ; *2 FOR ATTRIBUTE BYTE
142C  06                3569     C          PUSH    ES                           ; ESTABLISH ADDRESSING
142D  1F                3570     C          POP     DS                           ;  FOR BOTH POINTERS
142E  80 FB 00          3571     C          CMP     BL,0                         ; 0 MEANS BLANK FIELD
1431  C3                3572     C          RET                                  ; RETURN WITH FLAGS SET
1432                    3573     C  SCROLL_POSITION ENDP
                        3574     C
                        3575     C  ;----- MOVE_ROW
                        3576     C
1432                    3577     C  N10     PROC    NEAR
1432  8A CA             3578     C          MOV     CL,DL                        ; GET # OF COLS TO MOVE
1434  56                3579     C          PUSH    SI
1435  57                3580     C          PUSH    DI                           ; SAVE START ADDRESS
1436  F3/ A5            3581     C          REP     MOVSW                        ; MOVE THAT LINE ON SCREEN
1438  5F                3582     C          POP     DI
1439  5E                3583     C          POP     SI                           ; RECOVER ADDRESSES
143A  C3                3584     C          RET
143B                    3585     C  N10     ENDP
                        3586     C
                        3587     C  ;----- CLEAR_ROW
                        3588     C
143B                    3589     C  N11     PROC    NEAR
143B  8A CA             3590     C          MOV     CL,DL                        ; GET # COLUMNS TO CLEAR
143D  57                3591     C          PUSH    DI
143E  F3/ AB            3592     C          REP     STOSW                        ; STORE THE FILL CHARACTER
1440  5F                3593     C          POP     DI
1441  C3                3594     C          RET
1442                    3595     C  N11     ENDP
                        3596     C
                        3597     C  ;--------------------------------------------------------
                        3598     C  ; SCROLL_DOWN                                          :
                        3599     C  ;       THIS ROUTINE MOVES THE CHARACTERS WITHIN A     :
                        3600     C  ;       DEFINED BLOCK DOWN ON THE SCREEN, FILLING THE  :
                        3601     C  ;       TOP LINES WITH A DEFINED CHARACTER             :
                        3602     C  ; INPUT                                                :
                        3603     C  ;       (AH) = CURRENT CRT MODE                        :
                        3604     C  ;       (AL) = NUMBER OF LINES TO SCROLL               :
                        3605     C  ;       (CX) = UPPER LEFT CORNER OF REGION             :
                        3606     C  ;       (DX) = LOWER RIGHT CORNER OF REGION            :
                        3607     C  ;       (BH) = FILL CHARACTER                          :
                        3608     C  ;       (DS) = DATA SEGMENT                            :
                        3609     C  ;       (ES) = REGEN SEGMENT                           :
                        3610     C  ; OUTPUT                                               :
                        3611     C  ;       NONE -- SCREEN IS SCROLLED                     :
                        3612     C  ;--------------------------------------------------------
1442                    3613     C  SCROLL_DOWN     PROC    NEAR
1442  FD                3614     C          STD                                  ; SCROLL DOWN
1443  8A D8             3615     C          MOV     BL,AL                        ; LINE COUNT TO BL
1445  E8 16EB R         3616     C          CALL    MK_ES
1448  53                3617     C          PUSH    BX                           ; SAVE ATTRIBUTE IN BH
1449  8B C2             3618     C          MOV     AX,DX                        ; LOWER RIGHT CORNER
144B  E8 13F2 R         3619     C          CALL    SCROLL_POSITION              ; GET REGEN LOCATION
144E  74 20             3620     C          JZ      N16
1450  2B F0             3621     C          SUB     SI,AX                        ; SI IS FROM ADDRESS
1452  8A E6             3622     C          MOV     AH,DH                        ; GET TOTAL # ROWS
1454  2A E3             3623     C          SUB     AH,BL                        ; COUNT TO MOVE IN SCROLL
1456                    3624     C  N13:
1456  E8 1432 R         3625     C          CALL    N10                          ; MOVE ONE ROW
1459  2B F5             3626     C          SUB     SI,BP
145B  2B FD             3627     C          SUB     DI,BP
145D  FE CC             3628     C          DEC     AH
145F  75 F5             3629     C          JNZ     N13
1461                    3630     C  N14:
1461  58                3631     C          POP     AX                           ; RECOVER ATTRIBUTE IN AH
1462  B0 20             3632     C          MOV     AL,' '
1464                    3633     C  N15:
1464  E8 143B R         3634     C          CALL    N11                          ; CLEAR ONE ROW
1467  2B FD             3635     C          SUB     DI,BP                        ; GO TO NEXT ROW
1469  FE CB             3636     C          DEC     BL
146B  75 F7             3637     C          JNZ     N15
146D  E9 13DA R         3638     C          JMP     N5                           ; SCROLL_END
1470                    3639     C  N16:
1470  8A DE             3640     C          MOV     BL,DH
1472  EB ED             3641     C          JMP     N14
1474                    3642     C  SCROLL_DOWN     ENDP
                        3643     C
                        3644     C  ;--------------------------------------------------------
                        3645     C  ; SCROLL UP                                            :
                        3646     C  ;       THIS ROUTINE SCROLLS UP THE INFORMATION ON THE CRT :
                        3647     C  ; ENTRY                                                :
                        3648     C  ;       CH,CL = UPPER LEFT CORNER OF REGION TO SCROLL  :
                        3649     C  ;       DH,DL = LOWER RIGHT CORNER OF REGION TO SCROLL :
                        3650     C  ;        BOTH OF THE ABOVE ARE IN CHARACTER POSITIONS   :
                        3651     C  ;       BH = FILL VALUE FOR BLANKED LINES              :
                        3652     C  ;       AL = # LINES TO SCROLL (AL=0 MEANS BLANK THE ENTIRE :
                        3653     C  ;            FIELD)                                    :
                        3654     C  ;       DS = DATA SEGMENT                              :
```

```
                                3655     C ;       ES = REGEN SEGMENT                                          :
                                3656     C ; EXIT                                                              :
                                3657     C ;       NOTHING, THE SCREEN IS SCROLLED                             :
                                3658     C ;-----------------------------------------------------------------------
 1474                           3659     C GRAPHICS_UP   PROC    NEAR
 1474  8A D8                   3660     C               MOV     BL,AL                   ; SAVE LINE COUNT IN BL
 1476  8B C1                   3661     C               MOV     AX,CX                   ; GET UPPER LEFT POSITION
                                3662     C                                               ;  INTO AX REG
                                3663     C
                                3664     C ;----- USE CHARACTER SUBROUTINE FOR POSITIONING
                                3665     C ;----- ADDRESS RETURNED IS MULTIPLIED BY 2 FROM CORRECT VALUE
                                3666     C
 1478  E8 16A7 R               3667     C               CALL    GRAPH_POSN
 1478  8B F8                   3668     C               MOV     DI,AX                   ; SAVE RESULT AS
                                3669     C                                               ;  DESTINATION ADDRESS
                                3670     C
                                3671     C ;----- DETERMINE SIZE OF WINDOW
                                3672     C
 147D  2B D1                    3673     C               SUB     DX,CX
 147F  81 C2 0101               3674     C               ADD     DX,101H                 ; ADJUST VALUES
 1483  D0 E6                   3675     C               SAL     DH,1                    ; MULTIPLY # ROWS BY 4
                                3676     C                                               ;  SINCE 8 VERT DOTS/CHAR
 1485  D0 E6                   3677     C               SAL     DH,1                    ;  AND EVEN/ODD ROWS
                                3678     C
                                3679     C ;----- DETERMINE CRT MODE
                                3680     C
 1487  80 3E 0449 R 06          3681     C               CMP     CRT_MODE,6              ; TEST FOR MEDIUM RES
 148C  73 04                    3682     C               JNC     R7                      ; FIND_SOURCE
                                3683     C
                                3684     C ;----- MEDIUM RES UP
                                3685     C
 148E  D0 E2                    3686     C               SAL     DL,1                    ; * 2,
 1490  D1 E7                   3687     C               SAL     DI,1                    ;  SINCE 2 BYTES/CHAR
                                3688     C
                                3689     C ;----- DETERMINE THE SOURCE ADDRESS IN THE BUFFER
                                3690     C
 1492                           3691     C R7:                                           ; FIND_SOURCE
 1492  06                       3692     C               PUSH    ES                      ; GET SEGMENTS BOTH
 1493  1F                       3693     C               POP     DS                      ;  POINTING TO REGEN
 1494  2A ED                    3694     C               SUB     CH,CH                   ; 0 TO HIGH OF COUNT REG
 1496  D0 E3                    3695     C               SAL     BL,1                    ; NUMBER OF LINES *4
 1498  D0 E3                    3696     C               SAL     BL,1
 149A  74 2D                    3697     C               JZ      R11                     ; IF 0, BLANK ENTIRE FIELD
 149C  8A C3                    3698     C               MOV     AL,BL                   ; NUMBER OF LINES IN AL
 149E  B4 50                    3699     C               MOV     AH,80                   ; 80 BYTES/ROW
 14A0  F6 E4                    3700     C               MUL     AH                      ; OFFSET TO SOURCE
 14A2  8B F7                    3701     C               MOV     SI,DI                   ; SET UP SOURCE
 14A4  03 F0                    3702     C               ADD     SI,AX                   ;  ADD IN OFFSET TO IT
 14A6  8A E6                    3703     C               MOV     AH,DH                   ; NUMBER OF ROWS IN FIELD
 14A8  2A E3                    3704     C               SUB     AH,BL                   ; DETERMINE NUMBER TO MOVE
                                3705     C
                                3706     C ;----- LOOP THROUGH, MOVING ONE ROW AT A TIME, BOTH EVEN AND ODD FIELDS
                                3707     C
 14AA                           3708     C R8:                                           ; ROW_LOOP
 14AA  E8 14CD R                3709     C               CALL    R17                     ; MOVE ONE ROW
 14AD  81 EE 1FB0               3710     C               SUB     SI,2000H-80             ; MOVE TO NEXT ROW
 14B1  81 EF 1FB0               3711     C               SUB     DI,2000H-80
 14B5  FE CC                    3712     C               DEC     AH                      ; NUMBER OF ROWS TO MOVE
 14B7  75 F1                    3713     C               JNZ     R8                      ; CONTINUE TILL ALL MOVED
                                3714     C
                                3715     C ;----- FILL IN THE VACATED LINE(S)
                                3716     C
 14B9                           3717     C R9:                                           ; CLEAR_ENTRY
 14B9  8A C7                    3718     C               MOV     AL,BH                   ; ATTRIBUTE TO FILL WITH
 14BB                           3719     C R10:
 14BB  E8 14E6 R                3720     C               CALL    R18                     ; CLEAR THAT ROW
 14BE  81 EF 1FB0               3721     C               SUB     DI,2000H-80             ; POINT TO NEXT LINE
 14C2  FE CB                    3722     C               DEC     BL                      ; NUMBER OF LINES TO FILL
 14C4  75 F5                    3723     C               JNZ     R10                     ; CLEAR_LOOP
 14C6  E9 219E R                3724     C               JMP     V_RET
 14C9                           3725     C R11:                                          ; BLANK_FIELD
 14C9  8A DE                    3726     C               MOV     BL,DH                   ; SET BLANK COUNT TO
                                3727     C                                               ;  EVERYTHING IN FIELD
 14CB  EB EC                    3728     C               JMP     R9                      ; CLEAR THE FIELD
 14CD                           3729     C GRAPHICS_UP   ENDP
                                3730     C
                                3731     C ;----- ROUTINE TO MOVE ONE ROW OF INFORMATION
                                3732     C
 14CD                           3733     C R17   PROC    NEAR
 14CD  8A CA                    3734     C               MOV     CL,DL                   ; NUM OF BYTES IN THE ROW
 14CF  56                       3735     C               PUSH    SI
 14D0  57                       3736     C               PUSH    DI                      ; SAVE POINTERS
 14D1  F3/ A4                   3737     C               REP     MOVSB                   ; MOVE THE EVEN FIELD
 14D3  5F                       3738     C               POP     DI
 14D4  5E                       3739     C               POP     SI
 14D5  81 C6 2000               3740     C               ADD     SI,2000H
 14D9  81 C7 2000               3741     C               ADD     DI,2000H                ; POINT TO THE ODD FIELD
 14DD  56                       3742     C               PUSH    SI
 14DE  57                       3743     C               PUSH    DI                      ; SAVE THE POINTERS
 14DF  8A CA                    3744     C               MOV     CL,DL                   ; COUNT BACK
 14E1  F3/ A4                   3745     C               REP     MOVSB                   ; MOVE THE ODD FIELD
 14E3  5F                       3746     C               POP     DI
 14E4  5E                       3747     C               POP     SI                      ; POINTERS BACK
 14E5  C3                       3748     C               RET                             ; RETURN TO CALLER
 14E6                           3749     C R17   ENDP
                                3750     C
                                3751     C ;----- CLEAR A SINGLE ROW
                                3752     C
 14E6                           3753     C R18   PROC    NEAR
 14E6  8A CA                    3754     C               MOV     CL,DL                   ; NUMBER OF BYTES IN FIELD
 14E8  57                       3755     C               PUSH    DI                      ; SAVE POINTER
 14E9  F3/ AA                   3756     C               REP     STOSB                   ; STORE THE NEW VALUE
 14EB  5F                       3757     C               POP     DI                      ; POINTER BACK
 14EC  81 C7 2000               3758     C               ADD     DI,2000H                ; POINT TO ODD FIELD
 14F0  57                       3759     C               PUSH    DI
 14F1  8A CA                    3760     C               MOV     CL,DL
 14F3  F3/ AA                   3761     C               REP     STOSB                   ; FILL THE ODD FIELD
 14F5  5F                       3762     C               POP     DI
 14F6  C3                       3763     C               RET                             ; RETURN TO CALLER
 14F7                           3764     C R18   ENDP
                                3765     C
 14F7                           3766     C MEM_DET PROC  NEAR
                                3767     C               ASSUME  DS:ABSO
 14F7  50                       3768     C               PUSH    AX
 14F8  1E                       3769     C               PUSH    DS
 14F9  E8 0CFE R                3770     C               CALL    DDS
 14FC  8A 26 0487 R             3771     C               MOV     AH,INFO
 1500  80 E4 60                3772     C               AND     AH,060H
 1503  1F                       3773     C               POP     DS
 1504  58                       3774     C               POP     AX
 1505  74 02                    3775     C               JZ      MIN
 1507  F9                       3776     C               STC
 1508  C3                       3777     C               RET
                                3778     C MIN:
 1509  F8                       3779     C               CLC
 150A  C3                       3780     C               RET
```

```
150B                            3781    C  MEM_DET ENDP
                                3782    C
                                3783    C  ;----- SCROLL ACTIVE PAGE UP
                                3784    C
150B                            3785    C  SC_2:
150B  E9 13A3 R                 3786    C          JMP     SCROLL_UP
                                3787    C
150E                            3788    C  AH6:
                                3789    C          ASSUME  DS:ABS0
150E  E8 12D1 R                 3790    C          CALL    FLTA
1511  8A 26 0449 R              3791    C          MOV     AH,CRT_MODE                  ; GET CURRENT MODE
1515  80 FC 07                  3792    C          CMP     AH,07H
1518  76 F1                     3793    C          JBE     SC_2                         ; ANY OF THE OLD MODES
151A  80 FC 0D                  3794    C          CMP     AH,0DH
151D  73 17                     3795    C          JAE     GRAPHICS_UP_2                ; NEW GRAPHICS MODES
151F  E9 219E R                 3796    C          JMP     V_RET                        ; NOT A RECOGNIZED MODE
                                3797    C
1522                            3798    C  GR_ST_1 PROC    NEAR
1522  BA A000                   3799    C          MOV     DX,0A000H                    ; REGEN BUFFER
1525  BD 0511                   3800    C          MOV     BP,0511H                     ; GRAPHICS WRITE MODE
1528  80 FC 0F                  3801    C          CMP     AH,0FH
152B  72 08                     3802    C          JB      VV1
152D  E8 14F7 R                 3803    C          CALL    MEM_DET
1530  73 03                     3804    C          JNC     VV1
1532  BD 0501                   3805    C          MOV     BP,0501H                     ; GRAPHICS WRITE MODE
1535                            3806    C  VV1:
1535  C3                        3807    C          RET
1536                            3808    C  GR_ST_1 ENDP
                                3809    C
1536                            3810    C  GRAPHICS_UP_2   PROC    NEAR
                                3811    C          ASSUME  DS:ABS0
1536  52                        3812    C          PUSH    DX
1537  E8 1522 R                 3813    C          CALL    GR_ST_1                      ; SET SEGMENT, WRITE MODE
                                3814    C          SRLOAD  ES                           ; SET REGEN
153A  8E C2                     3815    C+         MOV     ES,DX
153C  5A                        3816    C          POP     DX
153D  8A D8                     3817    C          MOV     BL,AL                        ; NUMBER OF LINES
153F  8B C1                     3818    C          MOV     AX,CX                        ; UPPER LEFT CORNER
1541  53                        3819    C          PUSH    BX
1542  8A 3E 0462 R              3820    C          MOV     BH,ACTIVE_PAGE               ; ACTIVE PAGE FOR SCROLL
1546  E8 16C6 R                 3821    C          CALL    GRX_PSN                      ; ADDRESS IN REGEN
1549  5B                        3822    C          POP     BX
154A  8B F8                     3823    C          MOV     DI,AX                        ; SET POINTER
154C  2B D1                     3824    C          SUB     DX,CX                        ; DETERMINE WINDOW
154E  81 C2 0101                3825    C          ADD     DX,0101H                     ; ADJUST
1552  2A E4                     3826    C          SUB     AH,AH                        ; ZERO HIGH BYTE
1554  8A C3                     3827    C          MOV     AL,BL                        ; LINE COUNT
1556  52                        3828    C          PUSH    DX
1557  F7 26 0485 R              3829    C          MUL     POINTS                       ; BYTES PER CHARACTER
155B  F7 26 044A R              3830    C          MUL     CRT_COLS                     ; COLUMNS
155F  8B F7                     3831    C          MOV     SI,DI                        ; SET UP SOURCE INDEX
1561  03 F0                     3832    C          ADD     SI,AX                        ; ADJUST
                                3833    C          ASSUME  DS:NOTHING
1563  06                        3834    C          PUSH    ES
1564  1F                        3835    C          POP     DS
1565  5A                        3836    C          POP     DX
1566  0A DB                     3837    C          OR      BL,BL                        ; LINE COUNT
1568  74 3F                     3838    C          JZ      AR9
156A  8A CE                     3839    C          MOV     CL,DH
156C  2A CB                     3840    C          SUB     CL,BL
156E  2A ED                     3841    C          SUB     CH,CH
                                3842    C
                                3843    C          ASSUME  DS:ABS0
1570  1E                        3844    C          PUSH    DS
1571  E8 0CFE R                 3845    C          CALL    DDS                          ; LOW MEMORY SEGMENT
1574  50                        3846    C          PUSH    AX
1575  52                        3847    C          PUSH    DX
1576  8B C1                     3848    C          MOV     AX,CX
1578  F7 26 0485 R              3849    C          MUL     POINTS                       ; BYTES PER CHAR
157C  8B C8                     3850    C          MOV     CX,AX                        ; SET THE COUNT
157E  5A                        3851    C          POP     DX
157F  58                        3852    C          POP     AX
                                3853    C          ASSUME  DS:NOTHING
1580  1F                        3854    C          POP     DS
                                3855    C
1581  52                        3856    C          PUSH    DX
1582  8B C5                     3857    C          MOV     AX,BP
1584  B6 03                     3858    C          MOV     DH,3
1586  B2 CE                     3859    C          MOV     DL,GRAPH_ADDR                ; GRAPHICS
1588  E8 0D15 R                 3860    C          CALL    OUT_DX
158B  B2 C4                     3861    C          MOV     DL,SEQ_ADDR                  ; SEQUENCER
158D  B8 020F                   3862    C          MOV     AX,020FH                     ; ENABLE ALL MAPS
1590  E8 0D15 R                 3863    C          CALL    OUT_DX
1593  5A                        3864    C          POP     DX
1594  E8 12E0 R                 3865    C          CALL    CRANK                        ; SCROLL THE SCREEN
                                3866    C
1597  52                        3867    C          PUSH    DX
1598  4D                        3868    C          DEC     BP
1599  8B C5                     3869    C          MOV     AX,BP
159B  B6 03                     3870    C          MOV     DH,3
159D  B2 CE                     3871    C          MOV     DL,GRAPH_ADDR
159F  E8 0D15 R                 3872    C          CALL    OUT_DX
15A2  5A                        3873    C          POP     DX
15A3                            3874    C  AR10:
15A3  E8 1353 R                 3875    C          CALL    BLNK_3
15A6  E9 219E R                 3876    C          JMP     V_RET
15A9                            3877    C  AR9:
15A9  8A DE                     3878    C          MOV     BL,DH                        ; BLANK ENTIRE WINDOW
15AB  EB F6                     3879    C          JMP     AR10
15AD                            3880    C  GRAPHICS_UP_2   ENDP
                                3881    C
                                3882    C  ;----- SCROLL ACTIVE DISPLAY PAGE DOWN
                                3883    C
15AD                            3884    C  SC_3:
15AD  E9 1442 R                 3885    C          JMP     SCROLL_DOWN
                                3886    C
15B0                            3887    C  AH7:
                                3888    C          ASSUME  DS:ABS0
15B0  E8 12D1 R                 3889    C          CALL    FLTA
15B3  8A 26 0449 R              3890    C          MOV     AH,CRT_MODE
15B7  80 FC 03                  3891    C          CMP     AH,03H                       ; OLD COLOR ALPHA
15BA  76 F1                     3892    C          JBE     SC_3
15BC  80 FC 07                  3893    C          CMP     AH,07H                       ; MONOCHROME ALPHA
15BF  74 EC                     3894    C          JE      SC_3
                                3895    C
15C1  80 FC 0D                  3896    C          CMP     AH,0DH                       ; NEW GRAPHICS MODES
15C4  73 0C                     3897    C          JAE     GRAPHICS_DN_2
15C6  80 FC 06                  3898    C          CMP     AH,06H                       ; OLD GRAPHICS MODES
15C9  77 04                     3899    C          JA      M_0
15CB  B4 07                     3900    C          MOV     AH,07H
15CD  CD 42                     3901    C          INT     42H
15CF                            3902    C  M_0:
15CF  E9 219E R                 3903    C          JMP     V_RET
                                3904    C
15D2                            3905    C  GRAPHICS_DN_2   PROC    NEAR
15D2  FD                        3906    C          STD                                  ; DIRECTION TO DECREMENT
```

```
15D3  8A D8                    3907  C          MOV     BL,AL                   ; LINE COUNT
15D5  52                       3908  C          PUSH    DX                      ; SAVE LOWER RIGHT
15D6  E8 1522 R                3909  C          CALL    GR_ST_1
                               3910  C          SRLOAD  ES                      ; SET REGEN SEGMENT
15D9  8E C2                    3911  C+         MOV     ES,DX
15DB  5A                       3912  C          POP     DX
15DC  8B C2                    3913  C          MOV     AX,DX
15DE  FE C4                    3914  C          INC     AH                      ; MOV CHAR ROW UP BY ONE
15E0  53                       3915  C          PUSH    BX
15E1  8A 3E 0462 R             3916  C          MOV     BH,ACTIVE_PAGE
15E5  E8 16C6 R                3917  C          CALL    GRX_PSN                 ; ADDRESS IN REGEN
15E8  5B                       3918  C          POP     BX
15E9  2B 06 044A R             3919  C          SUB     AX,CRT_COLS             ; ONE SCAN OVERSHOOT
15ED  8B F8                    3920  C          MOV     DI,AX
15EF  2B D1                    3921  C          SUB     DX,CX                   ; CALCULATE WINDOW
15F1  81 C2 0101               3922  C          ADD     DX,0101H                ; ADJUST COUNT
15F5  2A E4                    3923  C          SUB     AH,AH
15F7  8A C3                    3924  C          MOV     AL,BL
15F9  52                       3925  C          PUSH    DX
15FA  F7 26 0485 R             3926  C          MUL     POINTS                  ; BYTES PER CHAR
15FE  F7 26 044A R             3927  C          MUL     CRT_COLS                ; BYTES PER ROW
1602  8B F7                    3928  C          MOV     SI,DI
1604  2B F0                    3929  C          SUB     SI,AX
                               3930  C          ASSUME  DS:NOTHING
1606  06                       3931  C          PUSH    ES                      ; SET DS TO
1607  1F                       3932  C          POP     DS                      ;  THE REGEN SEGMENT
1608  5A                       3933  C          POP     DX
1609  0A DB                    3934  C          OR      BL,BL                   ; SCROLL COUNT
160B  74 40                    3935  C          JZ      DXR9                    ; BLANK ENTIRE WINDOW
160D  8A CE                    3936  C          MOV     CL,DH
160F  2A CB                    3937  C          SUB     CL,BL
1611  2A ED                    3938  C          SUB     CH,CH
                               3939  C
                               3940  C          ASSUME  DS:ABSO
1613  1E                       3941  C          PUSH    DS
1614  E8 0CFE R                3942  C          CALL    DDS
1617  50                       3943  C          PUSH    AX
1618  52                       3944  C          PUSH    DX
1619  8B C1                    3945  C          MOV     AX,CX
161B  F7 26 0485 R             3946  C          MUL     POINTS                  ; BYTES PER CHAR
161F  8B C8                    3947  C          MOV     CX,AX
1621  5A                       3948  C          POP     DX
1622  58                       3949  C          POP     AX
                               3950  C          ASSUME  DS:NOTHING
1623  1F                       3951  C          POP     DS
                               3952  C
1624  52                       3953  C          PUSH    DX
1625  8B C5                    3954  C          MOV     AX,BP
1627  B6 03                    3955  C          MOV     DH,3
1629  B2 CE                    3956  C          MOV     DL,GRAPH_ADDR           ; GRAPHICS
162B  E8 0D15 R                3957  C          CALL    OUT_DX
162E  B2 C4                    3958  C          MOV     DL,SEQ_ADDR             ; SEQUENCER
1630  B8 020F                  3959  C          MOV     AX,020FH                ; ENABLE ALL MAPS
1633  E8 0D15 R                3960  C          CALL    OUT_DX
1636  5A                       3961  C          POP     DX
1637  E8 12FE R                3962  C          CALL    CRANK_4                 ; SCROLL THE SCREEN
                               3963  C
163A  52                       3964  C          PUSH    DX
163B  4D                       3965  C          DEC     BP
163C  8B C5                    3966  C          MOV     AX,BP
163E  B6 03                    3967  C          MOV     DH,3
1640  B2 CE                    3968  C          MOV     DL,GRAPH_ADDR
1642  E8 0D15 R                3969  C          CALL    OUT_DX
1645  5A                       3970  C          POP     DX
1646                           3971  C  DXR10:
1646  E8 137B R                3972  C          CALL    BLNK_4
1649  FC                       3973  C          CLD
164A  E9 219E R                3974  C          JMP     V_RET
164D                           3975  C  DXR9:
164D  8A DE                    3976  C          MOV     BL,DH                   ; BLANK ENTIRE WINDOW
164F  EB F5                    3977  C          JMP     DXR10
1651                           3978  C  GRAPHICS_DN_2  ENDP
                               3979  C
                               3980  C          SUBTTL
                               3981
                               3982  C          INCLUDE         VGRW.INC
                               3983  C          SUBTTL  VGRW.INC
                               3984  C          PAGE
                               3985  C
                               3986  C          ASSUME  DS:ABSO
1651                           3987  C  FIND_POSITION   PROC    NEAR
1651  8A CF                    3988  C          MOV     CL,BH                   ; DISPLAY PAGE TO CX
1653  32 ED                    3989  C          XOR     CH,CH
1655  8B F1                    3990  C          MOV     SI,CX                   ; MOVE TO SI FOR INDEX
1657  D1 E6                    3991  C          SAL     SI,1                    ; * 2 FOR WORD OFFSET
1659  8B 84 0450 R             3992  C          MOV     AX,[SI+ OFFSET CURSOR_POSN]     ; ROW/COLUMN OF THAT PAGE
165D  33 DB                    3993  C          XOR     BX,BX                   ; SET START ADDRESS TO 0
165F  E3 06                    3994  C          JCXZ    P5                      ; NO_PAGE
1661                           3995  C  P4:                                     ; PAGE_LOOP
1661  03 1E 044C R             3996  C          ADD     BX,CRT_LEN              ; LENGTH OF BUFFER
1665  E2 FA                    3997  C          LOOP    P4
1667                           3998  C  P5:                                     ; NO_PAGE
1667  E8 1146 R                3999  C          CALL    POSITION                ; DETERMINE LOC IN REGEN
166A  03 D8                    4000  C          ADD     BX,AX                   ; ADD TO START OF REGEN
166C  C3                       4001  C          RET
166D                           4002  C  FIND_POSITION   ENDP
                               4003  C
                               4004  C  ;--------------------------------------------------------
                               4005  C  ; EXPAND_MED_COLOR                                      :
                               4006  C  ;       THIS ROUTINE EXPANDS THE LOW 2 BITS IN BL TO    :
                               4007  C  ;       FILL THE ENTIRE BX REGISTER                     :
                               4008  C  ; ENTRY                                                 :
                               4009  C  ;       BL = COLOR TO BE USED ( LOW 2 BITS )            :
                               4010  C  ; EXIT                                                  :
                               4011  C  ;       BX = COLOR TO BE USED ( 8 REPLICATIONS OF THE   :
                               4012  C  ;       2 COLOR BITS )                                  :
                               4013  C  ;--------------------------------------------------------
166D                           4014  C  S19     PROC    NEAR
166D  80 E3 03                 4015  C          AND     BL,3                    ; ISOLATE THE COLOR BITS
1670  8A C3                    4016  C          MOV     AL,BL                   ; COPY TO AL
1672  51                       4017  C          PUSH    CX                      ; SAVE REGISTER
1673  B9 0003                  4018  C          MOV     CX,3                    ; NUMBER OF TIMES
1676                           4019  C  S20:
1676  D0 E0                    4020  C          SAL     AL,1
1678  D0 E0                    4021  C          SAL     AL,1                    ; LEFT SHIFT BY 2
167A  0A D8                    4022  C          OR      BL,AL                   ; ANOTHER COLOR VERSION
                               4023  C                                          ;  INTO BL
167C  E2 F8                    4024  C          LOOP    S20                     ; FILL ALL OF BL
167E  8A FB                    4025  C          MOV     BH,BL                   ; FILL UPPER PORTION
1680  59                       4026  C          POP     CX                      ; REGISTER BACK
1681  C3                       4027  C          RET                             ; ALL DONE
1682                           4028  C  S19     ENDP
                               4029  C  ;--------------------------------------------------------
                               4030  C  ; EXPAND_BYTE                                          :
                               4031  C  ;       THIS ROUTINE TAKES THE BYTE IN AL AND DOUBLES   :
                               4032  C  ;       ALL OF THE BITS, TURNING THE 8 BITS INTO        :
```

```
                                4033  C  ;       16 BITS. THE RESULT IS LEFT IN AX                :
                                4034  C  ;--------------------------------------------------------
1682                            4035  C  S21     PROC    NEAR
1682  52                        4036  C         PUSH    DX                              ; SAVE REGISTERS
1683  51                        4037  C         PUSH    CX
1684  53                        4038  C         PUSH    BX
1685  2B D2                     4039  C         SUB     DX,DX                           ; RESULT REGISTER
1687  B9 0001                   4040  C         MOV     CX,1                            ; MASK REGISTER
168A                            4041  C  S22:
168A  8B D8                     4042  C         MOV     BX,AX                           ; BASE INTO TEMP
168C  23 D9                     4043  C         AND     BX,CX                           ; USE MASK TO EXTRACT BIT
168E  0B D3                     4044  C         OR      DX,BX                           ; PUT INTO RESULT REGISTER
1690  D1 E0                     4045  C         SHL     AX,1
1692  D1 E1                     4046  C         SHL     CX,1                            ; SHIFT BASE AND MASK BY 1
1694  8B D8                     4047  C         MOV     BX,AX                           ; BASE TO TEMP
1696  23 D9                     4048  C         AND     BX,CX                           ; EXTRACT THE SAME BIT
1698  0B D3                     4049  C         OR      DX,BX                           ; PUT INTO RESULT
169A  D1 E1                     4050  C         SHL     CX,1                            ; SHIFT ONLY MASK NOW,
                                4051  C                                                 ;  MOVING TO NEXT BASE
169C  73 EC                     4052  C         JNC     S22                             ; USE MASK BIT COMING OUT
                                4053  C                                                 ;  TO TERMINATE
169E  8B C2                     4054  C         MOV     AX,DX                           ; RESULT TO PARM REGISTER
16A0  5B                        4055  C         POP     BX
16A1  59                        4056  C         POP     CX                              ; RECOVER REGISTERS
16A2  5A                        4057  C         POP     DX
16A3  C3                        4058  C         RET                                     ; ALL DONE
16A4                            4059  C  S21     ENDP
                                4060  C
16A4                            4061  C  S26     PROC    NEAR
16A4  A1 0450 R                 4062  C         MOV     AX,CURSOR_POSN                  ; GET CURRENT CURSOR
16A7                            4063  C  GRAPH_POSN     LABEL   NEAR
16A7  53                        4064  C         PUSH    BX                              ; SAVE REGISTER
16A8  8B D8                     4065  C         MOV     BX,AX                           ; SAVE A COPY OF CURSOR
16AA  8A C4                     4066  C         MOV     AL,AH                           ; GET ROWS TO AL
16AC  F6 26 044A R              4067  C         MUL     BYTE PTR CRT_COLS               ; MULTIPLY BY BYTES/COLUMN
16B0  D1 E0                     4068  C         SHL     AX,1                            ; *4 SINCE 4 ROWS/BYTE
16B2  D1 E0                     4069  C         SHL     AX,1
16B4  2A FF                     4070  C         SUB     BH,BH                           ; ISOLATE COLUMN VALUE
16B6  03 C3                     4071  C         ADD     AX,BX                           ; DETERMINE OFFSET
16B8  5B                        4072  C         POP     BX                              ; RECOVER POINTER
16B9  C3                        4073  C         RET                                     ; ALL DONE
16BA                            4074  C  S26     ENDP
                                4075  C
                                4076  C  ;--------------------------------------------------------------
                                4077  C  ; GR_CUR                                                    :
                                4078  C  ; ENTRY                                                     :
                                4079  C  ;       BH = DISPLAY PAGE                                    :
                                4080  C  ; EXIT                                                      :
                                4081  C  ;       AX = CURSOR POSITION FOR REQUESTED PAGE              :
                                4082  C  ;--------------------------------------------------------------
16BA                            4083  C  GR_CUR:
                                4084  C         ASSUME  DS:ABS0
16BA  53                        4085  C         PUSH    BX                              ; SAVE REGISTER
16BB  8A DF                     4086  C         MOV     BL,BH                           ; GET TO LOW BYTE
16BD  2A FF                     4087  C         SUB     BH,BH                           ; ZERO HIGH BYTE
16BF  D1 E3                     4088  C         SAL     BX,1                            ; *2 FOR WORD COUNT
16C1  8B 87 0450 R              4089  C         MOV     AX,[BX + OFFSET CURSOR_POSN]    ; CURSOR, REQUESTED PAGE
16C5  5B                        4090  C         POP     BX                              ; RECOVER REGISTER
                                4091  C  ;--------------------------------------------------------------
                                4092  C  ; GRX_PSN                                                   :
                                4093  C  ; ENTRY                                                     :
                                4094  C  ;       AX = CURSOR POSITION IN DESIRED PAGE                 :
                                4095  C  ;       BH = DESIRED PAGE                                    :
                                4096  C  ; EXIT                                                      :
                                4097  C  ;       AX = BYTE OFFSET INTO REGEN                          :
                                4098  C  ;--------------------------------------------------------------
16C6                            4099  C  GRX_PSN PROC    NEAR                                       :
16C6  53                        4100  C         PUSH    BX                              ; SAVE
16C7  51                        4101  C         PUSH    CX                              ; SAVE
16C8  52                        4102  C         PUSH    DX                              ; SAVE
16C9  2A ED                     4103  C         SUB     CH,CH                           ; ZERO
16CB  8A CF                     4104  C         MOV     CL,BH                           ; PAGE NUMBER
16CD  8B D8                     4105  C         MOV     BX,AX                           ; ROW, COLUMN
16CF  8A C4                     4106  C         MOV     AL,AH                           ; ROW
16D1  F6 26 044A R              4107  C         MUL     BYTE PTR CRT_COLS               ; ROW * COLUMNS/ROW
16D5  F7 26 0485 R              4108  C         MUL     POINTS                          ; BYTES PER ROW
16D9  2A FF                     4109  C         SUB     BH,BH                           ; ZERO TO LEAVE COL VALUE
16DB  03 C3                     4110  C         ADD     AX,BX                           ; ADD IN COLUMN
16DD  8B 1E 044C R              4111  C         MOV     BX,CRT_LEN                      ; PAGE LENGTH
16E1  E3 04                     4112  C         JCXZ    GP_2                            ; NO PAGE OFFSET
16E3                            4113  C  GP_3:
16E3  03 C3                     4114  C         ADD     AX,BX                           ; ADD IN THE PAGE LENGTH
16E5  E2 FC                     4115  C         LOOP    GP_3                            ; DO FOR NUMBER OF PAGES
16E7                            4116  C  GP_2:
16E7  5A                        4117  C         POP     DX                              ; RECOVER
16E8  59                        4118  C         POP     CX                              ; RECOVER
16E9  5B                        4119  C         POP     BX                              ; RECOVER
16EA  C3                        4120  C         RET
16EB                            4121  C  GRX_PSN ENDP
                                4122  C
16EB                            4123  C  MK_ES:
16EB  BE B800                   4124  C         MOV     SI,0B800H
16EE  8B 3E 0410 R              4125  C         MOV     DI,EQUIP_FLAG
16F2  81 E7 0030                4126  C         AND     DI,030H
16F6  83 FF 30                  4127  C         CMP     DI,030H
16F9  75 03                     4128  C         JNE     P6_A
16FB  BE B000                   4129  C         MOV     SI,0B000H
16FE                            4130  C  P6_A:
16FE  8E C6                     4131  C         MOV     ES,SI
1700  C3                        4132  C         RET
                                4133  C
                                4134  C  ;--------------------------------------------------------------
                                4135  C  ; READ_AC_CURRENT                                           :
                                4136  C  ;       THIS ROUTINE READS THE ATTRIBUTE AND CHARACTER       :
                                4137  C  ;       AT THE CURRENT CURSOR POSITION AND RETURNS THEM      :
                                4138  C  ;       TO THE CALLER                                        :
                                4139  C  ; INPUT                                                     :
                                4140  C  ;       (AH) = CURRENT CRT MODE                              :
                                4141  C  ;       (BH) = DISPLAY PAGE ( ALPHA MODES ONLY )             :
                                4142  C  ;       (DS) = DATA SEGMENT                                  :
                                4143  C  ;       (ES) = REGEN SEGMENT                                 :
                                4144  C  ;OUTPUT                                                     :
                                4145  C  ;       (AL) = CHAR READ                                     :
                                4146  C  ;       (AH) = ATTRIBUTE READ                                :
                                4147  C  ;--------------------------------------------------------------
                                4148  C         ASSUME  CS:CODE,DS:ABS0,ES:NOTHING
1701                            4149  C  READ_AC_CURRENT PROC    NEAR
1701  E8 16EB R                 4150  C         CALL    MK_ES
1704  E8 1651 R                 4151  C         CALL    FIND_POSITION
1707  8B F3                     4152  C         MOV     SI,BX                           ; ADDRESSING IN SI
                                4153  C
1709  8B 16 0463 R              4154  C         MOV     DX,ADDR_6845                    ; GET BASE ADDRESS
170D  83 C2 06                  4155  C         ADD     DX,6                            ; POINT AT STATUS PORT
                                4156  C
1710  F6 06 0487 R 04           4157  C         TEST    INFO,4
                                4158  C
```

```
1715  06                    4159  C          PUSH    ES
1716  1F                    4160  C          POP     DS                      ; SEGMENT FOR QUICK ACCESS
                            4161  C
1717  74 0B                 4162  C          JZ      P3A
                            4163  C
                            4164  C     ;-----' WAIT FOR HORIZONTAL RETRACE
                            4165  C
1719                        4166  C     P2:                                 ; WAIT FOR RETRACE LOW
1719  EC                    4167  C          IN      AL,DX                   ; GET STATUS
171A  A8 01                 4168  C          TEST    AL,1                    ; IS HORZ RETRACE LOW
171C  75 FB                 4169  C          JNZ     P2                      ; WAIT UNTIL IT IS
171E  FA                    4170  C          CLI                             ; NO MORE INTERRUPTS
171F                        4171  C     P3:                                 ; WAIT FOR RETRACE HIGH
171F  EC                    4172  C          IN      AL,DX                   ; GET STATUS
1720  A8 01                 4173  C          TEST    AL,1                    ; IS IT HIGH
1722  74 FB                 4174  C          JZ      P3                      ; WAIT UNTIL IT IS
1724                        4175  C     P3A:
1724  AD                    4176  C          LODSW                           ; GET THE CHAR/ATTR
1725  E9 219E R             4177  C          JMP     V_RET
1728                        4178  C     READ_AC_CURRENT ENDP
                            4179  C
                            4180  C     ;--------------------------------------------------------
                            4181  C     ; MED_READ_BYTE                                        :
                            4182  C     ;       THIS ROUTINE WILL TAKE 2 BYTES FROM THE REGEN  :
                            4183  C     ;       BUFFER, COMPARE AGAINST THE CURRENT FOREGROUND :
                            4184  C     ;       COLOR, AND PLACE THE CORRESPONDING ON/OFF BIT  :
                            4185  C     ;       PATTERN INTO THE CURRENT POSITION IN THE SAVE  :
                            4186  C     ;       AREA                                           :
                            4187  C     ; ENTRY                                                :
                            4188  C     ;       SI,DS = POINTER TO REGEN AREA OF INTEREST      :
                            4189  C     ;       BX = EXPANDED FOREGROUND COLOR                 :
                            4190  C     ;       BP = POINTER TO SAVE AREA                      :
                            4191  C     ; EXIT                                                 :
                            4192  C     ;       BP IS INCREMENT AFTER SAVE                     :
                            4193  C     ;--------------------------------------------------------
1728                        4194  C     S23     PROC    NEAR
1728  8A 24                 4195  C          MOV     AH,[SI]                 ; GET FIRST BYTE
172A  8A 44 01              4196  C          MOV     AL,[SI+1]               ; GET SECOND BYTE
172D  B9 C000               4197  C          MOV     CX,0C000H               ; 2 BIT MASK TO TEST
                            4198  C                                          ;  THE ENTRIES
1730  B2 00                 4199  C          MOV     DL,0                    ; RESULT REGISTER
1732                        4200  C     S24:
1732  85 C1                 4201  C          TEST    AX,CX                   ; IS THIS BACKGROUND?
1734  F8                    4202  C          CLC                             ; CLEAR CARRY IN HOPES
                            4203  C                                          ;  THAT IT IS
1735  74 01                 4204  C          JZ      S25                     ; IF 0, IT IS BACKGROUND
1737  F9                    4205  C          STC                             ; WASN'T, SO SET CARRY
1738                        4206  C     S25:
1738  D0 D2                 4207  C          RCL     DL,1                    ; MOVE THAT BIT INTO THE
173A  D1 E9                 4208  C          SHR     CX,1                    ;  RESULT
173C  D1 E9                 4209  C          SHR     CX,1                    ; MOVE THE MASK TO THE
                            4210  C                                          ;  RIGHT BY 2 BITS
173E  73 F2                 4211  C          JNC     S24                     ; DO IT AGAIN IF MASK
                            4212  C                                          ;  DIDN'T FALL OUT
1740  88 56 00              4213  C          MOV     [BP],DL                 ; STORE RESULT IN SAVE
1743  45                    4214  C          INC     BP                      ; ADJUST POINTER
1744  C3                    4215  C          RET                             ; ALL DONE
1745                        4216  C     S23     ENDP
                            4217  C
                            4218  C
1745                        4219  C     GRAPHICS_READ   PROC    NEAR
1745  E8 16EB R             4220  C          CALL    MK_ES
1748  E8 16A4 R             4221  C          CALL    S26                     ; CONVERTED TO OFFSET
174B  8B F0                 4222  C          MOV     SI,AX                   ; SAVE IN SI
174D  83 EC 08              4223  C          SUB     SP,8                    ; ALLOCATE SPACE TO SAVE
                            4224  C                                          ;  THE READ CODE POINT
1750  8B EC                 4225  C          MOV     BP,SP                   ; POINTER TO SAVE AREA
                            4226  C
                            4227  C     ;----- DETERMINE GRAPHICS MODES
                            4228  C
1752  80 3E 0449 R 06       4229  C          CMP     CRT_MODE,6
1757  06                    4230  C          PUSH    ES
1758  1F                    4231  C          POP     DS                      ; POINT TO REGEN SEGMENT
1759  72 1A                 4232  C          JC      S13P                    ; MEDIUM RESOLUTION
                            4233  C
                            4234  C     ;----- HIGH RESOLUTION READ
                            4235  C
                            4236  C     ;----- GET VALUES FROM REGEN BUFFER AND CONVERT TO CODE POINT
                            4237  C
175B  B6 04                 4238  C          MOV     DH,4                    ; NUMBER OF PASSES
175D                        4239  C     S12P:
175D  8A 04                 4240  C          MOV     AL,[SI]                 ; GET FIRST BYTE
175F  88 46 00              4241  C          MOV     [BP],AL                 ; SAVE IN STORAGE AREA
1762  45                    4242  C          INC     BP                      ; NEXT LOCATION
1763  8A 84 2000           4243  C          MOV     AL,[SI+2000H]           ; GET LOWER REGION BYTE
1767  88 46 00              4244  C          MOV     [BP],AL                 ; ADJUST AND STORE
176A  45                    4245  C          INC     BP
176B  83 C6 50              4246  C          ADD     SI,80                   ; POINTER INTO REGEN
176E  FE CE                 4247  C          DEC     DH                      ; LOOP CONTROL
1770  75 EB                 4248  C          JNZ     S12P                    ; DO IT SOME MORE
1772  EB 17 90              4249  C          JMP     S15P                    ; GO MATCH THE SAVED CODE
                            4250  C                                          ;  POINTS
                            4251  C
                            4252  C     ;----- MEDIUM RESOLUTION READ
                            4253  C
1775                        4254  C     S13P:                               ; MED_RES_READ
1775  D1 E6                 4255  C          SAL     SI,1                    ; OFFSET*2, 2 BYTES/CHAR
1777  B6 04                 4256  C          MOV     DH,4                    ; NUMBER OF PASSES
1779                        4257  C     S14P:
1779  E8 1728 R             4258  C          CALL    S23                     ; GET PAIR BYTES
                            4259  C                                          ;  INTO SINGLE SAVE
177C  81 C6 2000           4260  C          ADD     SI,2000H                ; GO TO LOWER REGION
1780  E8 1728 R             4261  C          CALL    S23                     ; GET THIS PAIR INTO SAVE
1783  81 EE 1FB0            4262  C          SUB     SI,2000H-80             ; ADJUST POINTER BACK INTO
1787  FE CE                 4263  C          DEC     DH                      ;  UPPER
1789  75 EE                 4264  C          JNZ     S14P                    ; KEEP GOING UNTIL 8 DONE
                            4265  C
                            4266  C     ;----- SAVE AREA HAS CHARACTER IN IT, MATCH IT
                            4267  C
178B                        4268  C     S15P:                               ; FIND_CHAR
178B  1E                    4269  C          PUSH    DS
178C  E8 0CFE R             4270  C          CALL    DDS
178F  C4 3E 010C R          4271  C          LES     DI,GRX_SET              ; ESTABLISH ADDRESSING
1793  1F                    4272  C          POP     DS
1794  83 ED 08              4273  C          SUB     BP,8                    ; ADJUST POINTER TO
                            4274  C                                          ;  BEGINNING OF SAVE AREA
1797  8B F5                 4275  C          MOV     SI,BP
1799  FC                    4276  C          CLD                             ; ENSURE DIRECTION
179A  B0 00                 4277  C          MOV     AL,0                    ; CURRENT CODE POINT BEING
179C                        4278  C     S16P:                               ;  MATCHED
179C  16                    4279  C          PUSH    SS                      ; ADDRESSING TO STACK
179D  1F                    4280  C          POP     DS                      ; FOR THE STRING COMPARE
179E  BA 0080               4281  C          MOV     DX,128                  ; NUMBER TO TEST AGAINST
17A1                        4282  C     S17P:
17A1  56                    4283  C          PUSH    SI                      ; SAVE SAVE AREA POINTER
17A2  57                    4284  C          PUSH    DI                      ; SAVE CODE POINTER
```

```
17A3  B9 0008                 4285  C          MOV     CX,8                    ; NUMBER OF BYTES TO MATCH
17A6  F3/ A6                  4286  C          REPE    CMPSB                   ; COMPARE THE 8 BYTES
17A8  5F                      4287  C          POP     DI                      ; RECOVER THE POINTERS
17A9  5E                      4288  C          POP     SI
17AA  74 1D                   4289  C          JZ      S18P                    ; IF ZERO FLAG SET,
                              4290  C                                          ;  THEN MATCH OCCURRED
17AC  FE C0                   4291  C          INC     AL                      ; NO MATCH, MOVE TO NEXT
17AE  83 C7 08                4292  C          ADD     DI,8                    ; NEXT CODE POINT
17B1  4A                      4293  C          DEC     DX                      ; LOOP CONTROL
17B2  75 ED                   4294  C          JNZ     S17P                    ; DO ALL OF THEM
                              4295  C
                              4296  C     ;----- CHAR NOT MATCHED, MIGHT BE IN USER SUPPLIED SECOND HALF
                              4297  C
17B4  3C 00                   4298  C          CMP     AL,0                    ; AL <> 0 IF ONLY 1ST
                              4299  C                                          ;  HALF SCANNED
17B6  74 11                   4300  C          JE      S18P                    ; IF = 0, THEN ALL HAS
                              4301  C                                          ;  BEEN SCANNED
                              4302  C          ASSUME  DS:ABS0
17B8  E8 0CFE R               4303  C          CALL    DDS
17BB  C4 3E 007C R            4304  C          LES     DI,EXT_PTR              ; GET POINTER
17BF  8C C0                   4305  C          MOV     AX,ES                   ; SEE IF THE PNTR EXISTS
17C1  0B C7                   4306  C          OR      AX,DI                   ; IF ALL 0, DOESN'T EXIST
17C3  74 04                   4307  C          JZ      S18P                    ; NO SENSE LOOKING
17C5  B0 80                   4308  C          MOV     AL,128                  ; ORIGIN FOR SECOND HALF
17C7  EB D3                   4309  C          JMP     S16P                    ; GO BACK AND TRY FOR IT
                              4310  C
                              4311  C     ;----- CHARACTER IS FOUND ( AL=0 IF NOT FOUND )
                              4312  C
17C9                          4313  C     S18P:
17C9  83 C4 08                4314  C          ADD     SP,8                    ; READJUST THE STACK,
                              4315  C                                          ;  THROW AWAY SAVE
17CC  E9 219E R               4316  C          JMP     V_RET                   ; ALL DONE
17CF                          4317  C     GRAPHICS_READ   ENDP
                              4318  C
                              4319  C
                              4320  C     ;----- READ CHARACTER/ATTRIBUTE AT CURRENT CURSOR POSITION
                              4321  C
17CF                          4322  C     AH8S:
17CF  E9 1701 R               4323  C          JMP     READ_AC_CURRENT
                              4324  C
17D2                          4325  C     AH8:
                              4326  C          ASSUME  DS:ABS0
17D2  8A 26 0449 R            4327  C          MOV     AH,CRT_MODE             ; GET THE CURRENT MODE
17D6  80 FC 07                4328  C          CMP     AH,07H
17D9  74 F4                   4329  C          JE      AH8S
17DB  80 FC 03                4330  C          CMP     AH,03H
17DE  76 EF                   4331  C          JBE     AH8S
17E0  80 FC 06                4332  C          CMP     AH,06H
17E3  77 03                   4333  C          JA      Z_1
17E5  E9 1745 R               4334  C          JMP     GRAPHICS_READ
17E8                          4335  C     Z_1:
17E8  80 FC 0F                4336  C          CMP     AH,0FH
17EB  72 52                   4337  C          JB      GRX_RD2
17ED  E8 14F7 R               4338  C          CALL    MEM_DET
17F0  72 4D                   4339  C          JC      GRX_RD2
17F2  EB 0A                   4340  C          JMP     SHORT GRX_RD1
17F4  80 FC 0D                4341  C          CMP     AH,0DH                  ; RANGE TEST
17F7  73 46                   4342  C          JAE     GRX_RD2                 ; FOUR MAP READ
17F9  B0 00                   4343  C          MOV     AL,0
17FB  E9 219E R               4344  C          JMP     V_RET
                              4345  C
17FE                          4346  C     GRX_RD1 PROC    NEAR
                              4347  C          ASSUME  DS:ABS0
                              4348  C          SRLOAD  ES,0A000H               ; REGEN SEGEMNT
17FE  BA A000                 4349  C+         MOV     DX,0A000H
1801  8E C2                   4350  C+         MOV     ES,DX
1803  E8 16BA R               4351  C          CALL    GR_CUR                  ; BYTE OFFSET INTO REGEN
1806  8B F0                   4352  C          MOV     SI,AX                   ; SAVE IN SI
1808  8B 1E 0485 R            4353  C          MOV     BX,POINTS               ; BYTES PER CHARACTER
180C  2B E3                   4354  C          SUB     SP,BX                   ; ALLOCATE SPACE TO SAVE
                              4355  C                                          ;  THE READ CODE POINT
180E  8B EC                   4356  C          MOV     BP,SP                   ; POINTER TO SAVE AREA
                              4357  C
                              4358  C     ;----- GET VALUES FROM REGEN BUFFER AND CONVERT TO CODE POINT
                              4359  C
1810  53                      4360  C          PUSH    BX                      ; SAVE BYTES PER CHARACTER
1811  24 01                   4361  C          AND     AL,1                    ; ODD OR EVEN BYTE
1813  8A C8                   4362  C          MOV     CL,AL                   ; USE FOR SHIFT
1815  B0 05                   4363  C          MOV     AL,5                    ; COLOR COMP VALUE (C0-C2)
1817  D2 E0                   4364  C          SHL     AL,CL                   ; (C1-C) IF ODD BYTE
1819  B4 07                   4365  C          MOV     AH,G_COLOR              ; COLOR COMPARE REGISTER
181B  B6 03                   4366  C          MOV     DH,3
181D  B2 CE                   4367  C          MOV     DL,GRAPH_ADDR
181F  E8 0D15 R               4368  C          CALL    OUT_DX                  ; SET GRAPHICS CHIP
1822  B8 0518                 4369  C          MOV     AX,518H                 ; READ MODE
1825  E8 0D15 R               4370  C          CALL    OUT_DX                  ; SET GRAPHICS CHIP
1828                          4371  C     S12_1:
1828  26: 8A 04               4372  C          MOV     AL,ES:[SI]              ; GET FIRST BYTE
182B  F6 D0                   4373  C          NOT     AL
182D  88 46 00                4374  C          MOV     SS:[BP],AL              ; SAVE IN STORAGE AREA
1830  45                      4375  C          INC     BP                      ; NEXT LOCATION
1831  03 36 044A R            4376  C          ADD     SI,CRT_COLS             ; POINTER INTO REGEN
1835  4B                      4377  C          DEC     BX                      ; LOOP CONTROL
1836  75 F0                   4378  C          JNZ     S12_1                   ; DO IT SOME MORE
1838  5B                      4379  C          POP     BX                      ; RECOVER BYTES PER CHAR
1839  B8 0510                 4380  C          MOV     AX,510H                 ; UNDO READ MODE
183C  EB 32 90                4381  C          JMP     GRX_RECG                ; CHAR REGONTION ROUTINE
183F                          4382  C     GRX_RD1 ENDP
                              4383  C
183F                          4384  C     GRX_RD2 PROC    NEAR
                              4385  C          ASSUME  DS:ABS0
                              4386  C          SRLOAD  ES,0A000H               ; REGEN SEGMENT
183F  BA A000                 4387  C+         MOV     DX,0A000H
1842  8E C2                   4388  C+         MOV     ES,DX
1844  E8 16BA R               4389  C          CALL    GR_CUR                  ; BYTE OFFSET INTO REGEN
1847  8B F0                   4390  C          MOV     SI,AX                   ; SAVE IN SI
1849  8B 1E 0485 R            4391  C          MOV     BX,POINTS               ; BYTES PER CHARACTER
184D  2B E3                   4392  C          SUB     SP,BX                   ; ALLOCATE SPACE TO SAVE
                              4393  C                                          ;  THE READ CODE POINT
184F  8B EC                   4394  C          MOV     BP,SP                   ; POINTER TO SAVE AREA
                              4395  C
                              4396  C     ;----- GET VALUES FROM REGEN BUFFER AND CONVERT TO CODE POINT
                              4397  C
1851  B6 03                   4398  C          MOV     DH,3
1853  B2 CE                   4399  C          MOV     DL,GRAPH_ADDR           ; GRAPHICS CHIP
1855  B8 0508                 4400  C          MOV     AX,508H                 ; COLOR COMPARE
1858  E8 0D15 R               4401  C          CALL    OUT_DX                  ; SET THE REGISTER
185B  53                      4402  C          PUSH    BX                      ; SAVE BYTES PER CHARACTER
185C                          4403  C     S12:
185C  26: 8A 04               4404  C          MOV     AL,ES:[SI]              ; GET COLOR COMPARED BYTE
185F  F6 D0                   4405  C          NOT     AL                      ; ADJUST
1861  88 46 00                4406  C          MOV     SS:[BP],AL              ; SAVE IN STORAGE AREA
1864  45                      4407  C          INC     BP                      ; NEXT LOCATION
1865  03 36 044A R            4408  C          ADD     SI,CRT_COLS             ; POINTER INTO REGEN
1869  4B                      4409  C          DEC     BX                      ; LOOP CONTROL
186A  75 F0                   4410  C          JNZ     S12                     ; DO IT SOME MORE
```

```
186C  5B                    4411    C          POP     BX                              ; RECOVER BYTES PER CHAR
186D  B8 0500               4412    C          MOV     AX,500H                         ; UNDO READ MODE
1870                        4413    C  GRX_RD2 ENDP
                            4414    C
1870                        4415    C  GRX_RECG:
                            4416    C
                            4417    C  ;----- SAVE AREA HAS CHARACTER IN IT, MATCH IT
                            4418    C
1870  E8 0D15 R             4419    C          CALL    OUT_DX                          ; SET READ MODE BACK
1873  C4 3E 010C R          4420    C          LES     DI,GRX_SET                      ; GET FONT DEFINITIONS
1877  2B EB                 4421    C          SUB     BP,BX                           ; ADJUST POINTER TO
                            4422    C                                                  ;  BEGINNING OF SAVE AREA
1879  8B F5                 4423    C          MOV     SI,BP
187B  FC                    4424    C          CLD                                     ; ENSURE DIRECTION
187C  B0 00                 4425    C          MOV     AL,0                            ; CODE POINT BEING MATCHED
187E  16                    4426    C          PUSH    SS                              ; ADDRESSING TO STACK
187F  1F                    4427    C          POP     DS                              ;  FOR THE STRING COMPARE
1880  BA 0100               4428    C          MOV     DX,256D                         ; NUMBER TO TEST AGAINST
1883                        4429    C  S17_5:
1883  56                    4430    C          PUSH    SI                              ; SAVE SAVE AREA POINTER
1884  57                    4431    C          PUSH    DI                              ; SAVE CODE POINTER
1885  8B CB                 4432    C          MOV     CX,BX                           ; NUMBER OF BYTES TO MATCH
1887  F3/ A6                4433    C          REPE    CMPSB                           ; COMPARE THE 8 BYTES
1889  5F                    4434    C          POP     DI                              ; RECOVER THE POINTERS
188A  5E                    4435    C          POP     SI
188B  74 07                 4436    C          JZ      S18_5                           ; IF ZFL SET, THEN MATCH
                            4437    C                                                  ;  OCCURRED
188D  FE C0                 4438    C          INC     AL                              ; NO MATCH, ON TO NEXT
188F  03 FB                 4439    C          ADD     DI,BX                           ; NEXT CODE POINT
1891  4A                    4440    C          DEC     DX                              ; LOOP CONTROL
1892  75 EF                 4441    C          JNZ     S17_5                           ; DO ALL OF THEM
1894                        4442    C  S18_5:                                          ; AL=CHAR, 0 IF NOT FOUND
1894  03 E3                 4443    C          ADD     SP,BX                           ; READJUST THE STACK
1896  E9 219E R             4444    C          JMP     V_RET
                            4445    C
                            4446    C  ;----- WRITE CHARACTER/ATTRIBUTE AT CURRENT CURSOR POSITION
                            4447    C
                            4448    C  ;--------------------------------------------------
                            4449    C  ; WRITE_AC_CURRENT                               :
                            4450    C  ;       THIS ROUTINE WRITES THE ATTRIBUTE        :
                            4451    C  ;       AND CHARACTER AT THE CURRENT CURSOR      :
                            4452    C  ;       POSITION                                 :
                            4453    C  ; INPUT                                          :
                            4454    C  ;       (AH) = CURRENT CRT MODE                  :
                            4455    C  ;       (BH) = DISPLAY PAGE                      :
                            4456    C  ;       (CX) = COUNT OF CHARACTERS TO WRITE      :
                            4457    C  ;       (AL) = CHAR TO WRITE                     :
                            4458    C  ;       (BL) = ATTRIBUTE OF CHAR TO WRITE        :
                            4459    C  ;       (DS) = DATA SEGMENT                      :
                            4460    C  ;       (ES) = REGEN SEGMENT                     :
                            4461    C  ; OUTPUT                                         :
                            4462    C  ;       NONE                                     :
                            4463    C  ;--------------------------------------------------
1899                        4464    C  AH9:
                            4465    C          ASSUME  DS:ABS0
1899  E8 0CFE R             4466    C          CALL    DDS
189C  8A 26 0449 R          4467    C          MOV     AH,CRT_MODE
                            4468    C
18A0  80 FC 04              4469    C          CMP     AH,4                            ; IS THIS GRAPHICS
18A3  72 08                 4470    C          JC      P6
18A5  80 FC 07              4471    C          CMP     AH,7                            ; IS THIS BW CARD
18A8  74 03                 4472    C          JE      P6
18AA  EB 74 90              4473    C          JMP     GRAPHICS_WRITE
18AD                        4474    C  P6:                                             ; WRITE_AC_CONTINUE
18AD  E8 16EB R             4475    C          CALL    MK_ES
18B0  8A E3                 4476    C          MOV     AH,BL                           ; GET ATTRIBUTE TO AH
18B2  50                    4477    C          PUSH    AX                              ; SAVE ON STACK
18B3  51                    4478    C          PUSH    CX                              ; SAVE WRITE COUNT
18B4  E8 1651 R             4479    C          CALL    FIND_POSITION
18B7  8B FB                 4480    C          MOV     DI,BX                           ; ADDRESS TO DI REGISTER
18B9  59                    4481    C          POP     CX                              ; WRITE COUNT
18BA  5B                    4482    C          POP     BX                              ; CHARACTER IN BX REG
18BB  8B 16 0463 R          4483    C          MOV     DX,ADDR_6845                    ; GET BASE ADDRESS
18BF  83 C2 06              4484    C          ADD     DX,6                            ; POINT AT STATUS PORT
                            4485    C
                            4486    C  ;----- WAIT FOR HORIZONTAL RETRACE
                            4487    C
18C2                        4488    C  P7:
18C2  F6 06 0487 R 04       4489    C          TEST    INFO,4
18C7  74 0B                 4490    C          JZ      P9A
18C9                        4491    C  P8:
18C9  EC                    4492    C          IN      AL,DX                           ; GET STATUS
18CA  A8 01                 4493    C          TEST    AL,1                            ; IS IT LOW
18CC  75 FB                 4494    C          JNZ     P8                              ; WAIT UNTIL IT IS
18CE  FA                    4495    C          CLI                                     ; NO MORE INTERRUPTS
18CF                        4496    C  P9:
18CF  EC                    4497    C          IN      AL,DX                           ; GET STATUS
18D0  A8 01                 4498    C          TEST    AL,1                            ; IS IT HIGH
18D2  74 FB                 4499    C          JZ      P9                              ; WAIT UNTIL IT IS
18D4                        4500    C  P9A:
18D4  8B C3                 4501    C          MOV     AX,BX                           ; RECOVER THE CHAR/ATTR
18D6  AB                    4502    C          STOSW                                   ; PUT THE CHAR/ATTR
18D7  FB                    4503    C          STI                                     ; INTERRUPTS BACK ON
18D8  E2 E8                 4504    C          LOOP    P7                              ; AS MANY TIMES
18DA  E9 219E R             4505    C          JMP     V_RET
                            4506    C
                            4507    C  ;----- WRITE CHARACTER ONLY AT CURRENT CURSOR POSITION
                            4508    C
                            4509    C  ;--------------------------------------------------
                            4510    C  ; WRITE_C_CURRENT                                :
                            4511    C  ;       THIS ROUTINE WRITES THE CHARACTER AT     :
                            4512    C  ;       THE CURRENT CURSOR POSITION, ATTRIBUTE   :
                            4513    C  ;       UNCHANGED                                :
                            4514    C  ; INPUT                                          :
                            4515    C  ;       (AH) = CURRENT CRT MODE                  :
                            4516    C  ;       (BH) = DISPLAY PAGE                      :
                            4517    C  ;       (CX) = COUNT OF CHARACTERS TO WRITE      :
                            4518    C  ;       (AL) = CHAR TO WRITE                     :
                            4519    C  ;       (DS) = DATA SEGMENT                      :
                            4520    C  ;       (ES) = REGEN SEGMENT                     :
                            4521    C  ; OUTPUT                                         :
                            4522    C  ;       NONE                                     :
                            4523    C  ;--------------------------------------------------
18DD                        4524    C  AHA:
                            4525    C          ASSUME  DS:ABS0
18DD  E8 0CFE R             4526    C          CALL    DDS
18E0  8A 26 0449 R          4527    C          MOV     AH,CRT_MODE
                            4528    C
18E4  80 FC 04              4529    C          CMP     AH,4                            ; IS THIS GRAPHICS
18E7  72 08                 4530    C          JC      P10
18E9  80 FC 07              4531    C          CMP     AH,7                            ; IS THIS BW CARD
18EC  74 03                 4532    C          JE      P10
                            4533    C
18EE  EB 30 90              4534    C          JMP     GRAPHICS_WRITE
18F1                        4535    C  P10:
18F1  E8 16EB R             4536    C          CALL    MK_ES
```

```
18F4  50                      4537  C          PUSH    AX                      ; SAVE ON STACK
18F5  51                      4538  C          PUSH    CX                      ; SAVE WRITE COUNT
18F6  E8 1651 R               4539  C          CALL    FIND_POSITION
18F9  8B FB                   4540  C          MOV     DI,BX                   ; ADDRESS TO DI
18FB  59                      4541  C          POP     CX                      ; WRITE COUNT
18FC  5B                      4542  C          POP     BX                      ; BL HAS CHAR TO WRITE
                              4543  C
                              4544  C ;----- WAIT FOR HORIZONTAL RETRACE
                              4545  C
18FD  8B 16 0463 R            4546  C          MOV     DX,ADDR_6845            ; GET BASE ADDRESS
1901  83 C2 06                4547  C          ADD     DX,6                    ; POINT AT STATUS PORT
1904                          4548  C P11:
1904  F6 06 0487 R 04         4549  C          TEST    INFO,4
1909  74 0B                   4550  C          JZ      P13A
190B                          4551  C P12:
190B  EC                      4552  C          IN      AL,DX                   ; GET STATUS
190C  A8 01                   4553  C          TEST    AL,1                    ; IS IT LOW
190E  75 FB                   4554  C          JNZ     P12                     ; WAIT UNTIL IT IS
1910  FA                      4555  C          CLI                             ; NO MORE INTERRUPTS
1911                          4556  C P13:
1911  EC                      4557  C          IN      AL,DX                   ; GET STATUS
1912  A8 01                   4558  C          TEST    AL,1                    ; IS IT HIGH
1914  74 FB                   4559  C          JZ      P13                     ; WAIT UNTIL IT IS
1916                          4560  C P13A:
1916  8A C3                   4561  C          MOV     AL,BL                   ; RECOVER CHAR
1918  AA                      4562  C          STOSB                           ; PUT THE CHAR/ATTR
1919  FB                      4563  C          STI                             ; INTERRUPTS BACK ON
191A  47                      4564  C          INC     DI                      ; BUMP POINTER PAST ATTR
191B  E2 E7                   4565  C          LOOP    P11                     ;  AS REQUESTED
191D  E9 219E R               4566  C          JMP     V_RET
                              4567  C
                              4568  C ;--------------------------------------------------------------------
                              4569  C ; GRAPHICS WRITE                                                   :
                              4570  C ;       THIS ROUTINE WRITES THE ASCII CHARACTER TO THE              :
                              4571  C ;       CURRENT POSITION ON THE SCREEN.                            :
                              4572  C ; ENTRY                                                            :
                              4573  C ;       AL = CHARACTER TO WRITE                                    :
                              4574  C ;       BL = COLOR ATTRIBUTE TO BE USED FOR FOREGROUND COLOR       :
                              4575  C ;        IF BIT 7 IS SET, THE CHAR IS XOR'D INTO THE REGEN         :
                              4576  C ;        BUFFER (0 IS USED FOR THE BACKGROUND COLOR)               :
                              4577  C ;       CX = NUMBER OF CHARS TO WRITE                              :
                              4578  C ;       DS = DATA SEGMENT                                          :
                              4579  C ;       ES = REGEN SEGMENT                                         :
                              4580  C ; EXIT                                                             :
                              4581  C ;       NOTHING IS RETURNED                                        :
                              4582  C ;                                                                  :
                              4583  C ; GRAPHICS READ                                                    :
                              4584  C ;       THIS ROUTINE READS THE ASCII CHARACTER AT THE CURRENT       :
                              4585  C ;       CURSOR POSITION ON THE SCREEN BY MATCHING THE DOTS ON       :
                              4586  C ;       THE SCREEN TO THE CHARACTER GENERATOR CODE POINTS           :
                              4587  C ; ENTRY                                                            :
                              4588  C ;       NONE  (0 IS ASSUMED AS THE BACKGROUND COLOR)               :
                              4589  C ; EXIT                                                             :
                              4590  C ;       AL = CHARACTER READ AT THAT POSITION (0 RETURNED IF         :
                              4591  C ;            NONE FOUND)                                           :
                              4592  C ;                                                                  :
                              4593  C ; FOR COMPATIBILITY ROUTINES, THE IMAGES USED TO FORM CHARS ARE    :
                              4594  C ;  CONTAINED IN ROM FOR THE 1ST 128 CHARS.  TO ACCESS CHARS        :
                              4595  C ;  IN THE SECOND HALF, THE USER MUST INITIALIZE THE VECTOR AT      :
                              4596  C ;  INTERRUPT 1FH (LOCATION 0007CH) TO POINT TO THE USER            :
                              4597  C ;  SUPPLIED TABLE OF GRAPHIC IMAGES (8X8 BOXES).                   :
                              4598  C ;  FAILURE TO DO SO WILL CAUSE IN STRANGE RESULTS                  :
                              4599  C ;--------------------------------------------------------------------
                              4600  C          ASSUME  CS:CODE,DS:ABS0,ES:NOTHING
1920                          4601  C GRAPHICS_WRITE  PROC    NEAR
1920  80 FC 07                4602  C          CMP     AH,7
1923  72 03                   4603  C          JB      S1_A
1925  E9 19D7 R               4604  C          JMP     GRX_WRT
1928                          4605  C S1_A:
1928  E8 16EB R               4606  C          CALL    MK_ES
192B  B4 00                   4607  C          MOV     AH,0                    ; 0 TO HIGH OF CODE POINT
192D  50                      4608  C          PUSH    AX                      ; SAVE CODE POINT VALUE
                              4609  C
                              4610  C ;----- DETERMINE POSITION IN REGEN BUFFER TO PUT CODE POINTS
                              4611  C
192E  E8 16A4 R               4612  C          CALL    S26                     ; LOC IN REGEN BUFFER
1931  8B F8                   4613  C          MOV     DI,AX                   ; REGEN POINTER IN DI
                              4614  C
                              4615  C ;----- DETERMINE REGION TO GET CODE POINTS FROM
                              4616  C
1933  58                      4617  C          POP     AX                      ; RECOVER CODE POINT
1934  3C 80                   4618  C          CMP     AL,80H                  ; IS IT IN SECOND HALF
1936  73 06                   4619  C          JAE     S1                      ; YES
                              4620  C
                              4621  C ;----- IMAGE IS IN FIRST HALF, CONTAINED IN ROM
                              4622  C
1938  C5 36 010C R            4623  C          LDS     SI,GRX_SET
193C  EB 06                   4624  C          JMP     SHORT S2                ; DETERMINE_MODE
                              4625  C
                              4626  C ;----- IMAGE IS IN SECOND HALF, IN USER RAM
                              4627  C
193E                          4628  C S1:                                     ; EXTEND_CHAR
193E  2C 80                   4629  C          SUB     AL,80H                  ; 0 ORIGIN FOR SECOND HALF
1940  C5 36 007C R            4630  C          LDS     SI,EXT_PTR
                              4631  C
                              4632  C ;----- DETERMINE GRAPHICS MODE IN OPERATION
                              4633  C
1944                          4634  C S2:                                     ; DETERMINE_MODE
1944  D1 E0                   4635  C          SAL     AX,1                    ; MULTIPLY CODE POINT
1946  D1 E0                   4636  C          SAL     AX,1                    ;  VALUE BY 8
1948  D1 E0                   4637  C          SAL     AX,1
194A  03 F0                   4638  C          ADD     SI,AX                   ; SI HAS OFFSET OF
194C  1E                      4639  C          PUSH    DS                      ;  DESIRES CODES
194D  E8 0CFE R               4640  C          CALL    DDS
1950  80 3E 0449 R 06         4641  C          CMP     CRT_MODE,6
1955  1F                      4642  C          POP     DS
1956  72 2C                   4643  C          JC      S7                      ; TEST FOR MEDIUM RES MODE
                              4644  C
                              4645  C ;----- HIGH RESOLUTION MODE
                              4646  C
1958                          4647  C S3:                                     ; HIGH_CHAR
1958  57                      4648  C          PUSH    DI                      ; SAVE REGEN POINTER
1959  56                      4649  C          PUSH    SI                      ; SAVE CODE POINTER
195A  B6 04                   4650  C          MOV     DH,4                    ; NUMBER OF TIMES THROUGH
195C                          4651  C S4:                                     ;  LOOP
195C  AC                      4652  C          LODSB                           ; GET BYTE FROM CODE POINT
195D  F6 C3 80                4653  C          TEST    BL,80H                  ; SHOULD WE USE THE
1960  75 16                   4654  C          JNZ     S6                      ;  FUNCTION TO PUT CHAR IN
1962  AA                      4655  C          STOSB                           ; STORE IN REGEN BUFFER
1963  AC                      4656  C          LODSB
1964                          4657  C S5:
1964  26: 88 85 1FFF          4658  C          MOV     ES:[DI+2000H-1],AL      ; STORE IN SECOND HALF
1969  83 C7 4F                4659  C          ADD     DI,79                   ; MOVE TO NEXT ROW IN REGEN
196C  FE CE                   4660  C          DEC     DH                      ; DONE WITH LOOP
196E  75 EC                   4661  C          JNZ     S4
1970  5E                      4662  C          POP     SI
```

```
1971  5F                        4663  C          POP     DI                      ; RECOVER REGEN POINTER
1972  47                        4664  C          INC     DI                      ; POINT TO NEXT CHAR POS
1973  E2 E3                     4665  C          LOOP    S3                      ; MORE CHARS TO WRITE
1975  E9 219E R                 4666  C          JMP     V_RET
1978                            4667  C  S6:
1978  26: 32 05                 4668  C          XOR     AL,ES:[DI]              ; XOR WITH CURRENT
1978  AA                        4669  C          STOSB                           ; STORE THE CODE POINT
197C  AC                        4670  C          LODSB                           ; AGAIN FOR ODD FIELD
197D  26: 32 85 1FFF            4671  C          XOR     AL,ES:[DI+2000H-1]
1982  EB E0                     4672  C          JMP     S5                      ; BACK TO MAINSTREAM
                                4673  C
                                4674  C  ;----- MEDIUM RESOLUTION WRITE
                                4675  C
1984                            4676  C  S7:                                     ; MED_RES_WRITE
1984  8A D3                     4677  C          MOV     DL,BL                   ; SAVE HIGH COLOR BIT
1986  D1 E7                     4678  C          SAL     DI,1                    ; OFFSET*2, 2 BYTES/CHAR
1988  E8 166D R                 4679  C          CALL    S19                     ; EXPAND BL TO FULL WORD
198B                            4680  C  S8:                                     ;  OF COLOR
198B  57                        4681  C          PUSH    DI                      ; SAVE REGEN POINTER
198C  56                        4682  C          PUSH    SI                      ; SAVE THE CODE POINTER
198D  B6 04                     4683  C          MOV     DH,4                    ; NUMBER OF LOOPS
198F                            4684  C  S9:
198F  AC                        4685  C          LODSB                           ; GET CODE POINT
1990  E8 1682 R                 4686  C          CALL    S21                     ; DOUBLE UP ALL THE BITS
1993  23 C3                     4687  C          AND     AX,BX                   ; CONVERT THEM TO FORE-
                                4688  C                                          ;  GROUND COLOR (0 BACK)
1995  F6 C2 80                  4689  C          TEST    DL,80H                  ; IS THIS XOR FUNCTION
1998  74 07                     4690  C          JZ      S10                     ; NO, STORE IT IN AS IT IS
199A  26: 32 25                 4691  C          XOR     AH,ES:[DI]              ; DO FUNCTION WITH HALF
199D  26: 32 45 01              4692  C          XOR     AL,ES:[DI+1]            ;  AND WITH OTHER HALF
19A1                            4693  C  S10:
19A1  26: 88 25                 4694  C          MOV     ES:[DI],AH              ; STORE FIRST BYTE
19A4  26: 88 45 01              4695  C          MOV     ES:[DI+1],AL            ; STORE SECOND BYTE
19A8  AC                        4696  C          LODSB                           ; GET CODE POINT
19A9  E8 1682 R                 4697  C          CALL    S21
19AC  23 C3                     4698  C          AND     AX,BX                   ; CONVERT TO COLOR
19AE  F6 C2 80                  4699  C          TEST    DL,80H                  ; IS THIS XOR FUNCTION
19B1  74 0A                     4700  C          JZ      S11                     ; NO, JUST STORE THE VALUE
19B3  26: 32 A5 2000            4701  C          XOR     AH,ES:[DI+2000H]        ; FUNCTION WITH FIRST HALF
19B8  26: 32 85 2001            4702  C          XOR     AL,ES:[DI+2001H]        ; AND WITH SECOND HALF
19BD                            4703  C  S11:
19BD  26: 88 A5 2000            4704  C          MOV     ES:[DI+2000H],AH
19C2  26: 88 85 2001            4705  C          MOV     ES:[DI+2000H+1],AL      ; STORE IN SECOND PORTION
19C7  83 C7 50                  4706  C          ADD     DI,80                   ; POINT TO NEXT LOCATION
19CA  FE CE                     4707  C          DEC     DH
19CC  75 C1                     4708  C          JNZ     S9                      ; KEEP GOING
19CE  5E                        4709  C          POP     SI                      ; RECOVER CODE PONTER
19CF  5F                        4710  C          POP     DI                      ; RECOVER REGEN POINTER
19D0  47                        4711  C          INC     DI                      ; POINT TO NEXT CHAR
19D1  47                        4712  C          INC     DI
19D2  E2 B7                     4713  C          LOOP    S8                      ; MORE TO WRITE
19D4  E9 219E R                 4714  C          JMP     V_RET
19D7                            4715  C  GRAPHICS_WRITE  ENDP
                                4716  C
                                4717  C  ;--------------------------------------------------------------------------
                                4718  C  ; ENTRY                                                                  :
                                4719  C  ;       AL = CHAR TO WRITE                                                 :
                                4720  C  ;       BH = DISPLAY PAGE                                                  :
                                4721  C  ;       BL = ATTRIBUTE/COLOR                                               :
                                4722  C  ;       CX = COUNT OF CHARS TO WRITE                                       :
                                4723  C  ;--------------------------------------------------------------------------
19D7                            4724  C  GRX_WRT PROC    NEAR
                                4725  C          ASSUME  DS:ABS0, ES:NOTHING
19D7  80 FC 0F                  4726  C          CMP     AH,0FH                  ; 640X350 GRAPHICS
19DA  72 0E                     4727  C          JB      NO_ADJ1
19DC  E8 14F7 R                 4728  C          CALL    MEM_DET                 ; BASE CARD
19DF  72 09                     4729  C          JC      NO_ADJ1
19E1  80 E3 85                  4730  C          AND     BL,10000101B            ; 85H, XOR C2 CO MASK
19E4  8A E3                     4731  C          MOV     AH,BL
19E6  D0 E4                     4732  C          SHL     AH,1                    ; EXPAND CO TO C1, C2 TO C3
19E8  0A DC                     4733  C          OR      BL,AH                   ; BUILD ?(80H) + (0,3,C,F)
19EA                            4734  C  NO_ADJ1:
19EA  2A E4                     4735  C          SUB     AH,AH                   ; ZERO
19EC  F7 26 0485 R              4736  C          MUL     POINTS                  ; OFFSET FONT TABLE BASE
19F0  50                        4737  C          PUSH    AX                      ; FONT TABLE DISPLACEMENT
19F1  E8 16BA R                 4738  C          CALL    GR_CUR                  ; GET OFFSET INTO REGEN
19F4  8B F8                     4739  C          MOV     DI,AX                   ;  INTO DESTINATION
19F6  8B 2E 0485 R              4740  C          MOV     BP,POINTS               ; BYTES PER CHAR
                                4741  C          SRLOAD  ES,0A000H               ; REGEN SEGEMNT
19FA  BA A000                   4742  C+         MOV     DX,0A000H
19FD  8E C2                     4743  C+         MOV     ES,DX
19FF  C5 36 010C R              4744  C          LDS     SI,GRX_SET              ; ADDRESSING TO FONTS
1A03  58                        4745  C          POP     AX                      ; RECOVER OFFSET
1A04  03 F0                     4746  C          ADD     SI,AX                   ; CHARACTER IN TABLE
1A06  B6 03                     4747  C          MOV     DH,3
1A08                            4748  C  S20A:
1A08  F6 C3 80                  4749  C          TEST    BL,080H                 ; TEST FOR XOR
1A0B  74 0B                     4750  C          JZ      NO_XOR                  ; NO XOR
1A0D  B2 CE                     4751  C          MOV     DL,GRAPH_ADDR
1A0F  B8 0318                   4752  C          MOV     AX,0318H                ; GRAPHICS CHIP XOR
1A12  E8 0D15 R                 4753  C          CALL    OUT_DX                  ; SET REGISTER
1A15  EB 1E 90                  4754  C          JMP     F_2                     ; SKIP BLANK
1A18                            4755  C  NO_XOR:  JMP     F_2                 ; BLANK BOX FOR CHAR
1A18  57                        4756  C          PUSH    DI                      ; SAVE REGEN POINTER
1A19  B2 C4                     4757  C          MOV     DL,SEQ_ADDR
1A1B  B8 020F                   4758  C          MOV     AX,020FH                ; ENABLE ALL MAPS
1A1E  E8 0D15 R                 4759  C          CALL    OUT_DX
1A21  2B C0                     4760  C          SUB     AX,AX                   ; STORE ZERO
1A23  51                        4761  C          PUSH    CX                      ; SAVE CHARACTER COUNT
1A24  8B CD                     4762  C          MOV     CX,BP                   ; GET BYTE COUNT
1A26  1E                        4763  C          PUSH    DS
1A27  E8 0CFE R                 4764  C          CALL    DDS
1A2A                            4765  C  S13A:
1A2A  AA                        4766  C          STOSB                           ; ZERO REGEN BYTE
1A2B  03 3E 044A R              4767  C          ADD     DI,CRT_COLS             ; NEXT BYTE OF BOX
1A2F  4F                        4768  C          DEC     DI                      ; ADJUST
1A30  E2 F8                     4769  C          LOOP    S13A                    ; NEXT BYTE
1A32  1F                        4770  C          POP     DS
1A33  59                        4771  C          POP     CX                      ; RECOVER CHARACTER COUNT
1A34  5F                        4772  C          POP     DI                      ; RECOVER REGEN POINTER
1A35                            4773  C  F_2:
1A35  B2 C4                     4774  C          MOV     DL,SEQ_ADDR
1A37  B4 02                     4775  C          MOV     AH,02H                  ; SET MAP MASK
1A39  8A C3                     4776  C          MOV     AL,BL                   ;  FOR COLOR
1A3B  E8 0D15 R                 4777  C          CALL    OUT_DX                  ; SET THE CHIP
1A3E  57                        4778  C          PUSH    DI                      ; SAVE OFFSET IN REGEN
1A3F  53                        4779  C          PUSH    BX                      ; SAVE COLOR VALUE
1A40  51                        4780  C          PUSH    CX                      ; SAVE CHACTER COUNT
1A41  8B DD                     4781  C          MOV     BX,BP                   ; LOOP CONTROL, BYTES/CHAR
1A43  1E                        4782  C          PUSH    DS                      ; SAVE FONT SEGMENT
1A44  E8 0CFE R                 4783  C          CALL    DDS                     ; SET LOW RAM SEGMENT
                                4784  C          ASSUME  DS:ABS0
1A47  8B 0E 044A R              4785  C          MOV     CX,CRT_COLS             ; GET COLUMN COUNT
1A4B  1F                        4786  C          POP     DS                      ; RESTORE FONT SEGMENT
                                4787  C          ASSUME  DS:NOTHING
1A4C                            4788  C  S1K:                                   ; WRITE OUT THE CHARACTER
```

```
1A4C  8A 04                4789  C           MOV     AL,DS:[SI]                      ; CODE POINT
1A4E  26: 8A 25            4790  C           MOV     AH,ES:[DI]                      ; LATCH DATA
1A51  26: 88 05            4791  C           MOV     ES:[DI],AL                      ; WRITE ONE BYTE OF FONT
1A54  46                   4792  C           INC     SI                              ; NEXT FONT POINT
1A55  03 F9                4793  C           ADD     DI,CX                           ; ONE ROW BELOW LAST POINT
1A57  4B                   4794  C           DEC     BX                              ; BYTES PER CHAR COUNTER
1A58  75 F2                4795  C           JNZ     S1K                             ; DO NEXT ROW OF CHARACTER
                           4796  C
1A5A  59                   4797  C           POP     CX                              ; CHARACTER COUNT
1A5B  5B                   4798  C           POP     BX                              ; COLOR VALUE
1A5C  2B F5                4799  C           SUB     SI,BP                           ; ADJUST PTR TO FONT TABLE
1A5E  5F                   4800  C           POP     DI                              ; REGEN POINTER
1A5F  47                   4801  C           INC     DI                              ; NEXT CHAR POSN IN REGEN
1A60  E2 A6                4802  C           LOOP    S20A                            ; WRITE ANOTHER CHARACTER
                           4803  C
1A62  B2 CE                4804  C           MOV     DL,GRAPH_ADDR
1A64  B8 0300              4805  C           MOV     AX,0300H                        ; NORMAL WRITE, NO ROTATE
1A67  E8 0D15 R            4806  C           CALL    OUT_DX                          ; SET THE CHIP
1A6A  B2 C4                4807  C           MOV     DL,SEQ_ADDR
1A6C  B8 020F              4808  C           MOV     AX,020FH                        ; ENABLE ALL MAPS
1A6F  E8 0D15 R            4809  C           CALL    OUT_DX                          ; SET THE CHIP
1A72  E9 219E R            4810  C           JMP     V_RET
1A75                       4811  C     GRX_WRT ENDP
                           4812  C
                           4813  C           SUBTTL
                           4814
                           4815        ;----- SET COLOR PALETTE
                           4816
1A75                       4817        AHB:
                           4818              ASSUME  DS:ABS0
1A75  80 3E 0463 R B4      4819              CMP     BYTE PTR ADDR_6845,0B4H
1A7A  74 09                4820              JE      M21_B                           ; CALL VALID ONLY FOR COLOR
1A7C  F6 06 0487 R 02      4821              TEST    INFO,2                          ; SEE IF ITS THE OLD COLOR CARD
1A81  74 05                4822              JZ      M21_A                           ; IF NOT, HANDLE IT HERE
1A83  CD 42                4823              INT     42H                             ; OLD CODE CALL
1A85                       4824        M21_B:
1A85  E9 219E R            4825              JMP     V_RET                           ; BACK TO CALLER
1A88                       4826        M21_A:
1A88  2B C0                4827              SUB     AX,AX
1A8A  8B E8                4828              MOV     BP,AX
1A8C  C4 3E 04A8 R         4829              LES     DI,SAVE_PTR
1A90  83 C7 04             4830              ADD     DI,4
1A93  26: C4 3D            4831              LES     DI,DWORD PTR ES:[DI]
1A96  8C C0                4832              MOV     AX,ES
1A98  0B C7                4833              OR      AX,DI
1A9A  74 01                4834              JZ      NOT4AHB
1A9C  45                   4835              INC     BP
1A9D                       4836        NOT4AHB:
1A9D  E8 1DC0 R            4837              CALL    PAL_INIT
1AA0  0A FF                4838              OR      BH,BH
1AA2  75 65                4839              JNZ     M20
                           4840
                           4841        ;----- HANDLE BH = 0 HERE
                           4842        ;       ALPHA MODES  => BL = OVERSCAN COLOR
                           4843        ;       GRAPHICS     => BL = OVERSCAN AND BACKGROUND COLOR
                           4844
                           4845        ;----- MOVE INTENSITY BIT FROM D3 TO D4 FOR COMPATIBILITY
                           4846
1AA4  8A FB                4847              MOV     BH,BL
1AA6  A0 0466 R            4848              MOV     AL,CRT_PALETTE
1AA9  24 E0                4849              AND     AL,0E0H
1AAB  80 E3 1F             4850              AND     BL,01FH
1AAE  0A C3                4851              OR      AL,BL
1AB0  A2 0466 R            4852              MOV     CRT_PALETTE,AL
1AB3  8A DF                4853              MOV     BL,BH
1AB5  80 E7 08             4854              AND     BH,08H
1AB8  D0 E7                4855              SHL     BH,1
1ABA  8A E8                4856              MOV     CH,AL
1ABC  80 E5 EF             4857              AND     CH,0EFH
1ABF  0A ED                4858              OR      CH,CH
1AC1  80 E3 0F             4859              AND     BL,0FH
1AC4  8A FB                4860              MOV     BH,BL
1AC6  D0 E3                4861              SHL     BL,1
1AC8  80 E3 10             4862              AND     BL,010H
1ACB  80 E7 07             4863              AND     BH,07H
1ACE  0A DF                4864              OR      BL,BH
                           4865
1AD0  A0 0449 R            4866              MOV     AL,CRT_MODE
1AD3  3C 03                4867              CMP     AL,3
1AD5  76 0E                4868              JBE     M21
                           4869
                           4870        ;----- GRAPHICS MODE DONE HERE (SET PALETTE 0 AND OVERSCAN)
                           4871
1AD7  B4 00                4872              MOV     AH,0
1AD9  8A C3                4873              MOV     AL,BL
1ADB  E8 1D9F R            4874              CALL    PAL_SET
                           4875
1ADE  0B ED                4876              OR      BP,BP
1AE0  74 03                4877              JZ      M21
1AE2  26: 88 1D            4878              MOV     ES:[DI],BL
                           4879
                           4880        ;----- ALPHA MODE DONE HERE (SET OVERSCAN REGISTER)
                           4881
1AE5                       4882        M21:
1AE5  80 3E 0449 R 03      4883              CMP     CRT_MODE,3                      ; CHECK FOR AN ENHANCED MODE
1AEA  77 05                4884              JA      SET_OVRSC                       ; NO CHANCE
1AEC  E8 0E9A R            4885              CALL    BRST_DET                        ; SEE IF WE ARE ENHANCED
1AEF  72 07                4886              JC      SKIP_OVRSC                      ; THERE IS NO BORDER
1AF1                       4887        SET_OVRSC:
1AF1  B4 11                4888              MOV     AH,011H                         ; OVERSCAN REGISTER
1AF3  8A C3                4889              MOV     AL,BL
1AF5  E8 1D9F R            4890              CALL    PAL_SET                         ; SET THE BORDER
1AF8                       4891        SKIP_OVRSC:
1AF8  0B ED                4892              OR      BP,BP
1AFA  74 04                4893              JZ      M21Y
1AFC  26: 88 5D 10         4894              MOV     ES:[DI][16D],BL
1B00                       4895        M21Y:
1B00  8A DD                4896              MOV     BL,CH
1B02  80 E3 20             4897              AND     BL,020H
1B05  B1 05                4898              MOV     CL,5
1B07  D2 EB                4899              SHR     BL,CL
                           4900
                           4901        ;----- HANDLE BH = 1 HERE
                           4902        ;       ALPHA MODES  => NO EFFECT
                           4903        ;       GRAPHICS     => LOW BIT OF BL = 0
                           4904        ;                         PALETTE 0 = BACKGROUND
                           4905        ;                         PALETTE 1 = GREEN
                           4906        ;                         PALETTE 2 = RED
                           4907        ;                         PALETTE 3 = BROWN
                           4908        ;                      => LOW BIT OF BL = 1
                           4909        ;                         PALETTE 0 = BACKGROUND
                           4910        ;                         PALETTE 1 = CYAN
                           4911        ;                         PALETTE 2 = MAGENTA
                           4912        ;                         PALETTE 3 = WHITE
                           4913        ;
                           4914
```

```
1B09                    4915      M20:
1B09  80 3E 0449 R 03   4916                CMP     CRT_MODE,3
1B0E  76 4A             4917                JBE     M80
                        4918
1B10  A0 0466 R         4919                MOV     AL,CRT_PALETTE
1B13  24 DF             4920                AND     AL,0DFH
1B15  80 E3 01          4921                AND     BL,1
1B18  74 02             4922                JZ      M22
1B1A  0C 20             4923                OR      AL,020H
1B1C                    4924      M22:
1B1C  A2 0466 R         4925                MOV     CRT_PALETTE,AL
1B1F  24 10             4926                AND     AL,010H
1B21  0C 02             4927                OR      AL,2
1B23  0A D8             4928                OR      BL,AL
1B25  B4 01             4929                MOV     AH,1
1B27  8A C3             4930                MOV     AL,BL
1B29  E8 1D9F R         4931                CALL    PAL_SET
                        4932
1B2C  0B ED             4933                OR      BP,BP
1B2E  74 04             4934                JZ      M22Y
1B30  26: 88 5D 01      4935                MOV     ES:[DI][1],BL
1B34                    4936      M22Y:
                        4937
1B34  FE C3             4938                INC     BL
1B36  FE C3             4939                INC     BL
1B38  B4 02             4940                MOV     AH,2
1B3A  8A C3             4941                MOV     AL,BL
1B3C  E8 1D9F R         4942                CALL    PAL_SET
                        4943
1B3F  0B ED             4944                OR      BP,BP
1B41  74 04             4945                JZ      M27Y
1B43  26: 88 5D 02      4946                MOV     ES:[DI][2],BL
1B47                    4947      M27Y:
                        4948
1B47  FE C3             4949                INC     BL
1B49  FE C3             4950                INC     BL
1B4B  B4 03             4951                MOV     AH,3
1B4D  8A C3             4952                MOV     AL,BL
1B4F  E8 1D9F R         4953                CALL    PAL_SET
                        4954
1B52  0B ED             4955                OR      BP,BP
1B54  74 04             4956                JZ      M80
1B56  26: 88 5D 03      4957                MOV     ES:[DI][3],BL
                        4958
1B5A                    4959      M80:
1B5A  E8 1DB7 R         4960                CALL    PAL_ON
1B5D  E9 219E R         4961                JMP     V_RET
                        4962
                        4963  C             INCLUDE         VDOT.INC
                        4964  C             SUBTTL  VDOT.INC
                        4965  C             PAGE
                        4966  C ;--------------------------------------------------
                        4967  C ; ENTRY                                          :
                        4968  C ;       DX = ROW                                 :
                        4969  C ;       CX = COLUMN                              :
                        4970  C ;       BH = PAGE                                :
                        4971  C ; EXIT                                           :
                        4972  C ;       BX = OFFSET INTO REGEN                   :
                        4973  C ;       AL = BIT MASK FOR COLUMN BYTE            :
                        4974  C ;--------------------------------------------------
1B60                    4975  C DOT_SUP_1     PROC    NEAR
                        4976  C
                        4977  C ;----- OFFSET = PAGE OFFSET + ROW * BYTES/ROW + COLUMN/8
                        4978  C
1B60  F7 26 044A R      4979  C             MUL     WORD PTR CRT_COLS               ; ROW * BYTES/ROW
1B64  51                4980  C             PUSH    CX                              ; SAVE COLUMN VALUE
1B65  D1 E9             4981  C             SHR     CX,1                            ; DIVIDE BY EIGHT TO
1B67  D1 E9             4982  C             SHR     CX,1                            ;  DETERMINE THE BYTE THAT
1B69  D1 E9             4983  C             SHR     CX,1                            ;  THIS DOT IS IN
                        4984  C                                                     ;  (8 BITS/BYTE)
1B6B  03 C1             4985  C             ADD     AX,CX                           ; BYTE OFFSET INTO PAGE
1B6D  8A DF             4986  C             MOV     BL,BH                           ; GET PAGE INTO BL
1B6F  2A FF             4987  C             SUB     BH,BH                           ; ZERO
1B71  8B CB             4988  C             MOV     CX,BX                           ; COUNT VALUE
1B73  8B 1E 044C R      4989  C             MOV     BX,CRT_LEN                      ; LENGTH OF ONE PAGE
1B77  E3 04             4990  C             JCXZ    DS_2                            ; PAGE ZERO
1B79                    4991  C DS_3:
1B79  03 C3             4992  C             ADD     AX,BX                           ; BUMP TO NEXT PAGE
1B7B  E2 FC             4993  C             LOOP    DS_3                            ; DO FOR THE REST
1B7D                    4994  C DS_2:
1B7D  59                4995  C             POP     CX                              ; RECOVER COLUMN VALUE
1B7E  8B D8             4996  C             MOV     BX,AX                           ; REGEN OFFSET
1B80  80 E1 07          4997  C             AND     CL,07H                          ; SHIFT COUNT FOR BIT MASK
1B83  B0 80             4998  C             MOV     AL,080H                         ; MASK BIT
1B85  D2 E8             4999  C             SHR     AL,CL                           ; POSITION MASK BIT
1B87  C3                5000  C             RET
1B88                    5001  C DOT_SUP_1     ENDP
                        5002  C
                        5003  C ;--------------------------------------------------------------
                        5004  C ; THIS SUBROUTINE DETERMINES THE REGEN BYTE LOCATION         :
                        5005  C ; OF THE INDICATED ROW COLUMN VALUE IN GRAPHICS MODE.        :
                        5006  C ; ENTRY --                                                   :
                        5007  C ;  DX = ROW VALUE (0-199)                                   :
                        5008  C ;  CX = COLUMN VALUE (0-639)                               :
                        5009  C ; EXIT --                                                    :
                        5010  C ;  SI = OFFSET INTO REGEN BUFFER FOR BYTE OF INTEREST      :
                        5011  C ;  AH = MASK TO STRIP OFF THE BITS OF INTEREST             :
                        5012  C ;  CL = BITS TO SHIFT TO RIGHT JUSTIFY THE MASK IN AH      :
                        5013  C ;  DH = # BITS IN RESULT                                   :
                        5014  C ;--------------------------------------------------------------
1B88                    5015  C R3      PROC    NEAR
1B88  53                5016  C             PUSH    BX                      ; SAVE BX DURING OPERATION
1B89  50                5017  C             PUSH    AX                      ; WILL SAVE AL DURING OPERATION
                        5018  C
                        5019  C ;----- DETERMINE 1ST BYTE IN IDICATED ROW BY MULTIPLYING ROW VALUE BY 40
                        5020  C ;----- ( LOW BIT OF ROW DETERMINES EVEN/ODD, 80 BYTES/ROW
                        5021  C
1B8A  B0 28             5022  C             MOV     AL,40
1B8C  52                5023  C             PUSH    DX                      ; SAVE ROW VALUE
1B8D  80 E2 FE          5024  C             AND     DL,0FEH                 ; STRIP OFF ODD/EVEN BIT
1B90  F6 E2             5025  C             MUL     DL                      ; AX HAS ADDRESS OF 1ST BYTE
                        5026  C                                             ;  OF INDICATED ROW
1B92  5A                5027  C             POP     DX                      ; RECOVER IT
1B93  F6 C2 01          5028  C             TEST    DL,1                    ; TEST FOR EVEN/ODD
1B96  74 03             5029  C             JZ      R4                      ; JUMP IF EVEN ROW
1B98  05 2000           5030  C             ADD     AX,2000H                ; OFFSET TO LOCATION OF ODD ROWS
1B9B                    5031  C R4:                                         ; EVEN_ROW
1B9B  8B F0             5032  C             MOV     SI,AX                   ; MOVE POINTER TO SI
1B9D  58                5033  C             POP     AX                      ; RECOVER AL VALUE
1B9E  8B D1             5034  C             MOV     DX,CX                   ; COLUMN VALUE TO DX
                        5035  C
                        5036  C ;----- DETERMINE GRAPHICS MODE CURRENTLY IN EFFECT
                        5037  C
                        5038  C ;--------------------------------------------------------------
                        5039  C ; SET UP THE REGISTERS ACCORDING TO THE MODE                  :
                        5040  C ;  CH = MASK FOR LOW OF COLUMN ADDRESS ( 7/3 FOR HIGH/MED RES)  :
```

```
                                5041     C ;  CL = # OF ADDRESS BITS IN COLUMN VALUE ( 3/2 FOR H/M)          :
                                5042     C ;  BL = MASK TO SELECT BITS FROM POINTED BYTE (80H/C0H FOR H/M) :
                                5043     C ;  BH = NUMBER OF VALID BITS IN POINTED BYTE ( 1/2 FOR H/M)      :
                                5044     C ;-----------------------------------------------------------------
                                5045     C
1BA0  BB 02C0                   5046     C         MOV     BX,2C0H
1BA3  B9 0302                   5047     C         MOV     CX,302H                 ; SET PARMS FOR MED RES
1BA6  80 3E 0449 R 06           5048     C         CMP     CRT_MODE,6
1BAB  72 06                     5049     C         JC      R5                      ; HANDLE IF MED ARES
1BAD  BB 0180                   5050     C         MOV     BX,180H
1BB0  B9 0703                   5051     C         MOV     CX,703H                 ; SET PARMS FOR HIGH RES
                                5052     C
                                5053     C ;----- DETERMINE BIT OFFSET IN BYTE FROM COLUMN MASK
                                5054     C
1BB3                            5055     C R5:
1BB3  22 EA                     5056     C         AND     CH,DL                   ; ADDRESS OF PEL WITHIN BYTE TO CH
                                5057     C
                                5058     C ;----- DETERMINE BYTE OFFSET FOR THIS LOCATION IN COLUMN
                                5059     C
1BB5  D3 EA                     5060     C         SHR     DX,CL                   ; SHIFT BY CORRECT AMOUNT
1BB7  03 F2                     5061     C         ADD     SI,DX                   ; INCREMENT THE POINTER
1BB9  8A F7                     5062     C         MOV     DH,BH                   ; GET THE # OF BITS IN RESULT TO DH
                                5063     C
                                5064     C ;----- MULTIPLY BH (VALID BITS IN BYTE) BY CH (BIT OFFSET)
                                5065     C
1BBB  2A C9                     5066     C         SUB     CL,CL                   ; ZERO INTO STORAGE LOCATION
1BBD                            5067     C R6:
1BBD  D0 C8                     5068     C         ROR     AL,1                    ; LEFT JUSTIFY THE VALUE
                                5069     C                                         ;  IN AL (FOR WRITE)
1BBF  02 CD                     5070     C         ADD     CL,CH                   ; ADD IN THE BIT OFFSET VALUE
1BC1  FE CF                     5071     C         DEC     BH                      ; LOOP CONTROL
1BC3  75 F8                     5072     C         JNZ     R6                      ; ON EXIT, CL HAS SHIFT COUNT
                                5073     C                                         ;  TO RESTORE BITS
1BC5  8A E3                     5074     C         MOV     AH,BL                   ; GET MASK TO AH
1BC7  D2 EC                     5075     C         SHR     AH,CL                   ; MOVE THE MASK TO CORRECT LOCATION
1BC9  5B                        5076     C         POP     BX                      ; RECOVER REG
1BCA  C3                        5077     C         RET                             ; RETURN WITH EVERYTHING SET UP
1BCB                            5078     C R3      ENDP
                                5079     C
                                5080     C ;-----------------------------------------------------------------
                                5081     C ; READ DOT  -- WRITE DOT                                         :
                                5082     C ;       THESE ROUTINES WILL WRITE A DOT, OR READ THE DOT AT      :
                                5083     C ;       THE INDICATED LOCATION                                   :
                                5084     C ; ENTRY --                                                       :
                                5085     C ;   DX = ROW (0-199)     (THE ACTUAL VALUE DEPENDS ON THE MODE)  :
                                5086     C ;   CX = COLUMN ( 0-639) ( THE VALUES ARE NOT RANGE CHECKED )    :
                                5087     C ;   AL = DOT VALUE TO WRITE (1,2 OR 4 BITS DEPENDING ON MODE,    :
                                5088     C ;          REQ'D FOR WRITE DOT ONLY, RIGHT JUSTIFIED)            :
                                5089     C ;          BIT 7 OF AL=1 INDICATES XOR THE VALUE INTO THE LOCATION :
                                5090     C ;   DS = DATA SEGMENT                                            :
                                5091     C ;   ES = REGEN SEGMENT                                           :
                                5092     C ;                                                                :
                                5093     C ; EXIT                                                           :
                                5094     C ;       AL = DOT VALUE READ, RIGHT JUSTIFIED, READ ONLY          :
                                5095     C ;-----------------------------------------------------------------
                                5096     C
                                5097     C ;----- WRITE DOT
                                5098     C
1BCB                            5099     C AHC:
                                5100     C         ASSUME  DS:ABS0
1BCB  80 3E 0449 R 07           5101     C         CMP     CRT_MODE,7
1BD0  77 2A                     5102     C         JA      WRITE_DOT_2
                                5103     C
1BD2                            5104     C WRITE_DOT       PROC    NEAR
                                5105     C         ASSUME  DS:ABS0,ES:NOTHING
1BD2  52                        5106     C         PUSH    DX
                                5107     C         SRLOAD  ES,0B800H
1BD3  BA B800                   5108     C+        MOV     DX,0B800H
1BD6  8E C2                     5109     C+        MOV     ES,DX
1BD8  5A                        5110     C         POP     DX
1BD9  50                        5111     C         PUSH    AX                      ; SAVE DOT VALUE
1BDA  50                        5112     C         PUSH    AX                      ;  TWICE
1BDB  E8 1B88 R                 5113     C         CALL    R3                      ; DETERMINE BYTE POSITION OF THE DOT
1BDE  D2 E8                     5114     C         SHR     AL,CL                   ; SHIFT TO SET UP THE BITS FOR OUTPUT
1BE0  22 C4                     5115     C         AND     AL,AH                   ; STRIP OFF THE OTHER BITS
1BE2  26: 8A 0C                 5116     C         MOV     CL,ES:[SI]              ; GET THE CURRENT BYTE
1BE5  5B                        5117     C         POP     BX                      ; RECOVER XOR FLAG
1BE6  F6 C3 80                  5118     C         TEST    BL,80H                  ; IS IT ON
1BE9  75 0D                     5119     C         JNZ     R2                      ; YES, XOR THE DOT
1BEB  F6 D4                     5120     C         NOT     AH                      ; SET THE MASK TO REMOVE THE
1BED  22 CC                     5121     C         AND     CL,AH                   ;  INDICATED BITS
1BEF  0A C1                     5122     C         OR      AL,CL                   ; OR IN THE NEW VALUE OF THOSE BITS
1BF1                            5123     C R1:                                     ; FINISH_DOT
1BF1  26: 88 04                 5124     C         MOV     ES:[SI],AL              ; RESTORE THE BYTE IN MEMORY
1BF4  58                        5125     C         POP     AX
1BF5  E9 219E R                 5126     C         JMP     V_RET
1BF8                            5127     C R2:                                     ; XOR_DOT
1BF8  32 C1                     5128     C         XOR     AL,CL                   ; EXCLUSIVE OR THE DOTS
1BFA  EB F5                     5129     C         JMP     R1                      ; FINISH UP THE WRITING
1BFC                            5130     C WRITE_DOT       ENDP
                                5131     C
1BFC                            5132     C WRITE_DOT_2     PROC    NEAR
1BFC  80 3E 0449 R 0F           5133     C         CMP     CRT_MODE,0FH
1C01  72 0D                     5134     C         JB      NO_ADJ2
1C03  E8 14F7 R                 5135     C         CALL    MEM_DET                         ; BASE CARD
1C06  72 08                     5136     C         JC      NO_ADJ2
1C08  24 85                     5137     C         AND     AL,10000101B                    ; 85H, XOR C2 C0 MASK
1C0A  8A E0                     5138     C         MOV     AH,AL
1C0C  D0 E4                     5139     C         SHL     AH,1                            ; EXPAND C0 TO C1, C2 TO C3
1C0E  0A C4                     5140     C         OR      AL,AH                           ; BUILD ?(80H) + (0,3,C,F)
1C10                            5141     C NO_ADJ2:
1C10  50                        5142     C         PUSH    AX
1C11  8B C2                     5143     C         MOV     AX,DX                           ; ROW VALUE
1C13  E8 1B60 R                 5144     C         CALL    DOT_SUP_1                       ; BX=OFFSET, AL=BIT MASK
1C16  B6 03                     5145     C         MOV     DH,3
1C18  B2 CE                     5146     C         MOV     DL,GRAPH_ADDR                   ; GRAPHICS CHIP
1C1A  B4 08                     5147     C         MOV     AH,G_BIT_MASK                   ; BIT MASK REGISTER
1C1C  E8 0D15 R                 5148     C         CALL    OUT_DX                          ; SET BIT MASK
1C1F  52                        5149     C         PUSH    DX
                                5150     C         SRLOAD  ES,0A000H                       ; REGEN SEGMENT
1C20  BA A000                   5151     C+        MOV     DX,0A000H
1C23  8E C2                     5152     C+        MOV     ES,DX
1C25  5A                        5153     C         POP     DX
1C26  58                        5154     C         POP     AX                              ; RECOVER COLOR
1C27  8A E8                     5155     C         MOV     CH,AL                           ; SAVE COLOR
1C29  F6 C5 80                  5156     C         TEST    CH,080H                         ; SEE IF XOR
1C2C  74 0A                     5157     C         JZ      WD_A                            ; NO XOR
1C2E  B4 03                     5158     C         MOV     AH,G_DATA_ROT                   ; DO XOR
1C30  B0 18                     5159     C         MOV     AL,018H                         ; XOR FUNCTION
1C32  E8 0D15 R                 5160     C         CALL    OUT_DX                          ; SET THE REGISTER
1C35  EB 12 90                  5161     C         JMP     WD_B                            ; SKIP THE BLANK
1C38                            5162     C WD_A:                                           ; BLANK THE DOT
1C38  B2 C4                     5163     C         MOV     DL,SEQ_ADDR                     ; SEQUENCER
1C3A  B4 02                     5164     C         MOV     AH,S_MAP                        ; MAP MASK
1C3C  B0 FF                     5165     C         MOV     AL,0FFH                         ; ENABLE ALL MAPS
1C3E  E8 0D15 R                 5166     C         CALL    OUT_DX                          ; SET THE REGISTER
```

```
1C41  26: 8A 07                5167    C               MOV     AL,ES:[BX]                      ; LATCH DATA
1C44  2A C0                    5168    C               SUB     AL,AL                           ; ZERO
1C46  26: 88 07                5169    C               MOV     ES:[BX],AL                      ; BLANK THE DOT
                               5170    C  WD_B:                                                ; SET THE COLOR MAP MASK
1C49  B2 C4                    5171    C               MOV     DL,SEQ_ADDR                     ; SEQUENCER
1C4B  B4 02                    5172    C               MOV     AH,S_MAP                        ; MAP MASK REGISTER
1C4D  8A C5                    5173    C               MOV     AL,CH                           ; COLOR VALUE
1C4F  24 0F                    5174    C               AND     AL,0FH                          ; VALUES 0-15
1C51  E8 0D15 R                5175    C               CALL    OUT_DX                          ; SET IT
1C54  26: 8A 07                5176    C               MOV     AL,ES:[BX]                      ; LATCH DATA
1C57  B0 FF                    5177    C               MOV     AL,0FFH                         ; WRITE VALUE
1C59  26: 88 07                5178    C               MOV     ES:[BX],AL                      ; SET THE DOT
                               5179    C
                               5180    C  ;----- NORMALIZE THE ENVIRONMENT
                               5181    C
1C5C  E8 0D15 R                5182    C               CALL    OUT_DX                          ; ALL MAPS ON
1C5F  B2 CE                    5183    C               MOV     DL,GRAPH_ADDR                   ; GRAPHICS CHIPS
1C61  B4 03                    5184    C               MOV     AH,G_DATA_ROT                   ; XOR REGISTER
1C63  2A C0                    5185    C               SUB     AL,AL                           ; NORMAL WRITES
1C65  E8 0D15 R                5186    C               CALL    OUT_DX                          ; SET IT
1C68  B4 08                    5187    C               MOV     AH,G_BIT_MASK                   ; BIT MASK
1C6A  B0 FF                    5188    C               MOV     AL,0FFH                         ; ALL BITS ON
1C6C  E8 0D15 R                5189    C               CALL    OUT_DX                          ; SET IT
1C6F  E9 219E R                5190    C               JMP     V_RET                           ; WRITE DOT DONE
1C72                           5191    C  WRITE_DOT_2  ENDP
                               5192    C
1C72                           5193    C  RD_S         PROC    NEAR
                               5194    C               ASSUME  DS:ABS0
1C72  50                       5195    C               PUSH    AX
1C73  52                       5196    C               PUSH    DX
                               5197    C               SRLOAD  ES,0A000H
1C74  BA A000                  5198    C+              MOV     DX,0A000H
1C77  8E C2                    5199    C+              MOV     ES,DX
1C79  5A                       5200    C               POP     DX
1C7A  58                       5201    C               POP     AX
1C7B  8B C2                    5202    C               MOV     AX,DX
1C7D  E8 1B60 R                5203    C               CALL    DOT_SUP_1
1C80  B5 07                    5204    C               MOV     CH,7
1C82  2A E9                    5205    C               SUB     CH,CL
1C84  2B D2                    5206    C               SUB     DX,DX
1C86  B0 00                    5207    C               MOV     AL,0
1C88  C3                       5208    C               RET
1C89                           5209    C  RD_S         ENDP
                               5210    C
1C89                           5211    C  RD_1S        PROC    NEAR
1C89  8A CD                    5212    C               MOV     CL,CH
1C8B  B4 04                    5213    C               MOV     AH,4
1C8D  52                       5214    C               PUSH    DX
1C8E  B6 03                    5215    C               MOV     DH,3
1C90  B2 CE                    5216    C               MOV     DL,GRAPH_ADDR
1C92  E8 0D15 R                5217    C               CALL    OUT_DX
1C95  5A                       5218    C               POP     DX
1C96  26: 8A 27                5219    C               MOV     AH,ES:[BX]
1C99  D2 EC                    5220    C               SHR     AH,CL
1C9B  80 E4 01                 5221    C               AND     AH,1
1C9E  C3                       5222    C               RET
1C9F                           5223    C  RD_1S        ENDP
                               5224    C
                               5225    C  ;----- READ DOT
                               5226    C
1C9F                           5227    C  AHD:
                               5228    C               ASSUME  DS:ABS0
1C9F  80 3E 0449 R 07          5229    C               CMP     CRT_MODE,7
1CA4  77 18                    5230    C               JA      R_1
                               5231    C
1CA6                           5232    C  READ_DOT     PROC    NEAR
                               5233    C               ASSUME  DS:ABS0,ES:NOTHING
1CA6  52                       5234    C               PUSH    DX
                               5235    C               SRLOAD  ES,0B800H
1CA7  BA B800                  5236    C+              MOV     DX,0B800H
1CAA  8E C2                    5237    C+              MOV     ES,DX
1CAC  5A                       5238    C               POP     DX
1CAD  E8 1B88 R                5239    C               CALL    R3                      ; DETERMINE BYTE POSITION OF DOT
1CB0  26: 8A 04                5240    C               MOV     AL,ES:[SI]              ; GET THE BYTE
1CB3  22 C4                    5241    C               AND     AL,AH                   ; MASK OFF THE OTHER BITS IN THE BYTE
1CB5  D2 E0                    5242    C               SHL     AL,CL                   ; LEFT JUSTIFY THE VALUE
1CB7  8A CE                    5243    C               MOV     CL,DH                   ; GET NUMBER OF BITS IN RESULT
1CB9  D2 C0                    5244    C               ROL     AL,CL                   ; RIGHT JUSTIFY THE RESULT
1CBB  E9 219E R                5245    C               JMP     V_RET
1CBE                           5246    C  READ_DOT     ENDP
                               5247    C
1CBE                           5248    C  R_1:
1CBE  80 3E 0449 R 0F          5249    C               CMP     CRT_MODE,0FH
1CC3  72 25                    5250    C               JB      READ_DOT_2
1CC5  E8 14F7 R                5251    C               CALL    MEN_DE
1CC8  72 20                    5252    C               JC      READ_DOT_2
                               5253    C
1CCA                           5254    C  READ_DOT_1   PROC    NEAR                    ; 2 MAPS
                               5255    C               ASSUME  DS:ABS0, ES:NOTHING
1CCA  E8 1C72 R                5256    C               CALL    RD_S
1CCD  E8 1C89 R                5257    C               CALL    RD_1S
1CD0  0A D4                    5258    C               OR      DL,AH
1CD2  D0 E4                    5259    C               SHL     AH,1
1CD4  0A D4                    5260    C               OR      DL,AH
1CD6  B0 02                    5261    C               MOV     AL,2
1CD8  E8 1C89 R                5262    C               CALL    RD_1S
1CDB  D0 E4                    5263    C               SHL     AH,1
1CDD  D0 E4                    5264    C               SHL     AH,1
1CDF  0A D4                    5265    C               OR      DL,AH
1CE1  D0 E4                    5266    C               SHL     AH,1
1CE3  0A D4                    5267    C               OR      DL,AH
1CE5  8A C2                    5268    C               MOV     AL,DL
1CE7  E9 219E R                5269    C               JMP     V_RET
1CEA                           5270    C  READ_DOT_1   ENDP
                               5271    C
1CEA                           5272    C  READ_DOT_2   PROC    NEAR                    ; 4 MAPS
                               5273    C               ASSUME  DS:ABS0, ES:NOTHING
1CEA  E8 1C72 R                5274    C               CALL    RD_S
1CED                           5275    C  RD_2A:
1CED  E8 1C89 R                5276    C               CALL    RD_1S
1CF0  8A C8                    5277    C               MOV     CL,AL
1CF2  D2 E4                    5278    C               SHL     AH,CL
1CF4  0A D4                    5279    C               OR      DL,AH
1CF6  FE C0                    5280    C               INC     AL
1CF8  3C 03                    5281    C               CMP     AL,3
1CFA  76 F1                    5282    C               JBE     RD_2A
1CFC  8A C2                    5283    C               MOV     AL,DL
1CFE  E9 219E R                5284    C               JMP     V_RET
1D01                           5285    C  READ_DOT_2   ENDP
                               5286    C
                               5287    C  ;--------------------------------------------------------------------------
                               5288    C  ; WRITE_TTY     WRITE TELETYPE TO ACTIVE PAGE                          :
                               5289    C  ;       THIS INTERFACE PROVIDES A TELETYPE LIKE INTERFACE TO THE VIDEO  :
                               5290    C  ;       CARD.  THE INPUT CHARACTER  IS WRITTEN TO THE  CURRENT CURSOR  :
                               5291    C  ;       POSITION, AND THE CURSOR IS MOVED TO THE NEXT POSITION. IF THE  :
                               5292    C  ;       CURSOR LEAVES THE LAST COLUMN OF THE FIELD,  THE COLUMN IS SET  :
```

```
                                5293    C ;       TO ZERO,  AND THE ROW VALUE IS INCREMENTED.   IF THE ROW VALUE  :
                                5294    C ;       LEAVES THE FIELD,  THE CURSOR IS PLACED ON THE LAST ROW, FIRST  :
                                5295    C ;       COLUMN,  AND THE ENTIRE SCREEN IS SCROLLED UP ONE LINE.   WHEN  :
                                5296    C ;       THE SCREEN IS SCROLLED UP, THE ATTRIBUTE FOR FILLING THE NEWLY  :
                                5297    C ;       BLANKED LINE IS READ FROM THE  CURSOR POSITION ON THE PREVIOUS  :
                                5298    C ;       LINE BEFORE THE SCROLL,  IN CHARACTER MODE.  IN GRAPHICS MODE,  :
                                5299    C ;       THE 0 COLOR IS USED.                                            :
                                5300    C ; ENTRY                                                                 :
                                5301    C ;       (AH) = CURRENT CRT MODE                                         :
                                5302    C ;       (AL) = CHARACTER TO BE WRITTEN                                  :
                                5303    C ;        NOTE THAT BACK SPACE, CAR RET, BELL AND LINE FEED ARE HANDLED  :
                                5304    C ;        AS COMMANDS RATHER THAN AS DISPLAYABLE GRAPHICS               :
                                5305    C ;       (BL) = FOREGROUND COLOR FOR CHAR WRITE IF CURRENTLY IN A         :
                                5306    C ;         GRAPHICS MODE                                                 :
                                5307    C ; EXIT                                                                  :
                                5308    C ;       ALL REGISTERS SAVED                                             :
                                5309    C ;-------------------------------------------------------------------------
1D01                            5310    C AHE:
                                5311    C               ASSUME  CS:CODE,DS:ABS0
1D01  50                        5312    C               PUSH    AX                              ; SAVE REGISTERS
1D02  8A 3E 0462 R              5313    C               MOV     BH,ACTIVE_PAGE                  ; GET THE ACTIVE PAGE
1D06  53                        5314    C               PUSH    BX                              ; SAVE
1D07  8A DF                     5315    C               MOV     BL,BH                           ; GET PAGE TO BL
1D09  32 FF                     5316    C               XOR     BH,BH                           ; CLEAR HIGH BYTE
1D0B  D1 E3                     5317    C               SAL     BX,1                            ; *2 FOR WORD OFFSET
1D0D  8B 97 0450 R              5318    C               MOV     DX,[BX + OFFSET CURSOR_POSN]    ; CURSOR, ACTIVE PAGE
1D11  5B                        5319    C               POP     BX                              ; RECOVER
                                5320    C
                                5321    C ;----- DX NOW HAS THE CURRENT CURSOR POSITION
                                5322    C
1D12  3C 0D                     5323    C               CMP     AL,0DH                          ; IS IT CARRIAGE RETURN
1D14  74 5C                     5324    C               JE      U9                              ; CAR_RET
1D16  3C 0A                     5325    C               CMP     AL,0AH                          ; IS IT A LINE FEED
1D18  74 5C                     5326    C               JE      U10                             ; LINE_FEED
1D1A  3C 08                     5327    C               CMP     AL,08H                          ; IS IT A BACKSPACE
1D1C  74 4C                     5328    C               JE      U8                              ; BACK_SPACE
1D1E  3C 07                     5329    C               CMP     AL,07H                          ; IS IT A BELL
1D20  74 5C                     5330    C               JE      U11                             ; BELL
                                5331    C
                                5332    C ;----- WRITE THE CHAR TO THE SCREEN
                                5333    C
1D22  B4 0A                     5334    C               MOV     AH,10                           ; WRITE CHAR ONLY
1D24  B9 0001                   5335    C               MOV     CX,1                            ; ONLY ONE CHAR
1D27  CD 10                     5336    C               INT     10H                             ; WRITE THE CHAR
                                5337    C
                                5338    C ;----- POSITION THE CURSOR FOR NEXT CHAR
                                5339    C
1D29  FE C2                     5340    C               INC     DL
1D2B  3A 16 044A R              5341    C               CMP     DL,BYTE PTR CRT_COLS            ; TEST FOR COLUMN OVERFLOW
1D2F  75 35                     5342    C               JNZ     U7                              ; SET_CURSOR
1D31  2A D2                     5343    C               SUB     DL,DL                           ; COLUMN FOR CURSOR
1D33  3A 36 0484 R              5344    C               CMP     DH,ROWS
1D37  75 2B                     5345    C               JNZ     U6                              ; SET_CURSOR_INC
                                5346    C
                                5347    C ;----- SCROLL REQUIRED
                                5348    C
1D39                            5349    C U1:
1D39  E8 115D R                 5350    C               CALL    SET_CPOS                        ; SET THE CURSOR
                                5351    C
                                5352    C ;----- DETERMINE VALUE TO FILL WITH DURING SCROLL
                                5353    C
1D3C  A0 0449 R                 5354    C               MOV     AL,CRT_MODE                     ; GET THE CURRENT MODE
1D3F  3C 04                     5355    C               CMP     AL,4
1D41  72 06                     5356    C               JB      U2                              ; READ-CURSOR
1D43  2A FF                     5357    C               SUB     BH,BH                           ; FILL WITH BACKGROUND
1D45  3C 07                     5358    C               CMP     AL,7
1D47  75 06                     5359    C               JNE     U3                              ; SCROLL-UP
1D49                            5360    C U2:                                                   ; READ-CURSOR
1D49  B4 08                     5361    C               MOV     AH,8
1D4B  CD 10                     5362    C               INT     10H                             ; READ CHAR/ATTR
1D4D  8A FC                     5363    C               MOV     BH,AH                           ; STORE IN BH
1D4F                            5364    C U3:                                                   ; SCROLL-UP
1D4F  B8 0601                   5365    C               MOV     AX,601H                         ; SCROLL ONE LINE
1D52  2B C9                     5366    C               SUB     CX,CX                           ; UPPER LEFT CORNER
1D54  8A 36 0484 R              5367    C               MOV     DH,ROWS                         ; LOWER RIGHT ROW
1D58  8A 16 044A R              5368    C               MOV     DL,BYTE PTR CRT_COLS            ; LOWER RIGHT COLUMN
1D5C  FE CA                     5369    C               DEC     DL
1D5E                            5370    C U4:                                                   ; VIDEO-CALL-RETURN
1D5E  CD 10                     5371    C               INT     10H                             ; SCROLL UP THE SCREEN
1D60                            5372    C U5:                                                   ; TTY-RETURN
1D60  58                        5373    C               POP     AX                              ; RESTORE THE CHARACTER
1D61  E9 219E R                 5374    C               JMP     V_RET                           ; RETURN TO CALLER
1D64                            5375    C U6:                                                   ; SET-CURSOR-INC
1D64  FE C6                     5376    C               INC     DH                              ; NEXT ROW
1D66                            5377    C U7:                                                   ; SET-CURSOR
1D66  B4 02                     5378    C               MOV     AH,2
1D68  EB F4                     5379    C               JMP     U4                              ; ESTABLISH THE NEW CURSOR
                                5380    C
                                5381    C ;----- BACK SPACE FOUND
                                5382    C
1D6A                            5383    C U8:
1D6A  0A D2                     5384    C               OR      DL,DL                           ; ALREADY AT END OF LINE
1D6C  74 F8                     5385    C               JZ      U7                              ; SET CURSOR
1D6E  FE CA                     5386    C               DEC     DL                              ; NO -- JUST MOVE IT BACK
1D70  EB F4                     5387    C               JMP     U7                              ; SET_CURSOR
                                5388    C
                                5389    C ;----- CARRIAGE RETURN FOUND
                                5390    C
1D72                            5391    C U9:
1D72  2A D2                     5392    C               SUB     DL,DL                           ; MOVE TO FIRST COLUMN
1D74  EB F0                     5393    C               JMP     U7                              ; SET_CURSOR
                                5394    C
                                5395    C ;----- LINE FEED FOUND
                                5396    C
1D76                            5397    C U10:
1D76  3A 36 0484 R              5398    C               CMP     DH,ROWS                         ; BOTTOM OF SCREEN
1D7A  75 E8                     5399    C               JNE     U6                              ; YES, SCROLL THE SCREEN
1D7C  EB BB                     5400    C               JMP     U1                              ; NO, JUST SET THE CURSOR
                                5401    C
                                5402    C ;----- BELL FOUND
                                5403    C
1D7E                            5404    C U11:
1D7E  B3 02                     5405    C               MOV     BL,2                            ; SET UP COUNT FOR BEEP
1D80  E8 0D20 R                 5406    C               CALL    BEEP                            ; SOUND THE POD BELL
1D83  EB DB                     5407    C               JMP     U5                              ; TTY_RETURN
                                5408    C
                                5409    C
                                5410    C ;----- CURRENT VIDEO STATE
                                5411    C
1D85                            5412    C AHF:
                                5413    C               ASSUME  DS:ABS0
1D85  8A 26 044A R              5414    C               MOV     AH,BYTE PTR CRT_COLS            ; GET NUMBER OF COLUMNS
1D89  8A 3E 0462 R              5415    C               MOV     BH,ACTIVE_PAGE
1D8D  A0 0487 R                 5416    C               MOV     AL,INFO
1D90  24 80                     5417    C               AND     AL,080H
1D92  0A 06 0449 R              5418    C               OR      AL,CRT_MODE
```

```
1D96  5F                      5419  C           POP     DI
1D97  5E                      5420  C           POP     SI
1D98  59                      5421  C           POP     CX                              ; DISCARD BX
1D99  59                      5422  C           POP     CX
1D9A  5A                      5423  C           POP     DX
1D9B  1F                      5424  C           POP     DS
1D9C  07                      5425  C           POP     ES
1D9D  5D                      5426  C           POP     BP
1D9E  CF                      5427  C           IRET
                              5428  C
                              5429  C           SUBTTL
                              5430
                              5431
1D9F                          5432      PAL_SET PROC    NEAR
1D9F  50                      5433              PUSH    AX
1DA0  E8 0D05 R               5434              CALL    WHAT_BASE
1DA3  FA                      5435              CLI
1DA4                          5436      VR:
1DA4  EC                      5437              IN      AL,DX
1DA5  A8 08                   5438              TEST    AL,08H                          ; VERTICAL RETRACE
1DA7  74 FB                   5439              JZ      VR
1DA9  58                      5440              POP     AX
1DAA  B2 C0                   5441              MOV     DL,ATTR_WRITE
1DAC  86 C4                   5442              XCHG    AL,AH
1DAE  EE                      5443              OUT     DX,AL
1DAF  86 C4                   5444              XCHG    AL,AH
1DB1  EE                      5445              OUT     DX,AL
1DB2  B0 20                   5446              MOV     AL,020H
1DB4  EE                      5447              OUT     DX,AL
1DB5  FB                      5448              STI
1DB6  C3                      5449              RET
1DB7                          5450      PAL_SET ENDP
                              5451
1DB7                          5452      PAL_ON  PROC    NEAR
1DB7  E8 1DC0 R               5453              CALL    PAL_INIT
1DBA  B2 C0                   5454              MOV     DL,ATTR_WRITE
1DBC  B0 20                   5455              MOV     AL,020H
1DBE  EE                      5456              OUT     DX,AL
1DBF  C3                      5457              RET
1DC0                          5458      PAL_ON  ENDP
                              5459
1DC0                          5460      PAL_INIT        PROC    NEAR
1DC0  E8 0D05 R               5461              CALL    WHAT_BASE
1DC3  EC                      5462              IN      AL,DX
1DC4  C3                      5463              RET
1DC5                          5464      PAL_INIT        ENDP
                              5465
                              5466      ;----- SET PALETTE REGISTERS
                              5467
1DC5                          5468      AH10:
                              5469              ASSUME  DS:ABS0
1DC5  F6 06 0487 R 02         5470              TEST    INFO,2
1DCA  75 07                   5471              JNZ     BM_OK                           ; IN MONOCHROME MODE
                              5472
                              5473      ;----- HERE THE EGA IS IN A COLOR MODE
                              5474
1DCC  80 3E 0463 R B4         5475              CMP     BYTE PTR ADDR_6845,0B4H
1DD1  74 33                   5476              JE      BM_OUT
1DD3                          5477      BM_OK:
1DD3  8A E0                   5478              MOV     AH,AL
1DD5  0A E4                   5479              OR      AH,AH
1DD7  75 30                   5480              JNZ     BM_1
                              5481
                              5482      ;----- SET INDIVIDUAL REGISTER
                              5483
1DD9  2B ED                   5484              SUB     BP,BP
1DDB  C4 3E 04A8 R            5485              LES     DI,SAVE_PTR
1DDF  83 C7 04                5486              ADD     DI,4
1DE2  26: C4 3D               5487              LES     DI,DWORD PTR ES:[DI]
1DE5  8C C0                   5488              MOV     AX,ES
1DE7  0B C7                   5489              OR      AX,DI
1DE9  74 01                   5490              JZ      TLO_1
1DEB  45                      5491              INC     BP
1DEC                          5492      TLO_1:
                              5493
1DEC  E8 1DC0 R               5494              CALL    PAL_INIT
1DEF  8A E3                   5495              MOV     AH,BL
1DF1  8A C7                   5496              MOV     AL,BH
1DF3  E8 1D9F R               5497              CALL    PAL_SET
1DF6  E8 1DB7 R               5498              CALL    PAL_ON
1DF9  0B ED                   5499              OR      BP,BP
1DFB  74 09                   5500              JZ      BM_OUT
1DFD  8A C7                   5501              MOV     AL,BH
1DFF  2A FF                   5502              SUB     BH,BH
1E01  03 FB                   5503              ADD     DI,BX
1E03  26: 88 05               5504              MOV     ES:[DI],AL
1E06                          5505      BM_OUT:
1E06  E9 219E R               5506              JMP     V_RET
                              5507
1E09                          5508      BM_1:
1E09  FE CC                   5509              DEC     AH
1E0B  75 2D                   5510              JNZ     BM_2
                              5511
1E0D  2B ED                   5512              SUB     BP,BP
1E0F  C4 3E 04A8 R            5513              LES     DI,SAVE_PTR
1E13  83 C7 04                5514              ADD     DI,4
1E16  26: C4 3D               5515              LES     DI,DWORD PTR ES:[DI]
1E19  8C C0                   5516              MOV     AX,ES
1E1B  0B C7                   5517              OR      AX,DI
1E1D  74 01                   5518              JZ      TLO_2
1E1F  45                      5519              INC     BP
1E20                          5520      TLO_2:
                              5521
                              5522      ;----- SET OVERSCAN REGISTER
                              5523
1E20  E8 1DC0 R               5524              CALL    PAL_INIT
1E23  B4 11                   5525              MOV     AH,011H
1E25  8A C7                   5526              MOV     AL,BH
1E27  E8 1D9F R               5527              CALL    PAL_SET
1E2A  E8 1DB7 R               5528              CALL    PAL_ON
                              5529
1E2D  0B ED                   5530              OR      BP,BP
1E2F  74 D5                   5531              JZ      BM_OUT
1E31  83 C7 11                5532              ADD     DI,011H
1E34  26: 88 3D               5533              MOV     ES:[DI],BH
                              5534
1E37  E9 219E R               5535              JMP     V_RET
                              5536
1E3A                          5537      BM_2:
1E3A  FE CC                   5538              DEC     AH
1E3C  75 40                   5539              JNZ     BM_3
                              5540
                              5541      ;----- SET 16 PALETTE REGISTERS AND OVERSCAN REGISTER
                              5542
1E3E  1E                      5543              PUSH    DS
1E3F  06                      5544              PUSH    ES
```

```
1E40  C4 3E 04A8 R          5545
1E44  83 C7 04              5546                    LES     DI,SAVE_PTR
1E47  26: C4 3D             5547                    ADD     DI,4
1E4A  8C C0                 5548                    LES     DI,DWORD PTR ES:[DI]            ; ES:DI PTR TO PAL SAVE AREA
1E4C  0B C7                 5549                    MOV     AX,ES
1E4E  74 09                 5550                    OR      AX,DI
                            5551                    JZ      TLO_3
                            5552
1E50  1F                    5553                    POP     DS                              ; PARAMETER ES
1E51  1E                    5554                    PUSH    DS
1E52  8B F2                 5555                    MOV     SI,DX                           ; PARAMETER OFFSET
1E54  B9 0011               5556                    MOV     CX,17D
1E57  F3/ A4                5557            REP     MOVSB
                            5558
1E59                        5559            TLO_3:
1E59  07                    5560                    POP     ES
1E5A  1F                    5561                    POP     DS
                            5562
1E5B  8B DA                 5563                    MOV     BX,DX
1E5D  E8 1DC0 R             5564                    CALL    PAL_INIT
1E60  2A E4                 5565                    SUB     AH,AH
1E62                        5566            BM_2A:
1E62  26: 8A 07             5567                    MOV     AL,ES:[BX]
1E65  E8 1D9F R             5568                    CALL    PAL_SET
1E68  FE C4                 5569                    INC     AH
1E6A  43                    5570                    INC     BX
1E6B  80 FC 10              5571                    CMP     AH,010H
1E6E  72 F2                 5572                    JB      BM_2A
1E70  FE C4                 5573                    INC     AH
1E72  26: 8A 07             5574                    MOV     AL,ES:[BX]
1E75  E8 1D9F R             5575                    CALL    PAL_SET
1E78  E8 1DB7 R             5576                    CALL    PAL_ON
1E7B  E9 219E R             5577                    JMP     V_RET
                            5578
1E7E                        5579            BM_3:
1E7E  FE CC                 5580                    DEC     AH
1E80  75 29                 5581                    JNZ     BM_4
                            5582
                            5583            ;----- TOGGLE INTENSIFY/BLINKING BIT
                            5584
1E82  53                    5585                    PUSH    BX
1E83  E8 0D5A R             5586                    CALL    MAKE_BASE
1E86  83 C3 33              5587                    ADD     BX,OTOH + LN_4
1E89  26: 8A 07             5588                    MOV     AL,ES:[BX]
1E8C  5B                    5589                    POP     BX
                            5590
1E8D  0A DB                 5591                    OR      BL,BL
1E8F  75 0A                 5592                    JNZ     BM_6
                            5593
                            5594            ;----- ENABLE INTENSIFY
                            5595
1E91  80 26 0465 R DF       5596                    AND     CRT_MODE_SET,11011111B
1E96  24 F7                 5597                    AND     AL,0F7H
1E98  EB 0C 90              5598                    JMP     BM_7
1E9B                        5599            BM_6:
1E9B  FE CB                 5600                    DEC     BL
1E9D  75 07                 5601                    JNZ     BM_7
                            5602
                            5603            ;----- ENABLE BLINK
                            5604
1E9F  80 0E 0465 R 20       5605                    OR      CRT_MODE_SET,020H
1EA4  0C 08                 5606                    OR      AL,08H
1EA6                        5607            BM_7:
1EA6  B4 10                 5608                    MOV     AH,P_MODE
1EA8  E8 1D9F R             5609                    CALL    PAL_SET
1EAB                        5610            BM_4:
1EAB  E9 219E R             5611                    JMP     V_RET
                            5612
                            5613    C               INCLUDE         VCHGEN.INC
                            5614    C               SUBTTL          VCHGEN.INC
                            5615    C               PAGE
                            5616    C       ;--------------------------------------------------
                            5617    C       ; ENTRY                                          :
                            5618    C       ;       AL = 0  USER SPECIFIED FONT              :
                            5619    C       ;            1  8 X 14 FONT                      :
                            5620    C       ;            2  8 X 8 DOUBLE DOT                 :
                            5621    C       ;       BL = BLOCK TO LOAD                       :
                            5622    C       ;--------------------------------------------------
1EAE                        5623    C       CH_GEN:
1EAE  50                    5624    C               PUSH    AX                              ; SAVE THE INVOLVED REGS
1EAF  55                    5625    C               PUSH    BP
1EB0  53                    5626    C               PUSH    BX
1EB1  51                    5627    C               PUSH    CX
1EB2  52                    5628    C               PUSH    DX
1EB3  06                    5629    C               PUSH    ES
                            5630    C
                            5631    C               ASSUME  DS:ABS0
1EB4  E8 0CFE R             5632    C               CALL    DDS                             ; SET DATA SEGMENT
1EB7  A0 0449 R             5633    C               MOV     AL,CRT_MODE                     ; GET THE CURRENT MODE
1EBA  50                    5634    C               PUSH    AX                              ; SAVE IT
1EBB  3C 07                 5635    C               CMP     AL,7                            ; IS THIS MONOCHROME
1EBD  74 07                 5636    C               JE      H14                             ; MONOCHROME VALUES
1EBF  C6 06 0449 R 0B       5637    C               MOV     CRT_MODE,0BH                    ; COLOR VALUES
1EC4  EB 05                 5638    C               JMP     SHORT H15                       ; SKIP
1EC6                        5639    C       H14:
1EC6  C6 06 0449 R 0C       5640    C               MOV     CRT_MODE,0CH                    ; MONOCHROME VALUES
1ECB                        5641    C       H15:
1ECB  E8 0DAB R             5642    C               CALL    SET_REGS
1ECE  E8 0CFE R             5643    C               CALL    DDS                             ; RESET THE DATA SEGMENT
1ED1  58                    5644    C               POP     AX                              ; RECOVER OLD MODE VALUE
1ED2  A2 0449 R             5645    C               MOV     CRT_MODE,AL                     ; RETURN TO LOW MEMORY
                            5646    C
1ED5  07                    5647    C               POP     ES                              ; RESTORE REGS THAT WERE
1ED6  5A                    5648    C               POP     DX                              ;  USED BY THE MODE SET
1ED7  59                    5649    C               POP     CX                              ;  ROUTINES
1ED8  5B                    5650    C               POP     BX
1ED9  5D                    5651    C               POP     BP
1EDA  58                    5652    C               POP     AX
                            5653    C
1EDB  0A C0                 5654    C               OR      AL,AL                           ; SET FLAGS
1EDD  74 17                 5655    C               JZ      DO_MAP2                         ; USER SPECIFIED FONT
1EDF  0E                    5656    C               PUSH    CS                              ; SET SEGMENT TO
1EE0  07                    5657    C               POP     ES                              ;  THIS MODULE
1EE1  2B D2                 5658    C               SUB     DX,DX                           ; ZERO OUT START OFFSET
1EE3  B9 0100               5659    C               MOV     CX,0256D                        ; CHAR COUNT (FULL SET)
1EE6  FE C8                 5660    C               DEC     AL                              ; WHICH PARAMETER
1EE8  75 07                 5661    C               JNZ     H7                              ; MUST BE ONE
1EEA  B7 0E                 5662    C               MOV     BH,014D                         ; BYTES PER CHARACTER
1EEC  BD 0000 E             5663    C               MOV     BP,OFFSET CGMN                  ; 8 X 14 TABLE OFFSET
1EEF  EB 05                 5664    C               JMP     SHORT DO_MAP2                   ; STORE IT
1EF1                        5665    C       H7:
1EF1  B7 08                 5666    C               MOV     BH,8                            ; 8 X 8 FONT
1EF3  BD 0000 E             5667    C               MOV     BP,OFFSET CGDDOT                ; ROM 8 X 8 DOUBLE DOT
                            5668    C
                            5669    C       ;--------------------------------------------------
                            5670    C       ; ALPHA CHARACTER GENERATOR LOAD                 :
```

```
                        5671     C  ;                                                    :
                        5672     C  ; ENTRY                                            :
                        5673     C  ;        ES:BP - POINTER TO TABLE                  :
                        5674     C  ;        CX    - COUNT OF CHARS                    :
                        5675     C  ;        DX    - CHAR COUNT OFFSET INTO MAP 2      :
                        5676     C  ;        BH    - BYTES PER CHARACTER               :
                        5677     C  ;        BL    - MAP 2 BLOCK TO LOAD               :
                        5678     C  ;-------------------------------------------------
1EF6                    5679     C  DO_MAP2:
1EF6  06                5680     C          PUSH    ES                                ; FONT TABLE SEGMENT
1EF7  1F                5681     C          POP     DS                                ; ADDRESSING TO TABLE
1EF8  52                5682     C          PUSH    DX                                ; SAVE REGISTER
                        5683     C          SRLOAD  ES,0A000H                         ; ADDRESSING TO MAP 2
1EF9  BA A000           5684     C+         MOV     DX,0A000H
1EFC  8E C2             5685     C+         MOV     ES,DX
1EFE  5A                5686     C          POP     DX                                ; RECOVER REGISTER
1EFF  51                5687     C          PUSH    CX                                ; MULTIPLY BY 020H SINCE
1F00  B1 05             5688     C          MOV     CL,5                              ;  MAXIMUM BYTES PER
1F02  D3 E2             5689     C          SHL     DX,CL                             ;  CHARACTER IS 32D=020H
1F04  59                5690     C          POP     CX                                ; RECOVER
1F05  0A DB             5691     C          OR      BL,BL                             ; WHICH 16K BLOCK TO LOAD
1F07  74 08             5692     C          JZ      H3                                ; BLOCK ZERO
1F09                    5693     C  H4:
1F09  81 C2 4000        5694     C          ADD     DX,04000H                         ; INCREMENT TO NEXT BLOCK
1F0D  FE CB             5695     C          DEC     BL                                ; ANY MORE
1F0F  75 F8             5696     C          JNZ     H4                                ; DO ANOTHER
1F11                    5697     C  H3:
1F11  8A C7             5698     C          MOV     AL,BH                             ; BYTES PER CHARACTER
1F13  2A E4             5699     C          SUB     AH,AH                             ; ZERO
1F15  8B FA             5700     C          MOV     DI,DX                             ; OFFSET INTO MAP
1F17  8B F5             5701     C          MOV     SI,BP                             ; OFFSET INTO TABLE
1F19  E3 0D             5702     C          JCXZ    LD_OVER                           ; CHARACTER COUNT
1F1B                    5703     C  LD:
1F1B  51                5704     C          PUSH    CX                                ; SAVE CHARACTER COUNT
1F1C  8B C8             5705     C          MOV     CX,AX                             ; ONE ENTIRE CHARACTER
1F1E  F3/ A4            5706     C          REP     MOVSB                             ;  AT A TIME
1F20  2B F8             5707     C          SUB     DI,AX                             ; ADJUST OFFSET
1F22  83 C7 20          5708     C          ADD     DI,020H                           ; NEXT CHARACTER POSITION
1F25  59                5709     C          POP     CX                                ; RECOVER CHARACTER COUNT
1F26  E2 F3             5710     C          LOOP    LD                                ; DO THE REST
1F28                    5711     C  LD_OVER:
1F28  C3                5712     C          RET
                        5713     C
1F29                    5714     C  BRK_1:
                        5715     C          ASSUME  DS:ABS0
1F29  E8 0CFE R         5716     C          CALL    DDS                               ; SET LOW MEMORY SEGMENT
1F2C  A3 0485 R         5717     C          MOV     POINTS,AX                         ; GET BYTES/CHARACTER
1F2F  8B 16 0463 R      5718     C          MOV     DX,ADDR_6845                      ; CRTC REGISTER
1F33  80 3E 0449 R 07   5719     C          CMP     CRT_MODE,7
1F38  75 05             5720     C          JNE     H11A
1F3A  B4 14             5721     C          MOV     AH,C_UNDERLN_LOC                  ; R14H
1F3C  E8 0D15 R         5722     C          CALL    OUT_DX                            ; SET THE UNDERLINE LOC
1F3F                    5723     C  H11A:
1F3F  FE C8             5724     C          DEC     AL                                ; POINTS - 1
1F41  B4 09             5725     C          MOV     AH,C_MAX_SCAN_LN                  ; R09H
1F43  E8 0D15 R         5726     C          CALL    OUT_DX                            ; SET THE CHARACTER HEIGHT
1F46  FE C8             5727     C          DEC     AL                                ; POINTS - 2
                        5728     C
1F48  8A E8             5729     C          MOV     CH,AL                             ; CURSOR START
1F4A  8A C8             5730     C          MOV     CL,AL                             ; CURSOR END
1F4C  FE C1             5731     C          INC     CL                                ; ADJUST END
1F4E  B4 01             5732     C          MOV     AH,1                              ; SET C_TYPE BIOS CALL
1F50  CD 10             5733     C          INT     10H                               ; SET THE CURSOR
                        5734     C
1F52  8A 1E 0449 R      5735     C          MOV     BL,CRT_MODE                       ; GET THE CURRENT MODE
1F56  BB 015E           5736     C          MOV     AX,350D                           ; MAX SCANS ON SCREEN
1F59  80 FB 03          5737     C          CMP     BL,3                              ; 640X200 ALPHA MODES
1F5C  77 08             5738     C          JA      H11                               ; MUST BE 350
1F5E  E8 0E9A R         5739     C          CALL    BRST_DET
1F61  72 03             5740     C          JC      H11
1F63  B8 00C8           5741     C          MOV     AX,200D                           ; SET FOR 200
1F66                    5742     C  H11:
1F66  99                5743     C          CWD                                       ; PREPARE TO DIVIDE
1F67  F7 36 0485 R      5744     C          DIV     POINTS                            ; MAX ROWS ON SCREEN
1F6B  48                5745     C          DEC     AX                                ; ADJUST
1F6C  A2 0484 R         5746     C          MOV     ROWS,AL                           ; SAVE ROWS
1F6F  FE C0             5747     C          INC     AL                                ; READJUST
1F71  2A E4             5748     C          SUB     AH,AH                             ; CLEAR
1F73  F7 26 0485 R      5749     C          MUL     POINTS                            ; ROWS*BYTES/CHAR
1F77  48                5750     C          DEC     AX                                ; ADJUST
1F78  8B 16 0463 R      5751     C          MOV     DX,ADDR_6845                      ; CRTC ADDRESS
1F7C  B4 12             5752     C          MOV     AH,C_VRT_DSP_END                  ; SCANS DISPLAYED
1F7E  E8 0D15 R         5753     C          CALL    OUT_DX                            ; SET IT
1F81  A0 0484 R         5754     C          MOV     AL,ROWS                           ; GET CHARACTER ROWS
1F84  FE C0             5755     C          INC     AL                                ; ADJUST
1F86  F6 26 044A R      5756     C          MUL     BYTE PTR CRT_COLS                 ; ROWS*COLUMNS
1F8A  D1 E0             5757     C          SHL     AX,1                              ; *2 FOR ALPHA MODE
1F8C  05 0100           5758     C          ADD     AX,256D                           ; SPACE BETWEEN PAGES
1F8F  A3 044C R         5759     C          MOV     CRT_LEN,AX                        ; BYTES PER PAGE
1F92  E8 0E96 R         5760     C          CALL    PH_5                              ; VIDEO ON
1F95  E9 219E R         5761     C          JMP     V_RET                             ; RETURN TO CALLER
                        5762     C
                        5763     C  ;----- LOADABLE CHARACTER GENERATOR ROUTINES
                        5764     C
1F98                    5765     C  AH11:
1F98  3C 10             5766     C          CMP     AL,010H                           ; CHECK PARAMETER
1F9A  73 37             5767     C          JAE     AH11_ALPHA1                       ; NEXT STAGE
                        5768     C
                        5769     C  ;----- ALPHA MODE ACTIVITY HERE
                        5770     C
1F9C  3C 03             5771     C          CMP     AL,03H                            ; RANGE CHECK
1F9E  73 17             5772     C          JAE     H1                                ; NEXT STAGE
1FA0  E8 1EAE R         5773     C          CALL    CH_GEN                            ; SET THE CHAR GEN
1FA3  E8 0DAB R         5774     C          CALL    SET_REGS
1FA6  E8 0E96 R         5775     C          CALL    PH_5                              ; VIDEO ON
                        5776     C          ASSUME  DS:ABS0
1FA9  E8 0CFE R         5777     C          CALL    DDS                               ; SET THE DATA SEGMENT
1FAC  8B 0E 0460 R      5778     C          MOV     CX,CURSOR_MODE                    ; GET THE MODE
1FB0  B4 01             5779     C          MOV     AH,1                              ; SET C_TYPE
1FB2  CD 10             5780     C          INT     10H                               ; EMULATE CORRECT CURSOR
1FB4  E9 219E R         5781     C          JMP     V_RET                             ; RETURN TO CALLER
                        5782     C
                        5783     C  ;----- SET THE CHARACTER GENERATOR BLOCK SELECT REGISTER
                        5784     C
1FB7                    5785     C  H1:
1FB7  75 17             5786     C          JNE     H2                                ; NOT IN RANGE
1FB9  B6 03             5787     C          MOV     DH,3
1FBB  B2 C4             5788     C          MOV     DL,SEQ_ADDR                       ; SEQUENCER
                        5789     C
1FBD  B8 0001           5790     C          MOV     AX,1                              ; AH=S_RESET, AL=1
1FC0  E8 0D15 R         5791     C          CALL    OUT_DX
                        5792     C
1FC3  B4 03             5793     C          MOV     AH,S_CGEN                         ; CHAR BLOCK REGISTER
1FC5  8A C3             5794     C          MOV     AL,BL                             ; GET THE VALUE
1FC7  E8 0D15 R         5795     C          CALL    OUT_DX                            ; SET IT
                        5796     C
```

```
1FCA  B8 0003                 5797     C              MOV     AX,3                            ; AH=S_RESET, AL=3
1FCD  E8 0D15 R               5798     C              CALL    OUT_DX
1FD0                          5799     C  H2:
1FD0  E9 219E R               5800     C              JMP     V_RET                           ; RETURN TO CALLER
                              5801     C
1FD3                          5802     C  AH11_ALPHA1:
                              5803     C              ASSUME  DS:ABS0
1FD3  3C 20                   5804     C              CMP     AL,020H
1FD5  73 26                   5805     C              JAE     AH11_GRAPHICS
                              5806     C
                              5807     C  ;----- ALPHA MODE ACTIVITY HERE
                              5808     C
1FD7  2C 10                   5809     C              SUB     AL,010H                         ; ADJUST TO 0 - N
1FD9  3C 02                   5810     C              CMP     AL,02H                          ; RANGE CHECK
1FDB  77 F3                   5811     C              JA      H2                              ; INVALID CALL
1FDD  50                      5812     C              PUSH    AX                              ; SAVE
1FDE  53                      5813     C              PUSH    BX
1FDF  E8 1EAE R               5814     C              CALL    CH_GEN                          ; LOAD THE CHAR GEN
1FE2  E8 0DAB R               5815     C              CALL    SET_REGS
1FE5  5B                      5816     C              POP     BX
1FE6  58                      5817     C              POP     AX                              ; RESTORE
1FE7  8A E0                   5818     C              MOV     AH,AL                           ; CALLING PARAMETER
1FE9  0A E4                   5819     C              OR      AH,AH                           ; USER MODE
1FEB  8A C7                   5820     C              MOV     AL,BH
1FED  74 09                   5821     C              JZ      H13                             ; DO NOT SET BYTES/CHAR
1FEF  B0 08                   5822     C              MOV     AL,8                            ; 8 X 8 FONT
1FF1  80 FC 01                5823     C              CMP     AH,1                            ; IS THE CALL FOR MONOC
1FF4  75 02                   5824     C              JNE     H13                             ; NO, LEAVE IT AT 8
1FF6  B0 0E                   5825     C              MOV     AL,14D                          ; MONOC SET
1FF8                          5826     C  H13:
1FF8  2A E4                   5827     C              SUB     AH,AH                           ; CLEAR UPPER BYTE
1FFA  E9 1F29 R               5828     C              JMP     BRK_1                           ; CONTINUE
                              5829     C
                              5830     C  ;----- GRAPHICS MODE ACTIVITY HERE
                              5831     C
1FFD                          5832     C  AH11_GRAPHICS:
                              5833     C              ASSUME  DS:ABS0
1FFD  3C 30                   5834     C              CMP     AL,030H
1FFF  73 6A                   5835     C              JAE     AH11_INFORM
2001  2C 20                   5836     C              SUB     AL,020H
2003  75 11                   5837     C              JNZ     F10
                              5838     C
                              5839     C  ;----- COMPATIBILITY, UPPER HALF GRAPHICS CHARACTER SET
                              5840     C
                              5841     C              ASSUME  DS:ABS0
                              5842     C              SRLOAD  DS,0
2005  2B D2                   5843     C+             SUB     DX,DX
2007  8E DA                   5844     C+             MOV     DS,DX
2009  FA                      5845     C              CLI
200A  89 2E 007C R            5846     C              MOV     WORD PTR EXT_PTR , BP
200E  8C 06 007E R            5847     C              MOV     WORD PTR EXT_PTR + 2 , ES
2012  FB                      5848     C              STI
2013                          5849     C  F11:
2013  E9 219E R               5850     C              JMP     V_RET
2016                          5851     C  F10:
                              5852     C              ASSUME  DS:ABS0
2016  52                      5853     C              PUSH    DX
                              5854     C              SRLOAD  DS,0
2017  2B D2                   5855     C+             SUB     DX,DX
2019  8E DA                   5856     C+             MOV     DS,DX
201B  5A                      5857     C              POP     DX
201C  3C 03                   5858     C              CMP     AL,03H                          ; RANGE CHECK
201E  77 F3                   5859     C              JA      F11
2020  FE C8                   5860     C              DEC     AL
2022  74 14                   5861     C              JZ      F19
2024  0E                      5862     C              PUSH    CS
2025  07                      5863     C              POP     ES
2026  FE C8                   5864     C              DEC     AL
2028  75 08                   5865     C              JNZ     F13
202A  B9 000E                 5866     C              MOV     CX,14D
202D  BD 0000 E               5867     C              MOV     BP,OFFSET CGMN                  ; ROM 8 X 14 CHARACTER SET
2030  EB 06                   5868     C              JMP     SHORT F19
2032                          5869     C  F13:
2032  B9 0008                 5870     C              MOV     CX,8
2035  BD 0000 E               5871     C              MOV     BP,OFFSET CGDDOT                ; ROM 8 X 8 DOUBLE DOT
2038                          5872     C  F19:
2038  FA                      5873     C              CLI
2039  89 2E 010C R            5874     C              MOV     WORD PTR GRX_SET , BP
203D  8C 06 010E R            5875     C              MOV     WORD PTR GRX_SET + 2 , ES
2041  FB                      5876     C              STI
                              5877     C              ASSUME  DS:ABS0
2042  E8 0CFE R               5878     C              CALL    DDS
2045  89 0E 0485 R            5879     C              MOV     POINTS,CX
2049  8A C3                   5880     C              MOV     AL,BL
204B  BB 2067 R               5881     C              MOV     BX,OFFSET RT
204E  0A C0                   5882     C              OR      AL,AL
2050  75 05                   5883     C              JNZ     DR_3
2052  8A C2                   5884     C              MOV     AL,DL
2054  EB 09 90                5885     C              JMP     DR_1
2057                          5886     C  DR_3:
2057  3C 03                   5887     C              CMP     AL,3
2059  76 02                   5888     C              JBE     DR_2
205B  B0 02                   5889     C              MOV     AL,2
205D                          5890     C  DR_2:
205D  2E: D7                  5891     C              XLAT    CS:RT
205F                          5892     C  DR_1:
205F  FE C8                   5893     C              DEC     AL
2061  A2 0484 R               5894     C              MOV     ROWS,AL
2064  E9 219E R               5895     C              JMP     V_RET
                              5896     C
2067                          5897     C  RT          LABEL   BYTE
2067  00 0E 19 2B             5898     C              DB      00D,14D,25D,43D
                              5899     C
                              5900     C
                              5901     C  ;----- INFORMATION RETURN DONE HERE
                              5902     C
206B                          5903     C  AH11_INFORM:
                              5904     C              ASSUME  DS:ABS0
206B  3C 30                   5905     C              CMP     AL,030H
206D  74 03                   5906     C              JE      F6
206F                          5907     C  F5:
206F  E9 219E R               5908     C              JMP     V_RET
2072                          5909     C  F6:
2072  8B 0E 0485 R            5910     C              MOV     CX,POINTS
2076  8A 16 0484 R            5911     C              MOV     DL,ROWS
207A  80 FF 07                5912     C              CMP     BH,7
207D  77 F0                   5913     C              JA      F5
207F  80 FF 01                5914     C              CMP     BH,1
2082  77 18                   5915     C              JA      F7
                              5916     C
                              5917     C              ASSUME  DS:ABS0
2084  52                      5918     C              PUSH    DX
                              5919     C              SRLOAD  DS,0
2085  2B D2                   5920     C+             SUB     DX,DX
2087  8E DA                   5921     C+             MOV     DS,DX
2089  5A                      5922     C              POP     DX
```

```
208A  0A FF                   5923  C           OR      BH,BH
208C  75 07                   5924  C           JNZ     F9
208E  C4 2E 007C R            5925  C           LES     BP,EXT_PTR
2092  EB 1A 90                5926  C           JMP     INFORM_OUT
2095                          5927  C   F9:
2095  C4 2E 010C R            5928  C           LES     BP,GRX_SET
2099  EB 13 90                5929  C           JMP     INFORM_OUT
                              5930  C
                              5931  C   ;----- HANDLE BH = 2  THRU  BH = 5 HERE  RETURN ROM TABLE POINTERS
                              5932  C
209C                          5933  C   F7:
                              5934  C           ASSUME  DS:ABS0
209C  80 EF 02                5935  C           SUB     BH,2
209F  8A DF                   5936  C           MOV     BL,BH
20A1  2A FF                   5937  C           SUB     BH,BH
20A3  D1 E3                   5938  C           SAL     BX,1
20A5  81 C3 20B7 R            5939  C           ADD     BX,OFFSET TBL_5
20A9  2E: 8B 2F               5940  C           MOV     BP,CS:[BX]
20AC  0E                      5941  C           PUSH    CS
20AD  07                      5942  C           POP     ES
                              5943  C
20AE                          5944  C   INFORM_OUT:
20AE  5F                      5945  C           POP     DI
20AF  5E                      5946  C           POP     SI
20B0  5B                      5947  C           POP     BX
20B1  58                      5948  C           POP     AX                              ; DISCARD SAVED CX
20B2  58                      5949  C           POP     AX                              ; DISCARD SAVED DX
20B3  1F                      5950  C           POP     DS
20B4  58                      5951  C           POP     AX                              ; DISCARD SAVED ES
20B5  58                      5952  C           POP     AX                              ; DISCARD SAVED BP
20B6  CF                      5953  C           IRET
                              5954  C
                              5955  C   ;----- TABLE OF CHARACTER GENERATOR OFFSETS
                              5956  C
20B7                          5957  C   TBL_5   LABEL   WORD
20B7  0000 E                  5958  C           DW      OFFSET  CGMN
20B9  0000 E                  5959  C           DW      OFFSET  CGDDOT
20BB  0000 E                  5960  C           DW      OFFSET  INT_1F_1
20BD  0000 E                  5961  C           DW      OFFSET  CGMN_FDG
                              5962  C
                              5963  C           SUBTTL
                              5964
                              5965      ;----- ALTERNATE SELECT
                              5966
20BF                          5967      AH12:
                              5968              ASSUME  DS:ABS0
20BF  80 FB 10                5969              CMP     BL,010H                         ; RETURN ACTIVE CALL
20C2  72 51                   5970              JB      ACT_1
20C4  74 1B                   5971              JE      ACT_3
20C6  80 FB 20                5972              CMP     BL,020H                         ; ALTERNATE PRINT SCREEN
20C9  74 03                   5973              JE      ACT_2
20CB  E9 219E R               5974              JMP     V_RET                           ; INVALID CALL
20CE                          5975      ACT_2:                                          ; NEW PRINT SCREEN
                              5976              SRLOAD  DS,0
20CE  2B D2                   5977  +           SUB     DX,DX
20D0  8E DA                   5978  +           MOV     DS,DX
20D2  FA                      5979              CLI
20D3  C7 06 0014 R 21A7 R     5980              MOV     WORD PTR INT5_PTR, OFFSET PRINT_SCREEN
20D9  8C 0E 0016 R            5981              MOV     WORD PTR INT5_PTR+2, CS
20DD  FB                      5982              STI
20DE  E9 219E R               5983              JMP     V_RET
20E1                          5984      ACT_3:
20E1  8A 3E 0487 R            5985              MOV     BH,INFO                         ; LOOKING FOR MONOC BIT
20E5  80 E7 02                5986              AND     BH,2                            ; ISOLATE
20E8  D0 EF                   5987              SHR     BH,1                            ; ADJUST
                              5988
20EA  A0 0487 R               5989              MOV     AL,INFO                         ; LOOKING FOR MEMORY
20ED  24 60                   5990              AND     AL,01100000B                    ; MEMORY BITS
20EF  B1 05                   5991              MOV     CL,5                            ; SHIFT COUNT
20F1  D2 E8                   5992              SHR     AL,CL                           ; ADJUST MEM VALUE
20F3  8A D8                   5993              MOV     BL,AL                           ; RETURN REGISTER
                              5994
20F5  8A 0E 0488 R            5995              MOV     CL,INFO_3                       ; FEATURE/SWITCH
20F9  8A E9                   5996              MOV     CH,CL                           ; DUPLICATE IN CH
20FB  80 E1 0F                5997              AND     CL,0FH                          ; MASK OFF SWITCH VALUE
20FE  D0 ED                   5998              SHR     CH,1                            ; MOVE FEATURE VALUE
2100  D0 ED                   5999              SHR     CH,1
2102  D0 ED                   6000              SHR     CH,1
2104  D0 ED                   6001              SHR     CH,1
2106  80 E5 0F                6002              AND     CH,0FH                          ; MASK IT
                              6003
2109  5F                      6004              POP     DI
210A  5E                      6005              POP     SI
210B  5A                      6006              POP     DX                              ; DISCARD BX
210C  5A                      6007              POP     DX                              ; DISCARD CX
210D  5A                      6008              POP     DX
210E  1F                      6009              POP     DS
210F  07                      6010              POP     ES
2110  5D                      6011              POP     BP
2111  CF                      6012              IRET
2112                          6013      AH12_X:
2112  E9 219E R               6014              JMP     V_RET                           ; RETURN TO CALLER
2115                          6015      ACT_1:
2115                          6016      STR_OUTZ:
2115  E9 219E R               6017              JMP     V_RET                           ; RETURN TO CALLER
                              6018
                              6019      ;----- WRITE STRING
                              6020
2118                          6021      AH13:
2118  3C 04                   6022              CMP     AL,04                           ; RANGE CHECK
211A  73 F9                   6023              JAE     STR_OUTZ                        ; INVALID PARAMETER
211C  E3 F7                   6024              JCXZ    STR_OUTZ
211E  53                      6025              PUSH    BX                              ; SAVE REGISTER
211F  8A DF                   6026              MOV     BL,BH                           ; GET PAGE TO LOW BYTE
2121  2A FF                   6027              SUB     BH,BH
2123  D1 E3                   6028              SAL     BX,1                            ; *2 FOR WORD OFFSET
2125  8B B7 0450 R            6029              MOV     SI,[BX + OFFSET CURSOR_POSN]    ; GET CURSOR POSITION
2129  5B                      6030              POP     BX                              ; RESTORE
212A  56                      6031              PUSH    SI                              ; CURRENT VALUE ON STACK
                              6032
212B  50                      6033              PUSH    AX
212C  B8 0200                 6034              MOV     AX,0200H                        ; SET THE CURSOR POSITION
212F  CD 10                   6035              INT     10H
2131  58                      6036              POP     AX
2132                          6037      STR_1:
2132  51                      6038              PUSH    CX
2133  53                      6039              PUSH    BX
2134  50                      6040              PUSH    AX
2135  86 E0                   6041              XCHG    AH,AL
2137  26: 8A 46 00            6042              MOV     AL,ES:[BP]                      ; GET THE CHAR TO WRITE
213B  45                      6043              INC     BP
213C  3C 0D                   6044              CMP     AL,0DH                          ; CARRIAGE RETURN
213E  74 3D                   6045              JE      STR_CR_LF
2140  3C 0A                   6046              CMP     AL,0AH                          ; LINE FEED
2142  74 39                   6047              JE      STR_CR_LF
2144  3C 08                   6048              CMP     AL,08H                          ; BACKSPACE
```

```
2146  74 35                  6049                  JE      STR_CR_LF
2148  3C 07                  6050                  CMP     AL,07H                          ; BELL
214A  74 31                  6051                  JE      STR_CR_LF
214C  B9 0001                6052                  MOV     CX,1                            ; COUNT OF CHARACTERS
214F  80 FC 02               6053                  CMP     AH,2                            ; CHECK WHERE ATTR IS
2152  72 05                  6054                  JB      DO_STR                          ; NOT IN THE STRING
2154  26: 8A 5E 00           6055                  MOV     BL,ES:[BP]                      ; GET THE ATTRIBUTE
2158  45                     6056                  INC     BP                              ; NEXT ITEM IN STRING
2159                         6057          DO_STR:
2159  B4 09                  6058                  MOV     AH,09H                          ; WRITE THE CHAR/ATTR
215B  CD 10                  6059                  INT     10H
215D  FE C2                  6060                  INC     DL                              ; NEXT CURSOR POSITION
215F  3A 16 044A R           6061                  CMP     DL,BYTE PTR CRT_COLS            ; COLUMN OVERFLOW
2163  72 11                  6062                  JB      STR_2                           ; NOT YET
2165  3A 36 0484 R           6063                  CMP     DH,ROWS
2169  75 07                  6064                  JNE     STR_3
216B  B8 0E0A                6065                  MOV     AX,0E0AH
216E  CD 10                  6066                  INT     10H
2170  FE CE                  6067                  DEC     DH
2172                         6068          STR_3:
2172  FE C6                  6069                  INC     DH                              ; NEXT ROW
2174  2A D2                  6070                  SUB     DL,DL                           ; COLUMN ZERO
2176                         6071          STR_2:
2176  B8 0200                6072                  MOV     AX,0200H                        ; SET THE CURSOR
2179  CD 10                  6073                  INT     10H
217B  EB 0E                  6074                  JMP     SHORT   STR_4
217D                         6075          STR_CR_LF:
217D  B4 0E                  6076                  MOV     AH,0EH
217F  CD 10                  6077                  INT     10H
2181  8A DF                  6078                  MOV     BL,BH                           ; GET PAGE TO LOW BYTE
2183  2A FF                  6079                  SUB     BH,BH
2185  D1 E3                  6080                  SAL     BX,1                            ; *2 FOR WORD OFFSET
2187  8B 97 0450 R           6081                  MOV     DX,[BX + OFFSET CURSOR_POSN]    ; GET CURSOR POSITION
218B                         6082          STR_4:
218B  58                     6083                  POP     AX
218C  5B                     6084                  POP     BX
218D  59                     6085                  POP     CX
218E  E2 A2                  6086                  LOOP    STR_1
                             6087
2190  5A                     6088                  POP     DX                              ; RECOVER CURSOR POSITION
                             6089                                                          ;  FROM PUSH SI ABOVE
2191  3C 01                  6090                  CMP     AL,1
2193  74 09                  6091                  JE      STR_OUT
2195  3C 03                  6092                  CMP     AL,3
2197  74 05                  6093                  JE      STR_OUT
2199  B8 0200                6094                  MOV     AX,0200H                        ; SET CURSOR POSITION
219C  CD 10                  6095                  INT     10H
219E                         6096          STR_OUT:
                             6097                                                          ; ALLOW FALL THROUGH
                             6098
                             6099
219E                         6100          V_RET   PROC    NEAR                            ; VIDEO BIOS RETURN
219E  5F                     6101                  POP     DI
219F  5E                     6102                  POP     SI
21A0  5B                     6103                  POP     BX
21A1  59                     6104                  POP     CX
21A2  5A                     6105                  POP     DX
21A3  1F                     6106                  POP     DS
21A4  07                     6107                  POP     ES
21A5  5D                     6108                  POP     BP
21A6  CF                     6109                  IRET
21A7                         6110          V_RET   ENDP
                             6111
21A7                         6112          COMBO_VIDEO     ENDP
                             6113
                             6114  C               INCLUDE         VPRSC.INC
                             6115  C               SUBTTL  VPRSC.INC
                             6116  C               PAGE
                             6117  C       ;--------------------------------------------------------------------
                             6118  C       ;    INTERRUPT 5                                                   :
                             6119  C       ;       THIS LOGIC WILL BE INVOKED BY INTERRUPT 05H TO PRINT THE    :
                             6120  C       ;       SCREEN. THE CURSOR POSITION AT THE TIME THIS ROUTINE IS INVOKED :
                             6121  C       ;       WILL BE SAVED AND RESTORED UPON COMPLETION. THE ROUTINE IS   :
                             6122  C       ;       INTENDED TO RUN WITH INTERRUPTS ENABLED. IF A SUBSEQUENT     :
                             6123  C       ;       'PRINT SCREEN' KEY IS DEPRESSED DURING THE TIME THIS ROUTINE :
                             6124  C       ;       IS PRINTING IT WILL BE IGNORED.                              :
                             6125  C       ;       ADDRESS 50:0 CONTAINS THE STATUS OF THE PRINT SCREEN:        :
                             6126  C       ;                                                                    :
                             6127  C       ;       50:0    =0      EITHER PRINT SCREEN HAS NOT BEEN CALLED      :
                             6128  C       ;                       OR UPON RETURN FROM A CALL THIS INDICATES    :
                             6129  C       ;                       A SUCCESSFUL OPERATION.                      :
                             6130  C       ;               =1      PRINT SCREEN IS IN PROGRESS                  :
                             6131  C       ;               =255    ERROR ENCOUNTERED DURING PRINTING            :
                             6132  C       ;--------------------------------------------------------------------
                             6133  C               ASSUME  CS:CODE,DS:ABS0
21A7                         6134  C       PRINT_SCREEN    PROC    FAR
21A7  FB                     6135  C               STI                             ; MUST RUN WITH INTS ENABLED
21A8  1E                     6136  C               PUSH    DS                      ; MUST USE 50:0 FOR DATA
21A9  50                     6137  C               PUSH    AX                      ;  AREA STORAGE
21AA  53                     6138  C               PUSH    BX
21AB  51                     6139  C               PUSH    CX                      ; USE THIS LATER FOR CURSOR LIMITS
21AC  52                     6140  C               PUSH    DX                      ; WILL HOLD CURRENT CURSOR POS
21AD  E8 0CFE R              6141  C               CALL    DDS
21B0  80 3E 0500 R 01        6142  C               CMP     STATUS_BYTE,1           ; SEE IF PRINT ALREADY IN PROGRESS
21B5  74 63                  6143  C               JZ      EXIT                    ; JUMP IF PRINT IN PROGRESS
21B7  C6 06 0500 R 01        6144  C               MOV     STATUS_BYTE,1           ; INDICATE PRINT NOW IN PROGRESS
21BC  B4 0F                  6145  C               MOV     AH,15                   ; WILL REQUEST THE CURRENT MODE
21BE  CD 10                  6146  C               INT     10H                     ;       [AL]=MODE (NOT USED)
                             6147  C                                               ;       [AH]=NUMBER COLUMNS/LINE
                             6148  C                                               ;       [BH]=VISUAL PAGE
                             6149  C       ;--------------------------------------------------------
                             6150  C       ;       AT THIS POINT WE KNOW THE COLUMNS/LINE ARE IN        :
                             6151  C       ;       [AX] AND THE PAGE IF APPLICABLE IS IN [BH]. THE STACK :
                             6152  C       ;       HAS DS,AX,BX,CX,DX PUSHED. [AL] HAS VIDEO MODE       :
                             6153  C       ;--------------------------------------------------------
21C0  8A CC                  6154  C               MOV     CL,AH                   ; WILL MAKE USE OF [CX] REG TO
21C2  8A 2E 0484 R           6155  C               MOV     CH,ROWS                 ; CONTROL ROW & COLUMNS
21C6  FE C5                  6156  C               INC     CH                      ; ADJUST
21C8  E8 2220 R              6157  C               CALL    CRLF                    ; CAR RETURN LINE FEED ROUTINE
21CB  51                     6158  C               PUSH    CX                      ; SAVE SCREEN BOUNDS
21CC  B4 03                  6159  C               MOV     AH,3                    ; WILL NOW READ THE CURSOR.
21CE  CD 10                  6160  C               INT     10H                     ; AND PRESERVE THE POSITION
21D0  59                     6161  C               POP     CX                      ; RECALL SCREEN BOUNDS
21D1  52                     6162  C               PUSH    DX                      ; RECALL [BH]=VISUAL PAGE
21D2  33 D2                  6163  C               XOR     DX,DX                   ; SET CURSOR POSITION TO [0,0]
                             6164  C       ;--------------------------------------------------------
                             6165  C       ;       THE LOOP FROM PRI10 TO THE INSTRUCTION PRIOR TO PRI20 :
                             6166  C       ;       IS THE LOOP TO READ EACH CURSOR POSITION FROM THE     :
                             6167  C       ;       SCREEN AND PRINT.                                    :
                             6168  C       ;--------------------------------------------------------
21D4                         6169  C       PRI10:
21D4  B4 02                  6170  C               MOV     AH,2                    ; TO INDICATE CURSOR SET REQUEST
21D6  CD 10                  6171  C               INT     10H                     ; NEW CURSOR POS ESTABLISHED
21D8  B4 08                  6172  C               MOV     AH,8                    ; TO INDICATE READ CHARACTER
21DA  CD 10                  6173  C               INT     10H                     ; CHARACTER NOW IN [AL]
21DC  0A C0                  6174  C               OR      AL,AL                   ; SEE IF VALID CHAR
```

```
21DE  75 02                    6175  C          JNZ     PRI15                   ; JUMP IF VALID CHAR
21E0  B0 20                    6176  C          MOV     AL,' '                  ; MAKE A BLANK
21E2                           6177  C  PRI15:
21E2  52                       6178  C          PUSH    DX                      ; SAVE CURSOR POSITION
21E3  33 D2                    6179  C          XOR     DX,DX                   ; INDICATE PRINTER 1
21E5  32 E4                    6180  C          XOR     AH,AH                   ; TO INDICATE PRINT CHAR IN [AL]
21E7  CD 17                    6181  C          INT     17H                     ; PRINT THE CHARACTER
21E9  5A                       6182  C          POP     DX                      ; RECALL CURSOR POSITION
21EA  F6 C4 29                 6183  C          TEST    AH,029H                 ; TEST FOR PRINTER ERROR
21ED  75 21                    6184  C          JNZ     ERR10                   ; JUMP IF ERROR DETECTED
21EF  FE C2                    6185  C          INC     DL                      ; ADVANCE TO NEXT COLUMN
21F1  3A CA                    6186  C          CMP     CL,DL                   ; SEE IF AT END OF LINE
21F3  75 DF                    6187  C          JNZ     PRI10                   ; IF NOT PROCEED
21F5  32 D2                    6188  C          XOR     DL,DL                   ; BACK TO COLUMN 0
21F7  8A E2                    6189  C          MOV     AH,DL                   ; [AH]=0
21F9  52                       6190  C          PUSH    DX                      ; SAVE NEW CURSOR POSITION
21FA  E8 2220 R                6191  C          CALL    CRLF                    ; LINE FEED CARRIAGE RETURN
21FD  5A                       6192  C          POP     DX                      ; RECALL CURSOR POSITION
21FE  FE C6                    6193  C          INC     DH                      ; ADVANCE TO NEXT LINE
2200  3A EE                    6194  C          CMP     CH,DH                   ; FINISHED?
2202  75 D0                    6195  C          JNZ     PRI10                   ; IF NOT CONTINUE
                               6196  C
2204  5A                       6197  C          POP     DX                      ; RECALL CURSOR POSITION
2205  B4 02                    6198  C          MOV     AH,2                    ; TO INDICATE CURSOR SET REQUEST
2207  CD 10                    6199  C          INT     10H                     ; CURSOR POSITION RESTORED
2209  C6 06 0500 R 00          6200  C          MOV     STATUS_BYTE,0           ; INDICATE FINISHED
220E  EB 0A                    6201  C          JMP     SHORT EXIT              ; EXIT THE ROUTINE
2210                           6202  C  ERR10:
2210  5A                       6203  C          POP     DX                      ; GET CURSOR POSITION
2211  B4 02                    6204  C          MOV     AH,2                    ; TO REQUEST CURSOR SET
2213  CD 10                    6205  C          INT     10H                     ; CURSOR POSITION RESTORED
2215  C6 06 0500 R FF          6206  C          MOV     STATUS_BYTE,0FFH        ; INDICATE ERROR
221A                           6207  C  EXIT:                                  ;
221A  5A                       6208  C          POP     DX                      ; RESTORE ALL THE REGISTERS USED
221B  59                       6209  C          POP     CX
221C  5B                       6210  C          POP     BX
221D  58                       6211  C          POP     AX
221E  1F                       6212  C          POP     DS
221F  CF                       6213  C          IRET
2220                           6214  C  PRINT_SCREEN    ENDP
                               6215  C
                               6216  C  ;------ CARRIAGE RETURN, LINE FEED SUBROUTINE
                               6217  C
2220                           6218  C  CRLF    PROC    NEAR
2220  33 D2                    6219  C          XOR     DX,DX                   ; PRINTER 0
2222  32 E4                    6220  C          XOR     AH,AH                   ; WILL NOW SEND INITIAL CR, LF
                               6221  C                                          ; TO PRINTER
2224  B0 0D                    6222  C          MOV     AL,0DH                  ; CR
2226  CD 17                    6223  C          INT     17H                     ; SEND THE LINE FEED
2228  32 E4                    6224  C          XOR     AH,AH                   ; NOW FOR THE CR
222A  B0 0A                    6225  C          MOV     AL,0AH                  ; LF
222C  CD 17                    6226  C          INT     17H                     ; SEND THE CARRIAGE RETURN
222E  C3                       6227  C          RET
222F                           6228  C  CRLF    ENDP
                               6229  C
                               6230  C          SUBTTL
                               6231
222F                           6232       CODE    ENDS
                               6233               END
```

```
                                1
                                2          PAGE,120
                                3          SUBTTL  MONOCHROME CHARACTER GENERATOR
0000                            4  CODE    SEGMENT PUBLIC
                                5          PUBLIC  CGMN
0000                            6  CGMN    LABEL   BYTE
                                7                                                  ; BW 8*14 PATTTERN
0000  00 00 00 00 00 00 00      8          DB      000H,000H,000H,000H,000H,000H,000H,000H ; TOP_HALF_00
      00 00
0008  00 00 00 00 00 00 00      9          DB      000H,000H,000H,000H,000H,000H,000H      ; BOTTOM_HALF 00
000E  00 00 7E 81 A5 81        10          DB      000H,000H,07EH,081H,0A5H,081H,081H,0BDH ; TH_01
      81 BD
0016  99 81 7E 00 00 00 00     11          DB      099H,081H,07EH,000H,000H,000H           ; BT_01
001C  00 00 7E FF DB FF        12          DB      000H,000H,07EH,0FFH,0DBH,0FFH,0FFH,0C3H ; TH_02
      FF C3
0024  E7 FF 7E 00 00 00 00     13          DB      0E7H,0FFH,07EH,000H,000H,000H           ; BT_02
002A  00 00 00 6C FE FE        14          DB      000H,000H,000H,06CH,0FEH,0FEH,0FEH,0FEH ; TH_03
      FE FE
0032  7C 38 10 00 00 00 00     15          DB      07CH,038H,010H,000H,000H,000H           ; BT_03
0038  00 00 00 10 38 7C        16          DB      000H,000H,000H,010H,038H,07CH,0FEH,07CH ; TH_04
      FE 7C
0040  38 10 00 00 00 00 00     17          DB      038H,010H,000H,000H,000H,000H           ; BT_04
0046  00 00 18 3C 3C E7        18          DB      000H,000H,018H,03CH,03CH,0E7H,0E7H,0E7H ; TH_05
      E7 E7
004E  18 18 3C 00 00 00 00     19          DB      018H,018H,03CH,000H,000H,000H           ; BT_05
0054  00 00 18 3C 7E FF        20          DB      000H,000H,018H,03CH,07EH,0FFH,0FFH,07EH ; TH_06
      FF 7E
005C  18 18 3C 00 00 00 00     21          DB      018H,018H,03CH,000H,000H,000H           ; BT_06
0062  00 00 00 00 00 18        22          DB      000H,000H,000H,000H,000H,018H,03CH,03CH ; TH_07
      3C 3C
006A  18 00 00 00 00 00 00     23          DB      018H,000H,000H,000H,000H,000H           ; BT_07
0070  FF FF FF FF FF E7        24          DB      0FFH,0FFH,0FFH,0FFH,0FFH,0E7H,0C3H,0C3H ; TH_08
      C3 C3
0078  E7 FF FF FF FF FF        25          DB      0E7H,0FFH,0FFH,0FFH,0FFH,0FFH           ; BT_08
007E  00 00 00 00 3C 66        26          DB      000H,000H,000H,000H,03CH,066H,042H,042H ; TH_09
      42 42
0086  66 3C 00 00 00 00 00     27          DB      066H,03CH,000H,000H,000H,000H           ; BT_09
008C  FF FF FF FF C3 99        28          DB      0FFH,0FFH,0FFH,0FFH,0C3H,099H,0BDH,0BDH ; TH_0A
      BD BD
0094  99 C3 FF FF FF FF        29          DB      099H,0C3H,0FFH,0FFH,0FFH,0FFH           ; BT_0A
009A  00 00 1E 0E 1A 32        30          DB      000H,000H,01EH,00EH,01AH,032H,078H,0CCH ; TH_0B
      78 CC
00A2  CC CC 78 00 00 00 00     31          DB      0CCH,0CCH,078H,000H,000H,000H           ; BT_0B
00A8  00 00 3C 66 66 66        32          DB      000H,000H,03CH,066H,066H,066H,03CH,018H ; TH_0C
      3C 18
00B0  7E 18 18 00 00 00 00     33          DB      07EH,018H,018H,000H,000H,000H           ; BT_0C
00B6  00 00 3F 33 3F 30        34          DB      000H,000H,03FH,033H,03FH,030H,030H,030H ; TH_0D
      30 30
00BE  70 F0 E0 00 00 00 00     35          DB      070H,0F0H,0E0H,000H,000H,000H           ; BT_0D
00C4  00 00 7F 63 7F 63        36          DB      000H,000H,07FH,063H,07FH,063H,063H,063H ; TH_0E
      63 63
00CC  67 E7 E6 C0 00 00 00     37          DB      067H,0E7H,0E6H,0C0H,000H,000H           ; BT_0E
00D2  00 00 18 18 DB 3C        38          DB      000H,000H,018H,018H,0DBH,03CH,0E7H,03CH ; TH_0F
      E7 3C
00DA  DB 18 18 00 00 00 00     39          DB      0DBH,018H,018H,000H,000H,000H           ; BT_0F
                               40
00E0  00 00 80 C0 E0 F8        41          DB      000H,000H,080H,0C0H,0E0H,0F8H,0FEH,0F8H ; TH_10
      FE F8
00E8  E0 C0 80 00 00 00 00     42          DB      0E0H,0C0H,080H,000H,000H,000H           ; BT_10
00EE  00 00 02 06 0E 3E        43          DB      000H,000H,002H,006H,00EH,03EH,0FEH,03EH ; TH_11
      FE 3E
00F6  0E 06 02 00 00 00 00     44          DB      00EH,006H,002H,000H,000H,000H           ; BT_11
00FC  00 00 18 3C 7E 18        45          DB      000H,000H,018H,03CH,07EH,018H,018H,018H ; TH_12
      18 18
0104  7E 3C 18 00 00 00 00     46          DB      07EH,03CH,018H,000H,000H,000H           ; BT_12
010A  00 00 66 66 66 66        47          DB      000H,000H,066H,066H,066H,066H,066H,066H ; TH-13
```

```
                66 66                                                66
0112            00 66 66 00 00 00 00                                 67          DB      000H,066H,066H,000H,000H,000H                   ; BT_13
0118            00 00 7F DB DB DB                                    68          DB      000H,000H,07FH,0DBH,0DBH,0DBH,07BH,01BH ; TH_14
                7B 1B                                                69
0120            1B 1B 1B 00 00 00 00                                 70          DB      01BH,01BH,01BH,000H,000H,000H                   ; BT_14
0126            00 7C C6 60 38 6C                                    71          DB      000H,07CH,0C6H,060H,038H,06CH,0C6H,0C6H ; TH_15
                C6 C6                                                72
012E            6C 38 0C C6 7C 00 00                                 73          DB      06CH,038H,00CH,0C6H,07CH,000H                   ; BT_15
0134            00 00 00 00 00 00 00                                 74          DB      000H,000H,000H,000H,000H,000H,000H,000H ; TH_16
                00 00                                                75
013C            FE FE FE 00 00 00 00                                 76          DB      0FEH,0FEH,0FEH,000H,000H,000H                   ; BT_16
0142            00 00 18 3C 7E 18                                    77          DB      000H,000H,018H,03CH,07EH,018H,018H,018H ; TH_17
                18 18                                                78
014A            7E 3C 18 7E 00 00 00                                 79          DB      07EH,03CH,018H,07EH,000H,000H                   ; BT_17
0150            00 00 18 3C 7E 18                                    80          DB      000H,000H,018H,03CH,07EH,018H,018H,018H ; TH_18
                18 18                                                81
0158            18 18 18 00 00 00 00                                 82          DB      018H,018H,018H,000H,000H,000H                   ; BT_18
015E            00 00 18 18 18 18                                    83          DB      000H,000H,018H,018H,018H,018H,018H,018H ; TH_19
                18 18                                                84
0166            7E 3C 18 00 00 00 00                                 85          DB      07EH,03CH,018H,000H,000H,000H                   ; BT_19
016C            00 00 00 00 18 0C                                    86          DB      000H,000H,000H,000H,018H,00CH,0FEH,00CH ; TH_1A
                FE 0C                                                87
0174            18 00 00 00 00 00 00                                 88          DB      018H,000H,000H,000H,000H,000H                   ; BT_1A
017A            00 00 00 00 30 60                                    89          DB      000H,000H,000H,000H,030H,060H,0FEH,060H ; TH_1B
                FE 60                                                90
0182            30 00 00 00 00 00 00                                 91          DB      030H,000H,000H,000H,000H,000H                   ; BT_1B
0188            00 00 00 00 00 C0                                    92          DB      000H,000H,000H,000H,000H,0C0H,0C0H,0C0H ; TH_1C
                C0 C0                                                93
0190            FE 00 00 00 00 00 00                                 94          DB      0FEH,000H,000H,000H,000H,000H                   ; BT_1C
0196            00 00 00 00 28 6C                                    95          DB      000H,000H,000H,000H,028H,06CH,0FEH,06CH ; TH_1D
                FE 6C                                                96
019E            28 00 00 00 00 00 00                                 97          DB      028H,000H,000H,000H,000H,000H                   ; BT_1D
01A4            00 00 00 10 38 38                                    98          DB      000H,000H,000H,010H,038H,038H,07CH,07CH ; TH_1E
                7C 7C                                                99
01AC            FE FE 00 00 00 00 00                                 100         DB      0FEH,0FEH,000H,000H,000H,000H                   ; BT_1E
01B2            00 00 00 FE FE 7C                                    101         DB      000H,000H,000H,0FEH,0FEH,07CH,07CH,038H ; TH_1F
                7C 38                                                102
01BA            38 10 00 00 00 00 00                                 103         DB      038H,010H,000H,000H,000H,000H                   ; BT_1F
                                                                     104
01C0            00 00 00 00 00 00 00                                 105         DB      000H,000H,000H,000H,000H,000H,000H,000H ; TH_20 SP
                00 00                                                106
01C8            00 00 00 00 00 00 00                                 107         DB      000H,000H,000H,000H,000H,000H                   ; BT_20 SP
01CE            00 00 18 3C 3C 3C                                    108         DB      000H,000H,018H,03CH,03CH,03CH,018H,018H ; TH_21 !
                18 18                                                109
01D6            00 18 18 00 00 00 00                                 110         DB      000H,018H,018H,000H,000H,000H                   ; BT_21 !
01DC            00 00 66 66 66 24 00                                 111         DB      000H,066H,066H,066H,024H,000H,000H,000H ; TH_22 "
                00 00                                                112
01E4            00 00 00 00 00 00 00                                 113         DB      000H,000H,000H,000H,000H,000H                   ; BT_22 "
01EA            00 00 6C 6C FE 6C                                    114         DB      000H,000H,06CH,06CH,0FEH,06CH,06CH,06CH ; TH_23 #
                6C 6C                                                115
01F2            FE 6C 6C 00 00 00 00                                 116         DB      0FEH,06CH,06CH,000H,000H,000H                   ; BT_23 #
01F8            18 18 7C C6 C2 C0                                    117         DB      018H,018H,07CH,0C6H,0C2H,0C0H,07CH,006H ; TH_24 $
                7C 06                                                118
0200            86 C6 7C 18 18 00                                    119         DB      086H,0C6H,07CH,018H,018H,000H                   ; BT_24 $
0206            00 00 00 00 C2 C6                                    120         DB      000H,000H,000H,000H,0C2H,0C6H,00CH,018H ; TH_25 '%'
                0C 18                                                121
020E            30 66 C6 00 00 00 00                                 122         DB      030H,066H,0C6H,000H,000H,000H                   ; BT_25 '%'
0214            00 00 38 6C 6C 38                                    123         DB      000H,000H,038H,06CH,06CH,038H,076H,0DCH ; TH_26 &
                76 DC                                                124
021C            CC CC 76 00 00 00 00                                 125         DB      0CCH,0CCH,076H,000H,000H,000H                   ; BT_26 &
0222            00 30 30 30 60 00                                    126         DB      000H,030H,030H,030H,060H,000H,000H,000H ; TH_27 '
                00 00                                                127
022A            00 00 00 00 00 00 00                                 128         DB      000H,000H,000H,000H,000H,000H                   ; BT 27 '
0230            00 00 0C 18 30 30                                    129         DB      000H,000H,00CH,018H,030H,030H,030H,030H ; TH_28 (
                30 30                                                130
0238            30 18 0C 00 00 00 00                                 131         DB      030H,018H,00CH,000H,000H,000H                   ; BT_28 (
023E            00 00 30 18 0C 0C                                    132         DB      000H,000H,030H,018H,00CH,00CH,00CH,00CH ; TH_29 )
                0C 0C                                                133
0246            0C 18 30 00 00 00 00                                 134         DB      00CH,018H,030H,000H,000H,000H                   ; BT_29 )
024C            00 00 00 00 00 66 3C                                 135         DB      000H,000H,000H,000H,066H,03CH,0FFH,03CH ; TH_2A *
                FF 3C                                                136
0254            66 00 00 00 00 00 00                                 137         DB      066H,000H,000H,000H,000H,000H                   ; BT_2A *
025A            00 00 00 00 18 18                                    138         DB      000H,000H,000H,000H,018H,018H,07EH,018H ; TH_2B +
                7E 18                                                139
0262            18 00 00 00 00 00 00                                 140         DB      018H,000H,000H,000H,000H,000H                   ; BT_2B +
0268            00 00 00 00 00 00                                    141         DB      000H,000H,000H,000H,000H,000H,000H,000H ; TH_2C ,
                00 00                                                142
0270            18 18 18 30 00 00 00                                 143         DB      018H,018H,018H,030H,000H,000H                   ; BT_2C ,
0276            00 00 00 00 00 00                                    144         DB      000H,000H,000H,000H,000H,000H,0FEH,000H ; TH_2D -
                FE 00                                                145
027E            00 00 00 00 00 00 00                                 146         DB      000H,000H,000H,000H,000H,000H                   ; BT_2D -
0284            00 00 00 00 00 00 00                                 147         DB      000H,000H,000H,000H,000H,000H,000H,000H ; TH_2E .
                00 00                                                148
028C            00 18 18 00 00 00 00                                 149         DB      000H,018H,018H,000H,000H,000H                   ; BT_2E .
0292            00 00 02 06 0C 18                                    150         DB      000H,000H,002H,006H,00CH,018H,030H,060H ; TH_2F /
                30 60                                                151
029A            C0 80 00 00 00 00 00                                 152         DB      0C0H,080H,000H,000H,000H,000H                   ; BT_2F /
                                                                     153
02A0            00 00 7C C6 CE DE                                    154         DB      000H,000H,07CH,0C6H,0CEH,0DEH,0F6H,0E6H ; TH_30 0
                F6 E6                                                155
02A8            C6 C6 7C 00 00 00 00                                 156         DB      0C6H,0C6H,07CH,000H,000H,000H                   ; BT_30 0
02AE            00 00 18 38 78 18                                    157         DB      000H,000H,018H,038H,078H,018H,018H,018H ; TH_31 1
                18 18                                                158
02B6            18 18 7E 00 00 00 00                                 159         DB      018H,018H,07EH,000H,000H,000H                   ; BT_31 1
02BC            00 00 7C C6 06 0C                                    160         DB      000H,000H,07CH,0C6H,006H,00CH,018H,030H ; TH_32 2
                18 30                                                161
02C4            60 C6 FE 00 00 00 00                                 162         DB      060H,0C6H,0FEH,000H,000H,000H                   ; BT_32 2
02CA            00 00 7C C6 06 06                                    163         DB      000H,000H,07CH,0C6H,006H,006H,03CH,006H ; TH_33 3
                3C 06                                                164
02D2            06 C6 7C 00 00 00 00                                 165         DB      006H,0C6H,07CH,000H,000H,000H                   ; BT_33 3
02D8            00 00 0C 1C 3C 6C                                    166         DB      000H,000H,00CH,01CH,03CH,06CH,0CCH,0FEH ; TH_34 4
                CC FE                                                167
02E0            0C 0C 1E 00 00 00 00                                 168         DB      00CH,00CH,01EH,000H,000H,000H                   ; BT_34 4
02E6            00 00 FE C0 C0 C0                                    169         DB      000H,000H,0FEH,0C0H,0C0H,0C0H,0FCH,006H ; TH_35 5
                FC 06                                                170
02EE            06 C6 7C 00 00 00 00                                 171         DB      006H,0C6H,07CH,000H,000H,000H                   ; BT_35 5
02F4            00 00 38 60 C0 C0                                    172         DB      000H,000H,038H,060H,0C0H,0C0H,0FCH,0C6H ; TH_36 6
                FC C6                                                173
02FC            C6 C6 7C 00 00 00 00                                 174         DB      0C6H,0C6H,07CH,000H,000H,000H                   ; BT_36 6
0302            00 00 FE C6 06 0C                                    175         DB      000H,000H,0FEH,0C6H,006H,00CH,018H,030H ; TH_37 7
                18 30                                                176
030A            30 30 30 00 00 00 00                                 177         DB      030H,030H,030H,000H,000H,000H                   ; BT_37 7
0310            00 00 7C C6 C6 C6                                    178         DB      000H,000H,07CH,0C6H,0C6H,0C6H,07CH,0C6H ; TH_38 8
                7C C6                                                179
0318            C6 C6 7C 00 00 00 00                                 180         DB      0C6H,0C6H,07CH,000H,000H,000H                   ; BT_38 8
031E            00 00 7C C6 C6 C6                                    181         DB      000H,000H,07CH,0C6H,0C6H,0C6H,07EH,006H ; TH_39 9
                7E 06                                                182
0326            06 0C 78 00 00 00 00                                 183         DB      006H,00CH,078H,000H,000H,000H                   ; BT_39 9
032C            00 00 00 18 18 00                                    184         DB      000H,000H,000H,018H,018H,000H,000H,000H ; TH_3A :
                00 00                                                185
0334            18 18 00 00 00 00 00                                 186         DB      018H,018H,000H,000H,000H,000H                   ; BT_3A :
033A            00 00 00 18 18 00                                    187         DB      000H,000H,000H,018H,018H,000H,000H,000H ; TH_3B ;
                00 00                                                188
0342            18 18 30 00 00 00 00                                 189         DB      018H,018H,030H,000H,000H,000H                   ; BT_3B ;
0348            00 00 06 0C 18 30                                    190         DB      000H,000H,006H,00CH,018H,030H,060H,030H ; TH_3C <
                60 30                                                191
```

```
0350  18 0C 06 00 00 00          192          DB      018H,00CH,006H,000H,000H,000H           ; BT_3C <
0356  00 00 00 00 00 7E          193          DB      000H,000H,000H,000H,000H,07EH,000H,000H ; TH_3D =
      00 00                      194
035E  7E 00 00 00 00 00          195          DB      07EH,000H,000H,000H,000H,000H           ; BT_3D =
0364  00 00 60 30 18 0C          196          DB      000H,000H,060H,030H,018H,00CH,006H,00CH ; TH_3E >
      06 0C                      197
036C  18 30 60 00 00 00          198          DB      018H,030H,060H,000H,000H,000H           ; BT_3E >
0372  00 00 7C C6 C6 0C          199          DB      000H,000H,07CH,0C6H,0C6H,00CH,018H,018H ; TH_3F ?
      18 18                      200
037A  00 18 18 00 00 00          201          DB      000H,018H,018H,000H,000H,000H           ; BT_3F ?
                                 202
0380  00 00 7C C6 C6 DE          203          DB      000H,000H,07CH,0C6H,0C6H,0DEH,0DEH,0DEH ; TH_40 @
      DE DE                      204
0388  DC C0 7C 00 00 00          205          DB      0DCH,0C0H,07CH,000H,000H,000H           ; BT_40 @
038E  00 00 10 38 6C C6          206          DB      000H,000H,010H,038H,06CH,0C6H,0C6H,0FEH ; TH_41 A
      C6 FE                      207
0396  C6 C6 C6 00 00 00          208          DB      0C6H,0C6H,0C6H,000H,000H,000H           ; BT_41 A
039C  00 00 FC 66 66 66          209          DB      000H,000H,0FCH,066H,066H,066H,07CH,066H ; TH_42 B
      7C 66                      210
03A4  66 66 FC 00 00 00          211          DB      066H,066H,0FCH,000H,000H,000H           ; BT_42 B
03AA  00 00 3C 66 C2 C0          212          DB      000H,000H,03CH,066H,0C2H,0C0H,0C0H,0C0H ; TH_43 C
      C0 C0                      213
03B2  C2 66 3C 00 00 00          214          DB      0C2H,066H,03CH,000H,000H,000H           ; BT_43 C
03B8  00 00 F8 6C 66 66          215          DB      000H,000H,0F8H,06CH,066H,066H,066H,066H ; TH_44 D
      66 66                      216
03C0  66 6C F8 00 00 00          217          DB      066H,06CH,0F8H,000H,000H,000H           ; BT_44 D
03C6  00 00 FE 66 62 68          218          DB      000H,000H,0FEH,066H,062H,068H,078H,068H ; TH_45 E
      78 68                      219
03CE  62 66 FE 00 00 00          220          DB      062H,066H,0FEH,000H,000H,000H           ; BT_45 E
03D4  00 00 FE 66 62 68          221          DB      000H,000H,0FEH,066H,062H,068H,078H,068H ; TH_46 F
      78 68                      222
03DC  60 60 F0 00 00 00          223          DB      060H,060H,0F0H,000H,000H,000H           ; BT_46 F
03E2  00 00 3C 66 C2 C0          224          DB      000H,000H,03CH,066H,0C2H,0C0H,0C0H,0DEH ; TH_47 G
      C0 DE                      225
03EA  C6 66 3A 00 00 00          226          DB      0C6H,066H,03AH,000H,000H,000H           ; BT_47 G
03F0  00 00 C6 C6 C6 C6          227          DB      000H,000H,0C6H,0C6H,0C6H,0C6H,0FEH,0C6H ; TH_48 H
      FE C6                      228
03F8  C6 C6 C6 00 00 00          229          DB      0C6H,0C6H,0C6H,000H,000H,000H           ; BT_48 H
03FE  00 00 3C 18 18 18          230          DB      000H,000H,03CH,018H,018H,018H,018H,018H ; TH_49 I
      18 18                      231
0406  18 18 3C 00 00 00          232          DB      018H,018H,03CH,000H,000H,000H           ; BT_49 I
040C  00 00 1E 0C 0C 0C          233          DB      000H,000H,01EH,00CH,00CH,00CH,00CH,00CH ; TH_4A J
      0C 0C                      234
0414  CC CC 78 00 00 00          235          DB      0CCH,0CCH,078H,000H,000H,000H           ; BT_4A J
041A  00 00 E6 66 6C 6C          236          DB      000H,000H,0E6H,066H,06CH,06CH,078H,06CH ; TH_4B K
      78 6C                      237
0422  6C 66 E6 00 00 00          238          DB      06CH,066H,0E6H,000H,000H,000H           ; BT_4B K
0428  00 00 F0 60 60 60          239          DB      000H,000H,0F0H,060H,060H,060H,060H,060H ; TH_4C L
      60 60                      240
0430  62 66 FE 00 00 00          241          DB      062H,066H,0FEH,000H,000H,000H           ; BT_4C L
0436  00 00 C6 EE FE FE          242          DB      000H,000H,0C6H,0EEH,0FEH,0FEH,0D6H,0C6H ; TH_4D M
      D6 C6                      243
043E  C6 C6 C6 00 00 00          244          DB      0C6H,0C6H,0C6H,000H,000H,000H           ; BT_4D M
0444  00 00 C6 E6 F6 FE          245          DB      000H,000H,0C6H,0E6H,0F6H,0FEH,0DEH,0CEH ; TH_4E N
      DE CE                      246
044C  C6 C6 C6 00 00 00          247          DB      0C6H,0C6H,0C6H,000H,000H,000H           ; BT_4E N
0452  00 00 38 6C C6 C6          248          DB      000H,000H,038H,06CH,0C6H,0C6H,0C6H,0C6H ; TH_4F O
      C6 C6                      249
045A  C6 6C 38 00 00 00          250          DB      0C6H,06CH,038H,000H,000H,000H           ; BT_4F O
                                 251
0460  00 00 FC 66 66 66          252          DB      000H,000H,0FCH,066H,066H,066H,07CH,060H ; TH_50 P
      7C 60                      253
0468  60 60 F0 00 00 00          254          DB      060H,060H,0F0H,000H,000H,000H           ; BT_50 P
046E  00 00 7C C6 C6 C6          255          DB      000H,000H,07CH,0C6H,0C6H,0C6H,0C6H,0D6H ; TH_51 Q
      C6 D6                      256
0476  DE 7C 0C 0E 00 00          257          DB      0DEH,07CH,00CH,00EH,000H,000H           ; BT_51 Q
047C  00 00 FC 66 66 66          258          DB      000H,000H,0FCH,066H,066H,066H,07CH,06CH ; TH_52 R
      7C 6C                      259
0484  66 66 E6 00 00 00          260          DB      066H,066H,0E6H,000H,000H,000H           ; BT_52 R
048A  00 00 7C C6 C6 60          261          DB      000H,000H,07CH,0C6H,0C6H,060H,038H,00CH ; TH_53 S
      38 0C                      262
0492  C6 C6 7C 00 00 00          263          DB      0C6H,0C6H,07CH,000H,000H,000H           ; BT_53 S
0498  00 00 7E 7E 5A 18          264          DB      000H,000H,07EH,07EH,05AH,018H,018H,018H ; TH_54 T
      18 18                      265
04A0  18 18 3C 00 00 00          266          DB      018H,018H,03CH,000H,000H,000H           ; BT_54 T
04A6  00 00 C6 C6 C6 C6          267          DB      000H,000H,0C6H,0C6H,0C6H,0C6H,0C6H,0C6H ; TH_55 U
      C6 C6                      268
04AE  C6 C6 7C 00 00 00          269          DB      0C6H,0C6H,07CH,000H,000H,000H           ; BT_55 U
04B4  00 00 C6 C6 C6 C6          270          DB      000H,000H,0C6H,0C6H,0C6H,0C6H,0C6H,0C6H ; TH_56 V
      C6 C6                      271
04BC  6C 38 10 00 00 00          272          DB      06CH,038H,010H,000H,000H,000H           ; BT_56 V
04C2  00 00 C6 C6 C6 C6          273          DB      000H,000H,0C6H,0C6H,0C6H,0C6H,0D6H,0D6H ; TH_57 W
      D6 D6                      274
04CA  FE 7C 6C 00 00 00          275          DB      0FEH,07CH,06CH,000H,000H,000H           ; BT_57 W
04D0  00 00 C6 C6 6C 38          276          DB      000H,000H,0C6H,0C6H,06CH,038H,038H,038H ; TH_58 X
      38 38                      277
04D8  6C C6 C6 00 00 00          278          DB      06CH,0C6H,0C6H,000H,000H,000H           ; BT_58 X
04DE  00 00 66 66 66 66          279          DB      000H,000H,066H,066H,066H,066H,03CH,018H ; TH_59 Y
      3C 18                      280
04E6  18 18 3C 00 00 00          281          DB      018H,018H,03CH,000H,000H,000H           ; BT_59 Y
04EC  00 00 FE C6 8C 18          282          DB      000H,000H,0FEH,0C6H,08CH,018H,030H,060H ; TH_5A Z
      30 60                      283
04F4  C2 C6 FE 00 00 00          284          DB      0C2H,0C6H,0FEH,000H,000H,000H           ; BT_5A Z
04FA  00 00 3C 30 30 30          285          DB      000H,000H,03CH,030H,030H,030H,030H,030H ; TH_5B [
      30 30                      286
0502  30 30 3C 00 00 00          287          DB      030H,030H,03CH,000H,000H,000H           ; BT_5B [
0508  00 00 80 C0 E0 70          288          DB      000H,000H,080H,0C0H,0E0H,070H,038H,01CH ; TH_5C
      38 1C                      289
0510  0E 06 02 00 00 00          290          DB      00EH,006H,002H,000H,000H,000H           ; BT_5C
0516  00 00 3C 0C 0C 0C          291          DB      000H,000H,03CH,00CH,00CH,00CH,00CH,00CH ; TH_5D ]
      0C 0C                      292
051E  0C 0C 3C 00 00 00          293          DB      00CH,00CH,03CH,000H,000H,000H           ; BT_5D ]
0524  10 38 6C C6 00 00          294          DB      010H,038H,06CH,0C6H,000H,000H,000H,000H ; TH_5E
      00 00                      295
052C  00 00 00 00 00 00          296          DB      000H,000H,000H,000H,000H,000H           ; BT_5E
0532  00 00 00 00 00 00          297          DB      000H,000H,000H,000H,000H,000H,000H,000H ; TH_5F _
      00 00                      298
053A  00 00 00 00 FF 00          299          DB      000H,000H,000H,000H,0FFH,000H           ; BT_5F _
                                 300
0540  30 30 18 00 00 00          301          DB      030H,030H,018H,000H,000H,000H,000H,000H ; TH_60 '
      00 00                      302
0548  00 00 00 00 00 00          303          DB      000H,000H,000H,000H,000H,000H           ; BT_60 '
054E  00 00 00 00 00 78          304          DB      000H,000H,000H,000H,000H,078H,00CH,07CH ; TH_61 LOWER_CASE A
      0C 7C                      305
0556  CC CC 76 00 00 00          306          DB      0CCH,0CCH,076H,000H,000H,000H           ; BT_61 LOWER_CASE A
055C  00 00 E0 60 60 78          307          DB      000H,000H,0E0H,060H,060H,078H,06CH,066H ; TH_62 L.C. B
      6C 66                      308
0564  66 66 7C 00 00 00          309          DB      066H,066H,07CH,000H,000H,000H           ; BT_62 L.C. B
056A  00 00 00 00 00 7C          310          DB      000H,000H,000H,000H,000H,07CH,0C6H,0C0H ; TH_63 L.C. C
      C6 C0                      311
0572  C0 C6 7C 00 00 00          312          DB      0C0H,0C6H,07CH,000H,000H,000H           ; BT_63 L.C. C
0578  00 00 1C 0C 0C 3C          313          DB      000H,000H,01CH,00CH,00CH,03CH,06CH,0CCH ; TH_64 L.C. D
      6C CC                      314
0580  CC CC 76 00 00 00          315          DB      0CCH,0CCH,076H,000H,000H,000H           ; BT_64 L.C. D
0586  00 00 00 00 00 7C          316          DB      000H,000H,000H,000H,000H,07CH,0C6H,0FEH ; TH_65 L.C. E
      C6 FE                      317
```

```
058E  C0 C6 7C 00 00 00          318          DB      0C0H,0C6H,07CH,000H,000H,000H          ; BT_65 L.C. E
0594  00 00 38 6C 64 60          319          DB      000H,000H,038H,06CH,064H,060H,0F0H,060H ; TH_66 L.C. F
      F0 60                      320
059C  60 60 F0 00 00 00          321          DB      060H,060H,0F0H,000H,000H,000H          ; BT_66 L.C. F
05A2  00 00 00 00 00 76          322          DB      000H,000H,000H,000H,000H,076H,0CCH,0CCH ; TH_67 L.C. G
      CC CC                      323
05AA  CC 7C 0C CC 78 00          324          DB      0CCH,07CH,00CH,0CCH,078H,000H          ; BT_67 L.C. G
05B0  00 00 E0 60 60 6C          325          DB      000H,000H,0E0H,060H,060H,06CH,076H,066H ; TH_68 L.C. H
      76 66                      326
05B8  66 66 E6 00 00 00          327          DB      066H,066H,0E6H,000H,000H,000H          ; BT_68 L.C. H
05BE  00 00 18 18 00 38          328          DB      000H,000H,018H,018H,000H,038H,018H,018H ; TH_69 L.C. I
      18 18                      329
05C6  18 18 3C 00 00 00          330          DB      018H,018H,03CH,000H,000H,000H          ; BT_69 L.C. I
05CC  00 00 06 06 00 0E          331          DB      000H,000H,006H,006H,000H,00EH,006H,006H ; TH_6A L.C. J
      06 06                      332
05D4  06 06 66 66 3C 00          333          DB      006H,006H,066H,066H,03CH,000H          ; BT_6A L.C. J
05DA  00 00 E0 60 60 66          334          DB      000H,000H,0E0H,060H,060H,066H,06CH,078H ; TH_6B L.C. K
      6C 78                      335
05E2  6C 66 E6 00 00 00          336          DB      06CH,066H,0E6H,000H,000H,000H          ; BT_6B L.C. K
05E8  00 00 38 18 18 18          337          DB      000H,000H,038H,018H,018H,018H,018H,018H ; TH_6C L.C. L
      18 18                      338
05F0  18 18 3C 00 00 00          339          DB      018H,018H,03CH,000H,000H,000H          ; BT_6C L.C. L
05F6  00 00 00 00 00 EC          340          DB      000H,000H,000H,000H,000H,0ECH,0FEH,0D6H ; TH_6D L.C. M
      FE D6                      341
05FE  D6 D6 C6 00 00 00          342          DB      0D6H,0D6H,0C6H,000H,000H,000H          ; BT_6D L.C. M
0604  00 00 00 00 00 DC          343          DB      000H,000H,000H,000H,000H,0DCH,066H,066H ; TH_6E L.C. N
      66 66                      344
060C  66 66 66 00 00 00          345          DB      066H,066H,066H,000H,000H,000H          ; BT_6E L.C. N
0612  00 00 00 00 00 7C          346          DB      000H,000H,000H,000H,000H,07CH,0C6H,0C6H ; TH_6F L.C. O
      C6 C6                      347
061A  C6 C6 7C 00 00 00          348          DB      0C6H,0C6H,07CH,000H,000H,000H          ; BT_6F L.C. O
                                 349
0620  00 00 00 00 00 DC          350          DB      000H,000H,000H,000H,000H,0DCH,066H,066H ; TH_70 L.C. P
      66 66                      351
0628  66 7C 60 60 F0 00          352          DB      066H,07CH,060H,060H,0F0H,000H          ; BT_70 L.C. P
062E  00 00 00 00 00 76          353          DB      000H,000H,000H,000H,000H,076H,0CCH,0CCH ; TH_71 L.C. Q
      CC CC                      354
0636  CC 7C 0C 0C 1E 00          355          DB      0CCH,07CH,00CH,00CH,01EH,000H          ; BT_71 L.C. Q
063C  00 00 00 00 00 DC          356          DB      000H,000H,000H,000H,000H,0DCH,076H,066H ; TH_72 L.C. R
      76 66                      357
0644  60 60 F0 00 00 00          358          DB      060H,060H,0F0H,000H,000H,000H          ; BT_72 L.C. R
064A  00 00 00 00 00 7C          359          DB      000H,000H,000H,000H,000H,07CH,0C6H,070H ; TH_73 L.C. S
      C6 70                      360
0652  C6 C6 7C 00 00 00          361          DB      01CH,0C6H,07CH,000H,000H,000H          ; BT_73 L.C. S
0658  00 00 10 30 30 FC          362          DB      000H,000H,010H,030H,030H,0FCH,030H,030H ; TH_74 L.C. T
      30 30                      363
0660  30 36 1C 00 00 00          364          DB      030H,036H,01CH,000H,000H,000H          ; BT_74 L.C. T
0666  00 00 00 00 00 CC          365          DB      000H,000H,000H,000H,000H,0CCH,0CCH,0CCH ; TH_75 L.C. U
      CC CC                      366
066E  CC CC 76 00 00 00          367          DB      0CCH,0CCH,076H,000H,000H,000H          ; BT_75 L.C. U
0674  00 00 00 00 00 66          368          DB      000H,000H,000H,000H,000H,066H,066H,066H ; TH_76 L.C. V
      66 66                      369
067C  66 3C 18 00 00 00          370          DB      066H,03CH,018H,000H,000H,000H          ; BT_76 L.C. V
0682  00 00 00 00 00 C6          371          DB      000H,000H,000H,000H,000H,0C6H,0D6H,0D6H ; TH_77 L.C. W
      C6 D6                      372
068A  D6 FE 6C 00 00 00          373          DB      0D6H,0FEH,06CH,000H,000H,000H          ; BT_77 L.C. W
0690  00 00 00 00 00 C6          374          DB      000H,000H,000H,000H,000H,0C6H,06CH,038H ; TH_78 L.C. X
      6C 38                      375
0698  38 6C C6 00 00 00          376          DB      038H,06CH,0C6H,000H,000H,000H          ; BT_78 L.C. X
069E  00 00 00 00 00 C6          377          DB      000H,000H,000H,000H,000H,0C6H,0C6H,0C6H ; TH_79 L.C. Y
      C6 C6                      378
06A6  C6 7E 06 0C F8 00          379          DB      0C6H,07EH,006H,00CH,0F8H,000H          ; BT_79 L.C. Y
06AC  00 00 00 00 00 FE          380          DB      000H,000H,000H,000H,000H,0FEH,0CCH,018H ; TH_7A L.C. Z
      CC 18                      381
06B4  30 66 FE 00 00 00          382          DB      030H,066H,0FEH,000H,000H,000H          ; BT_7A L.C. Z
06BA  00 00 0E 18 18 18          383          DB      000H,000H,00EH,018H,018H,018H,070H,018H ; TH_7B L BRAK
      70 18                      384
06C2  18 18 0E 00 00 00          385          DB      018H,018H,00EH,000H,000H,000H          ; BT_7B L BRAK
06C8  00 00 18 18 18 18          386          DB      000H,000H,018H,018H,018H,018H,000H,018H ; TH_7C |
      00 18                      387
06D0  18 18 18 00 00 00          388          DB      018H,018H,018H,000H,000H,000H          ; BT_7C |
06D6  00 00 70 18 18 18          389          DB      000H,000H,070H,018H,018H,018H,00EH,018H ; TH_7D R BRAK
      0E 18                      390
06DE  18 18 70 00 00 00          391          DB      018H,018H,070H,000H,000H,000H          ; BT_7D R BRAK
06E4  00 00 76 DC 00 00          392          DB      000H,000H,076H,0DCH,000H,000H,000H,000H ; TH_7E TILDE
      00 00                      393
06EC  00 00 00 00 00 00          394          DB      000H,000H,000H,000H,000H,000H          ; BT_7E TILDE
06F2  00 00 00 00 10 38          395          DB      000H,000H,000H,000H,010H,038H,06CH,0C6H ; TH_7F DELTA
      6C C6                      396
06FA  C6 FE 00 00 00 00          397          DB      0C6H,0FEH,000H,000H,000H,000H          ; BT_7F DELTA
                                 398
0700  00 00 3C 66 C2 C0          399          DB      000H,000H,03CH,066H,0C2H,0C0H,0C0H,0C2H ; TH_80
      C0 C2                      400
0708  66 3C 0C 06 7C 00          401          DB      066H,03CH,00CH,006H,07CH,000H          ; BT_80
070E  00 00 CC CC 00 CC          402          DB      000H,000H,0CCH,0CCH,000H,0CCH,0CCH,0CCH ; TH_81
      CC CC                      403
0716  CC CC 76 00 00 00          404          DB      0CCH,0CCH,076H,000H,000H,000H          ; BT_81
071C  00 0C 18 30 00 7C          405          DB      000H,00CH,018H,030H,000H,07CH,0C6H,0FEH ; TH_82
      C6 FE                      406
0724  C0 C6 7C 00 00 00          407          DB      0C0H,0C6H,07CH,000H,000H,000H          ; BT_82
072A  00 10 38 6C 00 78          408          DB      000H,010H,038H,06CH,000H,078H,00CH,07CH ; TH_83
      0C 7C                      409
0732  CC CC 76 00 00 00          410          DB      0CCH,0CCH,076H,000H,000H,000H          ; BT_83
0738  00 00 CC CC 00 78          411          DB      000H,000H,0CCH,0CCH,000H,078H,00CH,07CH ; TH_84
      0C 7C                      412
0740  CC CC 76 00 00 00          413          DB      0CCH,0CCH,076H,000H,000H,000H          ; BT_84
0746  00 60 30 18 00 78          414          DB      000H,060H,030H,018H,000H,078H,00CH,07CH ; TH_85
      0C 7C                      415
074E  CC CC 76 00 00 00          416          DB      0CCH,0CCH,076H,000H,000H,000H          ; BT_85
0754  00 38 6C 38 00 78          417          DB      000H,038H,06CH,038H,000H,078H,00CH,07CH ; TH_86
      0C 7C                      418
075C  CC CC 76 00 00 00          419          DB      0CCH,0CCH,076H,000H,000H,000H          ; BT_86
0762  00 00 00 00 3C 66          420          DB      000H,000H,000H,000H,03CH,066H,060H,066H ; TH_87
      60 66                      421
076A  3C 0C 06 3C 00 00          422          DB      03CH,00CH,006H,03CH,000H,000H          ; BT_87
0770  00 10 38 6C 00 7C          423          DB      000H,010H,038H,06CH,000H,07CH,0C6H,0FEH ; TH_88
      C6 FE                      424
0778  C0 C6 7C 00 00 00          425          DB      0C0H,0C6H,07CH,000H,000H,000H          ; BT_88
077E  00 00 CC CC 00 7C          426          DB      000H,000H,0CCH,0CCH,000H,07CH,0C6H,0FEH ; TH_89
      C6 FE                      427
0786  C0 C6 7C 00 00 00          428          DB      0C0H,0C6H,07CH,000H,000H,000H          ; BT_89
078C  00 60 30 18 00 7C          429          DB      000H,060H,030H,018H,000H,07CH,0C6H,0FEH ; TH_8A
      C6 FE                      430
0794  C0 C6 7C 00 00 00          431          DB      0C0H,0C6H,07CH,000H,000H,000H          ; BT_8A
079A  00 00 66 66 00 38          432          DB      000H,000H,066H,066H,000H,038H,018H,018H ; TH_8B
      18 18                      433
07A2  18 18 3C 00 00 00          434          DB      018H,018H,03CH,000H,000H,000H          ; BT_8B
07A8  00 18 3C 66 00 38          435          DB      000H,018H,03CH,066H,000H,038H,018H,018H ; TH_8C
      18 18                      436
07B0  18 18 3C 00 00 00          437          DB      018H,018H,03CH,000H,000H,000H          ; BT_8C
07B6  00 60 30 18 00 38          438          DB      000H,060H,030H,018H,000H,038H,018H,018H ; TH_8D
      18 18                      439
07BE  18 18 3C 00 00 00          440          DB      018H,018H,03CH,000H,000H,000H          ; BT_8D
07C4  00 C6 C6 10 38 6C          441          DB      000H,0C6H,0C6H,010H,038H,06CH,0C6H,0C6H ; TH_8E
      C6 C6                      442
07CC  FE C6 C6 00 00 00          443          DB      0FEH,0C6H,0C6H,000H,000H,000H          ; BT_8E
```

```
07D2  38 6C 38 00 38 6C      444                DB      038H,06CH,038H,000H,038H,06CH,0C6H,0C6H ; TH_8F
      C6 C6                  445
07DA  FE C6 C6 00 00 00      446                DB      0FEH,0C6H,0C6H,000H,000H,000H           ; BT_8F
                             447
07E0  18 30 60 00 FE 66      448                DB      018H,030H,060H,000H,0FEH,066H,060H,07CH ; TH_90
      60 7C                  449
07E8  60 66 FE 00 00 00      450                DB      060H,066H,0FEH,000H,000H,000H           ; BT_90
07EE  00 00 00 00 CC 76      451                DB      000H,000H,000H,000H,0CCH,076H,036H,07EH ; TH_91
      36 7E                  452
07F6  D8 D8 6E 00 00 00      453                DB      0D8H,0D8H,06EH,000H,000H,000H           ; BT_91
07FC  00 00 00 3E 6C CC CC   454                DB      000H,000H,03EH,06CH,0CCH,0CCH,0FEH,0CCH ; TH_92
      FE CC                  455
0804  CC CC CE 00 00 00      456                DB      0CCH,0CCH,0CEH,000H,000H,000H           ; BT_92
080A  00 10 38 6C 00 7C      457                DB      000H,010H,038H,06CH,000H,07CH,0C6H,0C6H ; TH_93
      C6 C6                  458
0812  C6 C6 7C 00 00 00      459                DB      0C6H,0C6H,07CH,000H,000H,000H           ; BT_93
0818  00 00 C6 C6 00 7C      460                DB      000H,000H,0C6H,0C6H,000H,07CH,0C6H,0C6H ; TH_94
      C6 C6                  461
0820  C6 C6 7C 00 00 00      462                DB      0C6H,0C6H,07CH,000H,000H,000H           ; BT_94
0826  00 60 30 18 00 7C      463                DB      000H,060H,030H,018H,000H,07CH,0C6H,0C6H ; TH_95
      C6 C6                  464
082E  C6 C6 7C 00 00 00      465                DB      0C6H,0C6H,07CH,000H,000H,000H           ; BT_95
0834  00 30 78 CC 00 CC      466                DB      000H,030H,078H,0CCH,000H,0CCH,0CCH,0CCH ; TH_96
      CC CC                  467
083C  CC CC 76 00 00 00      468                DB      0CCH,0CCH,076H,000H,000H,000H           ; BT_96
0842  00 60 30 18 00 CC      469                DB      000H,060H,030H,018H,000H,0CCH,0CCH,0CCH ; TH_97
      CC CC                  470
084A  CC CC 76 00 00 00      471                DB      0CCH,0CCH,076H,000H,000H,000H           ; BT_97
0850  00 00 C6 C6 00 C6      472                DB      000H,000H,0C6H,0C6H,000H,0C6H,0C6H,0C6H ; TH_98
      C6 C6                  473
0858  C6 7E 06 0C 78 00      474                DB      0C6H,07EH,006H,00CH,078H,000H           ; BT_98
085E  00 C6 C6 38 6C C6      475                DB      000H,0C6H,0C6H,038H,06CH,0C6H,0C6H,0C6H ; TH_99
      C6 C6                  476
0866  C6 6C 38 00 00 00      477                DB      0C6H,06CH,038H,000H,000H,000H           ; BT_99
086C  00 C6 C6 00 C6 C6      478                DB      000H,0C6H,0C6H,000H,0C6H,0C6H,0C6H,0C6H ; TH_9A
      C6 C6                  479
0874  C6 C6 7C 00 00 00      480                DB      0C6H,0C6H,07CH,000H,000H,000H           ; BT_9A
087A  00 18 18 3C 66 60      481                DB      000H,018H,018H,03CH,066H,060H,060H,066H ; TH_9B
      60 66                  482
0882  3C 18 18 00 00 00      483                DB      03CH,018H,018H,000H,000H,000H           ; BT_9B
0888  00 38 6C 64 60 F0      484                DB      000H,038H,06CH,064H,060H,0F0H,060H,060H ; TH_9C
      60 60                  485
0890  60 E6 FC 00 00 00      486                DB      060H,0E6H,0FCH,000H,000H,000H           ; BT_9C
0896  00 00 66 66 3C 18      487                DB      000H,000H,066H,066H,03CH,018H,07EH,018H ; TH_9D
      7E 18                  488
089E  7E 18 18 00 00 00      489                DB      07EH,018H,018H,000H,000H,000H           ; BT_9D
08A4  00 F8 CC CC F8 C4      490                DB      000H,0F8H,0CCH,0CCH,0F8H,0C4H,0CCH,0DEH ; TH_9E
      CC DE                  491
08AC  CC CC C6 00 00 00      492                DB      0CCH,0CCH,0C6H,000H,000H,000H           ; BT_9E
08B2  00 0E 1B 18 18 18      493                DB      000H,00EH,01BH,018H,018H,018H,07EH,018H ; TH_9F
      7E 18                  494
08BA  18 18 18 D8 70 00      495                DB      018H,018H,018H,0D8H,070H,000H           ; BT_9F
                             496
08C0  00 18 30 60 00 78      497                DB      000H,018H,030H,060H,000H,078H,00CH,07CH ; TH_A0
      0C 7C                  498
08C8  CC CC 76 00 00 00      499                DB      0CCH,0CCH,076H,000H,000H,000H           ; BT_A0
08CE  00 0C 18 30 00 38      500                DB      000H,00CH,018H,030H,000H,038H,018H,018H ; TH_A1
      18 18                  501
08D6  18 18 3C 00 00 00      502                DB      018H,018H,03CH,000H,000H,000H           ; BT_A1
08DC  00 18 30 60 00 7C      503                DB      000H,018H,030H,060H,000H,07CH,0C6H,0C6H ; TH_A2
      C6 C6                  504
08E4  C6 C6 7C 00 00 00      505                DB      0C6H,0C6H,07CH,000H,000H,000H           ; BT_A2
08EA  00 18 30 60 00 CC      506                DB      000H,018H,030H,060H,000H,0CCH,0CCH,0CCH ; TH_A3
      CC CC                  507
08F2  CC CC 76 00 00 00      508                DB      0CCH,0CCH,076H,000H,000H,000H           ; BT_A3
08F8  00 00 76 DC 00 DC      509                DB      000H,000H,076H,0DCH,000H,0DCH,066H,066H ; TH_A4
      66 66                  510
0900  66 66 66 00 00 00      511                DB      066H,066H,066H,000H,000H,000H           ; BT_A4
0906  76 DC 00 C6 E6 F6      512                DB      076H,0DCH,000H,0C6H,0E6H,0F6H,0FEH,0DEH ; TH_A5
      FE DE                  513
090E  CE C6 C6 00 00 00      514                DB      0CEH,0C6H,0C6H,000H,000H,000H           ; BT_A5
0914  00 3C 6C 6C 3E 00      515                DB      000H,03CH,06CH,06CH,03EH,000H,07EH,000H ; TH_A6
      7E 00                  516
091C  00 00 00 00 00 00      517                DB      000H,000H,000H,000H,000H,000H           ; BT_A6
0922  00 38 6C 6C 38 00      518                DB      000H,038H,06CH,06CH,038H,000H,07CH,000H ; TH_A7
      7C 00                  519
092A  00 00 00 00 00 00      520                DB      000H,000H,000H,000H,000H,000H           ; BT_A7
0930  00 00 30 30 00 30      521                DB      000H,000H,030H,030H,000H,030H,030H,060H ; TH_A8
      30 60                  522
0938  C6 C6 7C 00 00 00      523                DB      0C6H,0C6H,07CH,000H,000H,000H           ; BT_A8
093E  00 00 00 00 00 00      524                DB      000H,000H,000H,000H,000H,000H,0FEH,0C0H ; TH_A9
      FE C0                  525
0946  C0 C0 00 00 00 00      526                DB      0C0H,0C0H,000H,000H,000H,000H           ; BT_A9
094C  00 00 00 00 00 00      527                DB      000H,000H,000H,000H,000H,000H,0FEH,006H ; TH_AA
      FE 06                  528
0954  06 06 00 00 00 00      529                DB      006H,006H,000H,000H,000H,000H           ; BT_AA
095A  00 C0 C0 C6 CC D8      530                DB      000H,0C0H,0C0H,0C6H,0CCH,0D8H,030H,060H ; TH_AB
      30 60                  531
0962  DC 86 0C 18 3E 00      532                DB      0DCH,086H,00CH,018H,03EH,000H           ; BT_AB
0968  00 C0 C0 C6 CC D8      533                DB      000H,0C0H,0C0H,0C6H,0CCH,0D8H,030H,066H ; TH_AC
      30 66                  534
0970  CE 9E 3E 06 06 00      535                DB      0CEH,09EH,03EH,006H,006H,000H           ; BT_AC
0976  00 00 18 18 00 18      536                DB      000H,000H,018H,018H,000H,018H,018H,03CH ; TH_AD
      18 3C                  537
097E  3C 3C 18 00 00 00      538                DB      03CH,03CH,018H,000H,000H,000H           ; BT_AD
0984  00 00 00 00 36 6C      539                DB      000H,000H,000H,000H,036H,06CH,0D8H,06CH ; TH_AE
      D8 6C                  540
098C  36 00 00 00 00 00      541                DB      036H,000H,000H,000H,000H,000H           ; BT_AE
0992  00 00 00 00 D8 6C      542                DB      000H,000H,000H,000H,0D8H,06CH,036H,06CH ; TH_AF
      36 6C                  543
099A  D8 00 00 00 00 00      544                DB      0D8H,000H,000H,000H,000H,000H           ; BT_AF
                             545
09A0  11 44 11 44 11 44      546                DB      011H,044H,011H,044H,011H,044H,011H,044H ; TH_B0
      11 44                  547
09A8  11 44 11 44 11 44      548                DB      011H,044H,011H,044H,011H,044H           ; BT_B0
09AE  55 AA 55 AA 55 AA      549                DB      055H,0AAH,055H,0AAH,055H,0AAH,055H,0AAH ; TH_B1
      55 AA                  550
09B6  55 AA 55 AA 55 AA      551                DB      055H,0AAH,055H,0AAH,055H,0AAH           ; BT_B1
09BC  DD 77 DD 77 DD 77      552                DB      0DDH,077H,0DDH,077H,0DDH,077H,0DDH,077H ; TH_B2
      DD 77                  553
09C4  DD 77 DD 77 DD 77      554                DB      0DDH,077H,0DDH,077H,0DDH,077H           ; BT_B2
09CA  18 18 18 18 18 18      555                DB      018H,018H,018H,018H,018H,018H,018H,018H ; TH_B3
      18 18                  556
09D2  18 18 18 18 18 18      557                DB      018H,018H,018H,018H,018H,018H           ; BT_B3
09D8  18 18 18 18 18 18      558                DB      018H,018H,018H,018H,018H,018H,018H,0F8H ; TH_B4
      18 F8                  559
09E0  18 18 18 18 18 18      560                DB      018H,018H,018H,018H,018H,018H           ; BT_B4
09E6  18 18 18 18 18 F8      561                DB      018H,018H,018H,018H,018H,0F8H,018H,0F8H ; TH_B5
      18 F8                  562
09EE  18 18 18 18 18 18      563                DB      018H,018H,018H,018H,018H,018H           ; BT_B5
09F4  36 36 36 36 36 36      564                DB      036H,036H,036H,036H,036H,036H,036H,0F6H ; TH_B6
      36 F6                  565
09FC  36 36 36 36 36 36      566                DB      036H,036H,036H,036H,036H,036H           ; BT_B6
0A02  00 00 00 00 00 00      567                DB      000H,000H,000H,000H,000H,000H,000H,0FEH ; TH_B7
      00 FE                  568
0A0A  36 36 36 36 36 36      569                DB      036H,036H,036H,036H,036H,036H           ; BT_B7
```

```
0A10  00 00 00 00 00 F8      570
      18 F8                  571
0A18  18 18 18 18 18 18     572                DB      018H,018H,018H,018H,018H,018H                   ; BT_B8
0A1E  36 36 36 36 36 F6     573                DB      036H,036H,036H,036H,036H,0F6H,006H,0F6H ; TH_B9
      06 F6                  574
0A26  36 36 36 36 36 36     575                DB      036H,036H,036H,036H,036H,036H                   ; BT_B9
0A2C  36 36 36 36 36 36     576                DB      036H,036H,036H,036H,036H,036H,036H,036H ; TH_BA
      36 36                  577
0A34  36 36 36 36 36 36     578                DB      036H,036H,036H,036H,036H,036H                   ; BT_BA
0A3A  00 00 00 00 00 FE     579                DB      000H,000H,000H,000H,000H,0FEH,006H,0F6H ; TH_BB
      06 F6                  580
0A42  36 36 36 36 36 36     581                DB      036H,036H,036H,036H,036H,036H                   ; BT_BB
0A48  36 36 36 36 36 F6     582                DB      036H,036H,036H,036H,036H,0F6H,006H,0FEH ; TH_BC
      06 FE                  583
0A50  00 00 00 00 00 00     584                DB      000H,000H,000H,000H,000H,000H                   ; BT_BC
0A56  36 36 36 36 36 36     585                DB      036H,036H,036H,036H,036H,036H,036H,0FEH ; TH_BD
      36 FE                  586
0A5E  00 00 00 00 00 00     587                DB      000H,000H,000H,000H,000H,000H                   ; BT_BD
0A64  18 18 18 18 18 F8     588                DB      018H,018H,018H,018H,018H,0F8H,018H,0F8H ; TH_BE
      18 F8                  589
0A6C  00 00 00 00 00 00     590                DB      000H,000H,000H,000H,000H,000H                   ; BT_BE
0A72  00 00 00 00 00 00     591                DB      000H,000H,000H,000H,000H,000H,000H,0F8H ; TH_BF
      00 F8                  592
0A7A  18 18 18 18 18 18     593                DB      018H,018H,018H,018H,018H,018H                   ; BT_BF
                             594
0A80  18 18 18 18 18 18     595                DB      018H,018H,018H,018H,018H,018H,018H,01FH ; TH_C0
      18 1F                  596
0A88  00 00 00 00 00 00     597                DB      000H,000H,000H,000H,000H,000H                   ; BT_C0
0A8E  18 18 18 18 18 18     598                DB      018H,018H,018H,018H,018H,018H,018H,0FFH ; TH_C1
      18 FF                  599
0A96  00 00 00 00 00 00     600                DB      000H,000H,000H,000H,000H,000H                   ; BT_C1
0A9C  00 00 00 00 00 00     601                DB      000H,000H,000H,000H,000H,000H,000H,0FFH ; TH_C2
      00 FF                  602
0AA4  18 18 18 18 18 18     603                DB      018H,018H,018H,018H,018H,018H                   ; BT_C2
0AAA  18 18 18 18 18 18     604                DB      018H,018H,018H,018H,018H,018H,018H,01FH ; TH_C3
      18 1F                  605
0AB2  18 18 18 18 18 18     606                DB      018H,018H,018H,018H,018H,018H                   ; BT_C3
0AB8  00 00 00 00 00 00     607                DB      000H,000H,000H,000H,000H,000H,000H,0FFH ; TH_C4
      00 FF                  608
0AC0  00 00 00 00 00 00     609                DB      000H,000H,000H,000H,000H,000H                   ; BT_C4
0AC6  18 18 18 18 18 18     610                DB      018H,018H,018H,018H,018H,018H,018H,0FFH ; TH_C5
      18 FF                  611
0ACE  18 18 18 18 18 18     612                DB      018H,018H,018H,018H,018H,018H                   ; BT_C5
0AD4  18 18 18 18 18 1F     613                DB      018H,018H,018H,018H,018H,01FH,018H,01FH ; TH_C6
      18 1F                  614
0ADC  18 18 18 18 18 18     615                DB      018H,018H,018H,018H,018H,018H                   ; BT_C6
0AE2  36 36 36 36 36 36     616                DB      036H,036H,036H,036H,036H,036H,036H,037H ; TH_C7
      36 37                  617
0AEA  36 36 36 36 36 36     618                DB      036H,036H,036H,036H,036H,036H                   ; BT_C7
0AF0  36 36 36 36 36 37     619                DB      036H,036H,036H,036H,036H,037H,030H,03FH ; TH_C8
      30 3F                  620
0AF8  00 00 00 00 00 00     621                DB      000H,000H,000H,000H,000H,000H                   ; BT_C8
0AFE  00 00 00 00 00 3F     622                DB      000H,000H,000H,000H,000H,03FH,030H,037H ; TH_C9
      30 37                  623
0B06  36 36 36 36 36 36     624                DB      036H,036H,036H,036H,036H,036H                   ; BT_C9
0B0C  36 36 36 36 36 F7     625                DB      036H,036H,036H,036H,036H,0F7H,000H,0FFH ; TH_CA
      00 FF                  626
0B14  00 00 00 00 00 00     627                DB      000H,000H,000H,000H,000H,000H                   ; BT_CA
0B1A  00 00 00 00 00 FF     628                DB      000H,000H,000H,000H,000H,0FFH,000H,0F7H ; TH_CB
      00 F7                  629
0B22  36 36 36 36 36 36     630                DB      036H,036H,036H,036H,036H,036H                   ; BT_CB
0B28  36 36 36 36 36 37     631                DB      036H,036H,036H,036H,036H,037H,030H,037H ; TH_CC
      30 37                  632
0B30  36 36 36 36 36 36     633                DB      036H,036H,036H,036H,036H,036H                   ; BT_CC
0B36  00 00 00 00 00 FF     634                DB      000H,000H,000H,000H,000H,0FFH,000H,0FFH ; TH_CD
      00 FF                  635
0B3E  00 00 00 00 00 00     636                DB      000H,000H,000H,000H,000H,000H                   ; BT_CD
0B44  36 36 36 36 36 F7     637                DB      036H,036H,036H,036H,036H,0F7H,000H,0F7H ; TH_CE
      00 F7                  638
0B4C  36 36 36 36 36 36     639                DB      036H,036H,036H,036H,036H,036H                   ; BT_CE
0B52  18 18 18 18 18 FF     640                DB      018H,018H,018H,018H,018H,0FFH,000H,0FFH ; TH_CF
      00 FF                  641
0B5A  00 00 00 00 00 00     642                DB      000H,000H,000H,000H,000H,000H                   ; BT_CF
                             643
0B60  36 36 36 36 36 36     644                DB      036H,036H,036H,036H,036H,036H,036H,0FFH ; TH_D0
      36 FF                  645
0B68  00 00 00 00 00 00     646                DB      000H,000H,000H,000H,000H,000H                   ; BT_D0
0B6E  00 00 00 00 00 FF     647                DB      000H,000H,000H,000H,000H,0FFH,000H,0FFH ; TH_D1
      00 FF                  648
0B76  18 18 18 18 18 18     649                DB      018H,018H,018H,018H,018H,018H                   ; BT_D1
0B7C  00 00 00 00 00 00     650                DB      000H,000H,000H,000H,000H,000H,000H,0FFH ; TH_D2
      00 FF                  651
0B84  36 36 36 36 36 36     652                DB      036H,036H,036H,036H,036H,036H                   ; BT_D2
0B8A  36 36 36 36 36 36     653                DB      036H,036H,036H,036H,036H,036H,036H,03FH ; TH_D3
      36 3F                  654
0B92  00 00 00 00 00 00     655                DB      000H,000H,000H,000H,000H,000H                   ; BT_D3
0B98  18 18 18 18 18 1F     656                DB      018H,018H,018H,018H,018H,01FH,018H,01FH ; TH_D4
      18 1F                  657
0BA0  00 00 00 00 00 00     658                DB      000H,000H,000H,000H,000H,000H                   ; BT_D4
0BA6  00 00 00 00 00 1F     659                DB      000H,000H,000H,000H,000H,01FH,018H,01FH ; TH_D5
      18 1F                  660
0BAE  18 18 18 18 18 18     661                DB      018H,018H,018H,018H,018H,018H                   ; BT_D5
0BB4  00 00 00 00 00 00     662                DB      000H,000H,000H,000H,000H,000H,000H,03FH ; TH_D6
      00 3F                  663
0BBC  36 36 36 36 36 36     664                DB      036H,036H,036H,036H,036H,036H                   ; BT_D6
0BC2  36 36 36 36 36 36     665                DB      036H,036H,036H,036H,036H,036H,036H,0FFH ; TH_D7
      36 FF                  666
0BCA  36 36 36 36 36 36     667                DB      036H,036H,036H,036H,036H,036H                   ; BT_D7
0BD0  18 18 18 18 18 FF     668                DB      018H,018H,018H,018H,018H,0FFH,018H,0FFH ; TH_D8
      18 FF                  669
0BD8  18 18 18 18 18 18     670                DB      018H,018H,018H,018H,018H,018H                   ; BT_D8
0BDE  18 18 18 18 18 18     671                DB      018H,018H,018H,018H,018H,018H,018H,0F8H ; TH_D9
      18 F8                  672
0BE6  00 00 00 00 00 00     673                DB      000H,000H,000H,000H,000H,000H                   ; BT_D9
0BEC  00 00 00 00 00 00     674                DB      000H,000H,000H,000H,000H,000H,000H,01FH ; TH_DA
      00 1F                  675
0BF4  18 18 18 18 18 18     676                DB      018H,018H,018H,018H,018H,018H                   ; BT_DA
0BFA  FF FF FF FF FF FF     677                DB      0FFH,0FFH,0FFH,0FFH,0FFH,0FFH,0FFH,0FFH ; TH_DB
      FF FF                  678
0C02  FF FF FF FF FF FF     679                DB      0FFH,0FFH,0FFH,0FFH,0FFH,0FFH                   ; BT_DB
0C08  00 00 00 00 00 00     680                DB      000H,000H,000H,000H,000H,000H,000H,0FFH ; TH_DC
      00 FF                  681
0C10  FF FF FF FF FF FF     682                DB      0FFH,0FFH,0FFH,0FFH,0FFH,0FFH                   ; BT_DC
0C16  F0 F0 F0 F0 F0 F0     683                DB      0F0H,0F0H,0F0H,0F0H,0F0H,0F0H,0F0H,0F0H ; TH_DD
      F0 F0                  684
0C1E  F0 F0 F0 F0 F0 F0     685                DB      0F0H,0F0H,0F0H,0F0H,0F0H,0F0H                   ; BT_DD
0C24  0F 0F 0F 0F 0F 0F     686                DB      00FH,00FH,00FH,00FH,00FH,00FH,00FH,00FH ; TH_DE
      0F 0F                  687
0C2C  0F 0F 0F 0F 0F 0F     688                DB      00FH,00FH,00FH,00FH,00FH,00FH                   ; BT_DE
0C32  FF FF FF FF FF FF     689                DB      0FFH,0FFH,0FFH,0FFH,0FFH,0FFH,0FFH,000H ; TH_DF
      FF 00                  690
0C3A  00 00 00 00 00 00     691                DB      000H,000H,000H,000H,000H,000H                   ; BT_DF
                             692
0C40  00 00 00 00 00 76     693                DB      000H,000H,000H,000H,000H,076H,0DCH,0D8H ; TH_E0
      DC D8                  694
0C48  D8 DC 76 00 00 00     695                DB      0D8H,0DCH,076H,000H,000H,000H                   ; BT_E0
```

```
0C4E  00 00 00 00 7C C6      696                DB      000H,000H,000H,000H,07CH,0C6H,0FCH,0C6H ; TH_E1
      FC C6                  697
0C56  C6 FC C0 C0 40 00      698                DB      0C6H,0FCH,0C0H,0C0H,040H,000H           ; BT_E1
0C5C  00 00 FE C6 C6 C0      699                DB      000H,000H,0FEH,0C6H,0C6H,0C0H,0C0H,0C0H ; TH_E2
      C0 C0                  700
0C64  C0 C0 C0 00 00 00      701                DB      0C0H,0C0H,0C0H,000H,000H,000H           ; BT_E2
0C6A  00 00 00 00 FE 6C      702                DB      000H,000H,000H,000H,0FEH,06CH,06CH,06CH ; TH_E3
      6C 6C                  703
0C72  6C 6C 6C 00 00 00      704                DB      06CH,06CH,06CH,000H,000H,000H           ; BT_E3
0C78  00 00 FE C6 60 30      705                DB      000H,000H,0FEH,0C6H,060H,030H,018H,030H ; TH_E4
      18 30                  706
0C80  60 C6 FE 00 00 00      707                DB      060H,0C6H,0FEH,000H,000H,000H           ; BT_E4
0C86  00 00 00 00 00 7E      708                DB      000H,000H,000H,000H,000H,07EH,0D8H,0D8H ; TH_E5
      D8 D8                  709
0C8E  D8 D8 70 00 00 00      710                DB      0D8H,0D8H,070H,000H,000H,000H           ; BT_E5
0C94  00 00 00 00 66 66      711                DB      000H,000H,000H,000H,066H,066H,066H,066H ; TH_E6
      66 66                  712
0C9C  7C 60 60 C0 00 00      713                DB      07CH,060H,060H,0C0H,000H,000H           ; BT_E6
0CA2  00 00 00 00 76 DC      714                DB      000H,000H,000H,000H,076H,0DCH,018H,018H ; TH_E7
      18 18                  715
0CAA  18 18 18 00 00 00      716                DB      018H,018H,018H,000H,000H,000H           ; BT_E7
0CB0  00 00 7E 18 3C 66      717                DB      000H,000H,07EH,018H,03CH,066H,066H,066H ; TH_E8
      66 66                  718
0CB8  3C 18 7E 00 00 00      719                DB      03CH,018H,07EH,000H,000H,000H           ; BT_E8
0CBE  00 00 38 6C C6 C6      720                DB      000H,000H,038H,06CH,0C6H,0C6H,0FEH,0C6H ; TH_E9
      FE C6                  721
0CC6  C6 6C 38 00 00 00      722                DB      0C6H,06CH,038H,000H,000H,000H           ; BT_E9
0CCC  00 00 38 6C C6 C6      723                DB      000H,000H,038H,06CH,0C6H,0C6H,0C6H,06CH ; TH_EA
      C6 6C                  724
0CD4  6C 6C EE 00 00 00      725                DB      06CH,06CH,0EEH,000H,000H,000H           ; BT_EA
0CDA  00 00 1E 30 18 0C      726                DB      000H,000H,01EH,030H,018H,00CH,03EH,066H ; TH_EB
      3E 66                  727
0CE2  66 66 3C 00 00 00      728                DB      066H,066H,03CH,000H,000H,000H           ; BT_EB
0CE8  00 00 00 00 00 7E      729                DB      000H,000H,000H,000H,000H,07EH,0DBH,0DBH ; TH_EC
      DB DB                  730
0CF0  7E 00 00 00 00 00      731                DB      07EH,000H,000H,000H,000H,000H           ; BT_EC
0CF6  00 00 03 06 7E DB      732                DB      000H,000H,003H,006H,07EH,0DBH,0DBH,0F3H ; TH_ED
      DB F3                  733
0CFE  7E 60 C0 00 00 00      734                DB      07EH,060H,0C0H,000H,000H,000H           ; BT_ED
0D04  00 00 1C 30 60 60      735                DB      000H,000H,01CH,030H,060H,060H,07CH,060H ; TH_EE
      7C 60                  736
0D0C  60 30 1C 00 00 00      737                DB      060H,030H,01CH,000H,000H,000H           ; BT_EE
0D12  00 00 00 7C C6 C6      738                DB      000H,000H,000H,07CH,0C6H,0C6H,0C6H,0C6H ; TH_EF
      C6 C6                  739
0D1A  C6 C6 C6 00 00 00      740                DB      0C6H,0C6H,0C6H,000H,000H,000H           ; BT_EF
                             741
0D20  00 00 00 FE 00 00      742                DB      000H,000H,000H,0FEH,000H,000H,0FEH,000H ; TH_F0
      FE 00                  743
0D28  00 FE 00 00 00 00      744                DB      000H,0FEH,000H,000H,000H,000H           ; BT_F0
0D2E  00 00 00 18 18 7E      745                DB      000H,000H,000H,018H,018H,07EH,018H,018H ; TH_F1
      18 18                  746
0D36  00 00 FF 00 00 00      747                DB      000H,000H,0FFH,000H,000H,000H           ; BT_F1
0D3C  00 00 30 18 0C 06      748                DB      000H,000H,030H,018H,00CH,006H,00CH,018H ; TH_F2
      0C 18                  749
0D44  30 00 7E 00 00 00      750                DB      030H,000H,07EH,000H,000H,000H           ; BT_F2
0D4A  00 00 0C 18 30 60      751                DB      000H,000H,00CH,018H,030H,060H,030H,018H ; TH_F3
      30 18                  752
0D52  0C 00 7E 00 00 00      753                DB      00CH,000H,07EH,000H,000H,000H           ; BT_F3
0D58  00 00 0E 1B 18 18      754                DB      000H,000H,00EH,01BH,018H,018H,018H,018H ; TH_F4
      18 18                  755
0D60  18 18 18 18 18 18      756                DB      018H,018H,018H,018H,018H,018H           ; BT_F4
0D66  18 18 18 18 18 18      757                DB      018H,018H,018H,018H,018H,018H,018H,018H ; TH_F5
      18 18                  758
0D6E  D8 D8 70 00 00 00      759                DB      0D8H,0D8H,070H,000H,000H,000H           ; BT_F5
0D74  00 00 00 18 18 00      760                DB      000H,000H,000H,018H,018H,000H,07EH,000H ; TH_F6
      7E 00                  761
0D7C  18 18 00 00 00 00      762                DB      018H,018H,000H,000H,000H,000H           ; BT_F6
0D82  00 00 00 00 76 DC      763                DB      000H,000H,000H,000H,076H,0DCH,000H,076H ; TH_F7
      00 76                  764
0D8A  DC 00 00 00 00 00      765                DB      0DCH,000H,000H,000H,000H,000H           ; BT_F7
0D90  00 38 6C 6C 38 00      766                DB      000H,038H,06CH,06CH,038H,000H,000H,000H ; TH_F8
      00 00                  767
0D98  00 00 00 00 00 00      768                DB      000H,000H,000H,000H,000H,000H           ; BT_F8
0D9E  00 00 00 00 00 00      769                DB      000H,000H,000H,000H,000H,000H,018H,018H ; TH_F9
      18 18                  770
0DA6  00 00 00 00 00 00      771                DB      000H,000H,000H,000H,000H,000H           ; BT_F9
0DAC  00 00 00 00 00 00      772                DB      000H,000H,000H,000H,000H,000H,000H,018H ; TH_FA
      00 18                  773
0DB4  00 00 00 00 00 00      774                DB      000H,000H,000H,000H,000H,000H           ; BT_FA
0DBA  00 0F 0C 0C 0C 0C      775                DB      000H,00FH,00CH,00CH,00CH,00CH,00CH,0ECH ; TH_FB
      0C EC                  776
0DC2  6C 3C 1C 00 00 00      777                DB      06CH,03CH,01CH,000H,000H,000H           ; BT_FB
0DC8  00 D8 6C 6C 6C 6C      778                DB      000H,0D8H,06CH,06CH,06CH,06CH,06CH,000H ; TH_FC
      6C 00                  779
0DD0  00 00 00 00 00 00      780                DB      000H,000H,000H,000H,000H,000H           ; BT_FC
0DD6  00 70 D8 30 60 C8      781                DB      000H,070H,0D8H,030H,060H,0C8H,0F8H,000H ; TH_FD
      F8 00                  782
0DDE  00 00 00 00 00 00      783                DB      000H,000H,000H,000H,000H,000H           ; BT_FD
0DE4  00 00 00 00 7C 7C      784                DB      000H,000H,000H,000H,07CH,07CH,07CH,07CH ; TH_FE
      7C 7C                  785
0DEC  7C 7C 00 00 00 00      786                DB      07CH,07CH,000H,000H,000H,000H           ; BT_FE
0DF2  00 00 00 00 00 00      787                DB      000H,000H,000H,000H,000H,000H,000H,000H ; TH_FF
      00 00                  788
0DFA  00 00 00 00 00 00      789                DB      000H,000H,000H,000H,000H,000H           ; BT_FF
0E00                         790    CODE        ENDS
                             791                END


                               1                PAGE,120
                               2                SUBTTL  MONOCHROME CHARACTER GENERATOR  -  ALPHA SUPPLEMENT
0000                           3    CODE        SEGMENT PUBLIC
                               4                PUBLIC  CGMN_FDG
0000                           5    CGMN_FDG    LABEL   BYTE
                               6
                               7    ; STRUCTURE OF THIS FILE
                               8    ;       DB      XXH     WHERE XX IS THE HEX CODE FOR THE FOLLOWING CHAR
                               9    ;       DB      [BYTES 0 - 13 OF THAT CHARACTER]
                              10    ;       ...
                              11    ;       DB      00H     INDICATES NO MORE REPLACEMENTS TO BE DONE
                              12
                              13
0000  1D                     14                DB      01DH                                    ;
0001  00 00 00 00 24 66      15                DB      000H,000H,000H,000H,024H,066H,0FFH,066H ; TH_1D
      FF 66                  16
0009  24 00 00 00 00 00      17                DB      024H,000H,000H,000H,000H,000H           ; BT_1D
000F  22                     18                DB      022H                                    ;
0010  00 63 63 63 22 00      19                DB      000H,063H,063H,063H,022H,000H,000H,000H ; TH_22 "
      00 00                  20
0018  00 00 00 00 00 00      21                DB      000H,000H,000H,000H,000H,000H           ; BT_22 "
001E  2B                     22                DB      02BH                                    ;
001F  00 00 00 18 18 18      23                DB      000H,000H,000H,018H,018H,018H,0FFH,018H ; TH_2B +
      FF 18                  24
0027  18 18 00 00 00 00      25                DB      018H,018H,000H,000H,000H,000H           ; BT_2B +
002D  2D                     26                DB      02DH                                    ;
002E  00 00 00 00 00 00      27                DB      000H,000H,000H,000H,000H,000H,0FFH,000H ; TH_2D -
      FF 00                  28
```

```
0036  00 00 00 00 00 00 00          29                DB      000H,000H,000H,000H,000H,000H           ; BT_2D -
003C  4D                            30                DB      04DH                                    ;
003D  00 00 C3 E7 FF DB             31                DB      000H,000H,0C3H,0E7H,0FFH,0DBH,0C3H,0C3H ; TH_4D M
      C3 C3                         32
0045  C3 C3 C3 00 00 00 00          33                DB      0C3H,0C3H,0C3H,000H,000H,000H           ; BT_4D M
004B  54                            34                DB      054H                                    ;
004C  00 00 FF DB 99 18             35                DB      000H,000H,0FFH,0DBH,099H,018H,018H,018H ; TH_54 T
      18 18                         36
0054  18 18 3C 00 00 00 00          37                DB      018H,018H,03CH,000H,000H,000H           ; BT_54 T
005A  56                            38                DB      056H                                    ;
005B  00 00 C3 C3 C3 C3             39                DB      000H,000H,0C3H,0C3H,0C3H,0C3H,0C3H,0C3H ; TH_56 V
      C3 C3                         40
0063  66 3C 18 00 00 00 00          41                DB      066H,03CH,018H,000H,000H,000H           ; BT_56 V
0069  57                            42                DB      057H                                    ;
006A  00 00 C3 C3 C3 C3             43                DB      000H,000H,0C3H,0C3H,0C3H,0C3H,0DBH,0DBH ; TH_57 W
      DB DB                         44
0072  FF 66 66 00 00 00 00          45                DB      0FFH,066H,066H,000H,000H,000H           ; BT_57 W
0078  58                            46                DB      058H                                    ;
0079  00 00 C3 C3 66 3C              47                DB      000H,000H,0C3H,0C3H,066H,03CH,018H,03CH ; TH_58 X
      18 3C                         48
0081  66 C3 C3 00 00 00 00          49                DB      066H,0C3H,0C3H,000H,000H,000H           ; BT_58 X
0087  59                            50                DB      059H                                    ;
0088  00 00 C3 C3 C3 66              51                DB      000H,000H,0C3H,0C3H,0C3H,066H,03CH,018H ; TH_59 Y
      3C 18                         52
0090  18 18 3C 00 00 00 00          53                DB      018H,018H,03CH,000H,000H,000H           ; BT_59 Y
0096  5A                            54                DB      05AH                                    ;
0097  00 00 FF C3 86 0C              55                DB      000H,000H,0FFH,0C3H,086H,00CH,018H,030H ; TH_5A Z
      18 30                         56
009F  61 C3 FF 00 00 00 00          57                DB      061H,0C3H,0FFH,000H,000H,000H           ; BT_5A Z
00A5  6D                            58                DB      06DH                                    ;
00A6  00 00 00 00 00 E6             59                DB      000H,000H,000H,000H,000H,0E6H,0FFH,0DBH ; TH_6D L.C. M
      FF DB                         60
00AE  DB DB DB 00 00 00 00          61                DB      0DBH,0DBH,0DBH,000H,000H,000H           ; BT_6D L.C. M
00B4  76                            62                DB      076H                                    ;
00B5  00 00 00 00 00 C3             63                DB      000H,000H,000H,000H,000H,0C3H,0C3H,0C3H ; TH_76 L.C. V
      C3 C3                         64
00BD  66 3C 18 00 00 00 00          65                DB      066H,03CH,018H,000H,000H,000H           ; BT_76 L.C. V
00C3  77                            66                DB      077H                                    ;
00C4  00 00 00 00 00 C3             67                DB      000H,000H,000H,000H,000H,0C3H,0C3H,0DBH ; TH_77 L.C. W
      C3 DB                         68
00CC  DB FF 66 00 00 00 00          69                DB      0DBH,0FFH,066H,000H,000H,000H           ; BT_77 L.C. W
00D2  91                            70                DB      091H                                    ;
00D3  00 00 00 00 00 6E 3B          71                DB      000H,000H,000H,000H,06EH,03BH,01BH,07EH ; TH_91
      1B 7E                         72
00DB  D8 DC 77 00 00 00 00          73                DB      0D8H,0DCH,077H,000H,000H,000H           ; BT_91
00E1  9B                            74                DB      09BH                                    ;
00E2  00 18 18 7E C3 C0             75                DB      000H,018H,018H,07EH,0C3H,0C0H,0C0H,0C3H ; TH_9B
      C0 C3                         76
00EA  7E 18 18 00 00 00 00          77                DB      07EH,018H,018H,000H,000H,000H           ; BT_9B
00F0  9D                            78                DB      09DH                                    ;
00F1  00 00 C3 66 3C 18             79                DB      000H,000H,0C3H,066H,03CH,018H,0FFH,018H ; TH_9D
      FF 18                         80
00F9  FF 18 18 00 00 00 00          81                DB      0FFH,018H,018H,000H,000H,000H           ; BT_9D
00FF  9E                            82                DB      09EH                                    ;
0100  00 FC 66 66 7C 62             83                DB      000H,0FCH,066H,066H,07CH,062H,066H,06FH ; TH_9E
      66 6F                         84
0108  66 66 F3 00 00 00 00          85                DB      066H,066H,0F3H,000H,000H,000H           ; BT_9E
010E  F1                            86                DB      0F1H                                    ;
010F  00 00 18 18 18 FF             87                DB      000H,000H,018H,018H,018H,0FFH,018H,018H ; TH_F1
      18 18                         88
0117  18 00 FF 00 00 00 00          89                DB      018H,000H,0FFH,000H,000H,000H           ; BT_F1
011D  F6                            90                DB      0F6H                                    ;
011E  00 00 18 18 00 00             91                DB      000H,000H,018H,018H,000H,000H,0FFH,000H ; TH_F6
      FF 00                         92
0126  00 18 18 00 00 00 00          93                DB      000H,018H,018H,000H,000H,000H           ; BT_F6
012C  00                            94                DB      000H                                    ; NO_MORE
012D                                95    CODE        ENDS
                                    96                END

                                     1                PAGE,120
                                     2                SUBTTL  DOUBLE DOT CHARACTER GENERATOR
0000                                 3    CODE        SEGMENT PUBLIC
                                     4                PUBLIC  CGDDOT,INT_1F_1
0000                                 5    CGDDOT      LABEL   BYTE
                                     6                                                               ; DOUBLE DOT
0000  00 00 00 00 00 00 00           7                DB      000H,000H,000H,000H,000H,000H,000H,000H ; D_00
      00 00                          8
0008  7E 81 A5 81 BD 99              9                DB      07EH,081H,0A5H,081H,0BDH,099H,081H,07EH ; D_01
      81 7E                         10
0010  7E FF DB FF C3 E7            11                DB      07EH,0FFH,0DBH,0FFH,0C3H,0E7H,0FFH,07EH ; D_02
      FF 7E                         12
0018  6C FE FE FE 7C 38            13                DB      06CH,0FEH,0FEH,0FEH,07CH,038H,010H,000H ; D_03
      10 00                         14
0020  10 38 7C FE 7C 38            15                DB      010H,038H,07CH,0FEH,07CH,038H,010H,000H ; D_04
      10 00                         16
0028  38 7C 38 FE FE 7C            17                DB      038H,07CH,038H,0FEH,0FEH,07CH,038H,07CH ; D_05
      38 7C                         18
0030  10 10 38 7C FE 7C            19                DB      010H,010H,038H,07CH,0FEH,07CH,038H,07CH ; D_06
      38 7C                         20
0038  00 00 18 3C 3C 18            21                DB      000H,000H,018H,03CH,03CH,018H,000H,000H ; D_07
      00 00                         22
0040  FF FF E7 C3 C3 E7            23                DB      0FFH,0FFH,0E7H,0C3H,0C3H,0E7H,0FFH,0FFH ; D_08
      FF FF                         24
0048  00 3C 66 42 42 66            25                DB      000H,03CH,066H,042H,042H,066H,03CH,000H ; D_09
      3C 00                         26
0050  FF C3 99 BD BD 99            27                DB      0FFH,0C3H,099H,0BDH,0BDH,099H,0C3H,0FFH ; D_0A
      C3 FF                         28
0058  0F 07 0F 7D CC CC            29                DB      00FH,007H,00FH,07DH,0CCH,0CCH,0CCH,078H ; D_0B
      CC 78                         30
0060  3C 66 66 66 3C 18            31                DB      03CH,066H,066H,066H,03CH,018H,07EH,018H ; D_0C
      7E 18                         32
0068  3F 33 3F 30 30 70            33                DB      03FH,033H,03FH,030H,030H,070H,0F0H,0E0H ; D_0D
      F0 E0                         34
0070  7F 63 7F 63 63 67            35                DB      07FH,063H,07FH,063H,063H,067H,0E6H,0C0H ; D_0E
      E6 C0                         36
0078  99 5A 3C E7 E7 3C            37                DB      099H,05AH,03CH,0E7H,0E7H,03CH,05AH,099H ; D_0F
      5A 99                         38
                                    39
0080  80 E0 F8 FE F8 E0            40                DB      080H,0E0H,0F8H,0FEH,0F8H,0E0H,080H,000H ; D_10
      80 00                         41
0088  02 0E 3E FE 3E 0E            42                DB      002H,00EH,03EH,0FEH,03EH,00EH,002H,000H ; D_11
      02 00                         43
0090  18 3C 7E 18 18 7E            44                DB      018H,03CH,07EH,018H,018H,07EH,03CH,018H ; D_12
      3C 18                         45
0098  66 66 66 66 66 00            46                DB      066H,066H,066H,066H,066H,000H,066H,000H ; D_13
      66 00                         47
00A0  7F DB DB 7B 1B 1B            48                DB      07FH,0DBH,0DBH,07BH,01BH,01BH,01BH,000H ; D_14
      1B 00                         49
00A8  3E 63 38 6C 6C 38            50                DB      03EH,063H,038H,06CH,06CH,038H,0CCH,078H ; D_15
      CC 78                         51
00B0  00 00 00 00 7E 7E            52                DB      000H,000H,000H,000H,07EH,07EH,07EH,000H ; D_16
      7E 00                         53
00B8  18 3C 7E 18 7E 3C            54                DB      018H,03CH,07EH,018H,07EH,03CH,018H,0FFH ; D_17
      18 FF                         55
00C0  18 3C 7E 18 18 18            56                DB      018H,03CH,07EH,018H,018H,018H,018H,000H ; D_18
```

```
                18 00                                   57
00C8  18 18 18 18 18 7E 3C      58      DB      018H,018H,018H,018H,07EH,03CH,018H,000H ; D_19
                18 00                                   59
00D0  00 18 0C FE 0C 18         60      DB      000H,018H,00CH,0FEH,00CH,018H,000H,000H ; D_1A
                00 00                                   61
00D8  00 30 60 FE 60 30         62      DB      000H,030H,060H,0FEH,060H,030H,000H,000H ; D_1B
                00 00                                   63
00E0  00 00 C0 C0 C0 FE         64      DB      000H,000H,0C0H,0C0H,0C0H,0FEH,000H,000H ; D_1C
                00 00                                   65
00E8  00 24 66 FF 66 24         66      DB      000H,024H,066H,0FFH,066H,024H,000H,000H ; D_1D
                00 00                                   67
00F0  00 18 3C 7E FF FF         68      DB      000H,018H,03CH,07EH,0FFH,0FFH,000H,000H ; D_1E
                00 00                                   69
00F8  00 FF FF 7E 3C 18         70      DB      000H,0FFH,0FFH,07EH,03CH,018H,000H,000H ; D_1F
                00 00                                   71
                                                        72
0100  00 00 00 00 00 00         73      DB      000H,000H,000H,000H,000H,000H,000H,000H ; SP D_20
                00 00                                   74
0108  30 78 78 30 30 00         75      DB      030H,078H,078H,030H,030H,000H,030H,000H ; ! D_21
                30 00                                   76
0110  6C 6C 6C 00 00 00         77      DB      06CH,06CH,06CH,000H,000H,000H,000H,000H ; " D_22
                00 00                                   78
0118  6C 6C FE 6C FE 6C         79      DB      06CH,06CH,0FEH,06CH,0FEH,06CH,06CH,000H ; # D_23
                6C 00                                   80
0120  30 7C C0 78 0C F8         81      DB      030H,07CH,0C0H,078H,00CH,0F8H,030H,000H ; $ D_24
                30 00                                   82
0128  00 C6 CC 18 30 66         83      DB      000H,0C6H,0CCH,018H,030H,066H,0C6H,000H ; PER CENT D_25
                C6 00                                   84
0130  38 6C 38 76 DC CC         85      DB      038H,06CH,038H,076H,0DCH,0CCH,076H,000H ; & D_26
                76 00                                   86
0138  60 60 C0 00 00 00         87      DB      060H,060H,0C0H,000H,000H,000H,000H,000H ; ' D_27
                00 00                                   88
0140  18 30 60 60 60 30         89      DB      018H,030H,060H,060H,060H,030H,018H,000H ; ( D_28
                18 00                                   90
0148  60 30 18 18 18 30         91      DB      060H,030H,018H,018H,018H,030H,060H,000H ; ) D_29
                60 00                                   92
0150  00 66 3C FF 3C 66         93      DB      000H,066H,03CH,0FFH,03CH,066H,000H,000H ; * D_2A
                00 00                                   94
0158  00 30 30 FC 30 30         95      DB      000H,030H,030H,0FCH,030H,030H,000H,000H ; + D_2B
                00 00                                   96
0160  00 00 00 00 00 30         97      DB      000H,000H,000H,000H,000H,030H,030H,060H ; , D_2C
                30 60                                   98
0168  00 00 00 FC 00 00         99      DB      000H,000H,000H,0FCH,000H,000H,000H,000H ; - D_2D
                00 00                                   100
0170  00 00 00 00 00 30         101     DB      000H,000H,000H,000H,000H,030H,030H,000H ; . D_2E
                30 00                                   102
0178  06 0C 18 30 60 C0         103     DB      006H,00CH,018H,030H,060H,0C0H,080H,000H ; / D_2F
                80 00                                   104
                                                        105
0180  7C C6 CE DE F6 E6         106     DB      07CH,0C6H,0CEH,0DEH,0F6H,0E6H,07CH,000H ; 0 D_30
                7C 00                                   107
0188  30 70 30 30 30 30         108     DB      030H,070H,030H,030H,030H,030H,0FCH,000H ; 1 D_31
                FC 00                                   109
0190  78 CC 0C 38 60 CC         110     DB      078H,0CCH,00CH,038H,060H,0CCH,0FCH,000H ; 2 D_32
                FC 00                                   111
0198  78 CC 0C 38 0C CC         112     DB      078H,0CCH,00CH,038H,00CH,0CCH,078H,000H ; 3 D_33
                78 00                                   113
01A0  1C 3C 6C CC FE 0C         114     DB      01CH,03CH,06CH,0CCH,0FEH,00CH,01EH,000H ; 4 D_34
                1E 00                                   115
01A8  FC C0 F8 0C 0C CC         116     DB      0FCH,0C0H,0F8H,00CH,00CH,0CCH,078H,000H ; 5 D_35
                78 00                                   117
01B0  38 60 C0 F8 CC CC         118     DB      038H,060H,0C0H,0F8H,0CCH,0CCH,078H,000H ; 6 D_36
                78 00                                   119
01B8  FC CC 0C 18 30 30         120     DB      0FCH,0CCH,00CH,018H,030H,030H,030H,000H ; 7 D_37
                30 00                                   121
01C0  78 CC CC 78 CC CC         122     DB      078H,0CCH,0CCH,078H,0CCH,0CCH,078H,000H ; 8 D_38
                78 00                                   123
01C8  78 CC CC 7C 0C 18         124     DB      078H,0CCH,0CCH,07CH,00CH,018H,070H,000H ; 9 D_39
                70 00                                   125
01D0  00 30 30 00 00 30         126     DB      000H,030H,030H,000H,000H,030H,030H,000H ; : D_3A
                30 00                                   127
01D8  00 30 30 00 00 30         128     DB      000H,030H,030H,000H,000H,030H,030H,060H ; ; D_3B
                30 60                                   129
01E0  18 30 60 C0 60 30         130     DB      018H,030H,060H,0C0H,060H,030H,018H,000H ; < D_3C
                18 00                                   131
01E8  00 00 FC 00 00 FC         132     DB      000H,000H,0FCH,000H,000H,0FCH,000H,000H ; = D_3D
                00 00                                   133
01F0  60 30 18 0C 18 30         134     DB      060H,030H,018H,00CH,018H,030H,060H,000H ; > D_3E
                60 00                                   135
01F8  78 CC 0C 18 30 00         136     DB      078H,0CCH,00CH,018H,030H,000H,030H,000H ; ? D_3F
                30 00                                   137
                                                        138
0200  7C C6 DE DE DE C0        139     DB      07CH,0C6H,0DEH,0DEH,0DEH,0C0H,078H,000H ; @ D_40
                78 00                                   140
0208  30 78 CC CC FC CC         141     DB      030H,078H,0CCH,0CCH,0FCH,0CCH,0CCH,000H ; A D_41
                CC 00                                   142
0210  FC 66 66 7C 66 66         143     DB      0FCH,066H,066H,07CH,066H,066H,0FCH,000H ; B D_42
                FC 00                                   144
0218  3C 66 C0 C0 C0 66         145     DB      03CH,066H,0C0H,0C0H,0C0H,066H,03CH,000H ; C D_43
                3C 00                                   146
0220  F8 6C 66 66 66 6C         147     DB      0F8H,06CH,066H,066H,066H,06CH,0F8H,000H ; D D_44
                F8 00                                   148
0228  FE 62 68 78 68 62         149     DB      0FEH,062H,068H,078H,068H,062H,0FEH,000H ; E D_45
                FE 00                                   150
0230  FE 62 68 78 68 60         151     DB      0FEH,062H,068H,078H,068H,060H,0F0H,000H ; F D_46
                F0 00                                   152
0238  3C 66 C0 C0 CE 66         153     DB      03CH,066H,0C0H,0C0H,0CEH,066H,03EH,000H ; G D_47
                3E 00                                   154
0240  CC CC CC FC CC CC         155     DB      0CCH,0CCH,0CCH,0FCH,0CCH,0CCH,0CCH,000H ; H D_48
                CC 00                                   156
0248  78 30 30 30 30 30         157     DB      078H,030H,030H,030H,030H,030H,078H,000H ; I D_49
                78 00                                   158
0250  1E 0C 0C 0C CC CC         159     DB      01EH,00CH,00CH,00CH,0CCH,0CCH,078H,000H ; J D_4A
                78 00                                   160
0258  E6 66 6C 78 6C 66         161     DB      0E6H,066H,06CH,078H,06CH,066H,0E6H,000H ; K D_4B
                E6 00                                   162
0260  F0 60 60 60 62 66         163     DB      0F0H,060H,060H,060H,062H,066H,0FEH,000H ; L D_4C
                FE 00                                   164
0268  C6 EE FE FE D6 C6         165     DB      0C6H,0EEH,0FEH,0FEH,0D6H,0C6H,0C6H,000H ; M D_4D
                C6 00                                   166
0270  C6 E6 F6 DE CE C6         167     DB      0C6H,0E6H,0F6H,0DEH,0CEH,0C6H,0C6H,000H ; N D_4E
                C6 00                                   168
0278  38 6C C6 C6 C6 6C         169     DB      038H,06CH,0C6H,0C6H,0C6H,06CH,038H,000H ; O D_4F
                38 00                                   170
                                                        171
0280  FC 66 66 7C 60 60         172     DB      0FCH,066H,066H,07CH,060H,060H,0F0H,000H ; P D_50
                F0 00                                   173
0288  78 CC CC CC DC 78         174     DB      078H,0CCH,0CCH,0CCH,0DCH,078H,01CH,000H ; Q D_51
                1C 00                                   175
0290  FC 66 66 7C 6C 66         176     DB      0FCH,066H,066H,07CH,06CH,066H,0E6H,000H ; R D_52
                E6 00                                   177
0298  78 CC E0 70 1C CC         178     DB      078H,0CCH,0E0H,070H,01CH,0CCH,078H,000H ; S D_53
                78 00                                   179
02A0  FC B4 30 30 30 30         180     DB      0FCH,0B4H,030H,030H,030H,030H,078H,000H ; T D_54
                78 00                                   181
02A8  CC CC CC CC CC CC         182     DB      0CCH,0CCH,0CCH,0CCH,0CCH,0CCH,0FCH,000H ; U D_55
```

```
                FC 00                                   183
02B0  CC CC CC CC CC 78                 184             DB      0CCH,0CCH,0CCH,0CCH,0CCH,078H,030H,000H ; V D_56
                30 00                                   185
02B8  C6 C6 C6 D6 FE EE                 186             DB      0C6H,0C6H,0C6H,0D6H,0FEH,0EEH,0C6H,000H ; W D_57
                C6 00                                   187
02C0  C6 C6 6C 38 38 6C                 188             DB      0C6H,0C6H,06CH,038H,038H,06CH,0C6H,000H ; X D_58
                C6 00                                   189
02C8  CC CC CC 78 30 30                 190             DB      0CCH,0CCH,0CCH,078H,030H,030H,078H,000H ; Y D_59
                78 00                                   191
02D0  FE C6 8C 18 32 66                 192             DB      0FEH,0C6H,08CH,018H,032H,066H,0FEH,000H ; Z D_5A
                FE 00                                   193
02D8  78 60 60 60 60 60                 194             DB      078H,060H,060H,060H,060H,060H,078H,000H ; [ D_5B
                78 00                                   195
02E0  C0 60 30 18 0C 06                 196             DB      0C0H,060H,030H,018H,00CH,006H,002H,000H ; BACKSLASH D_5C
                02 00                                   197
02E8  78 18 18 18 18 18                 198             DB      078H,018H,018H,018H,018H,018H,078H,000H ; ] D_5D
                78 00                                   199
02F0  10 38 6C C6 00 00                 200             DB      010H,038H,06CH,0C6H,000H,000H,000H,000H ; CIRCUMFLEX D_5E
                00 00                                   201
02F8  00 00 00 00 00 00                 202             DB      000H,000H,000H,000H,000H,000H,000H,0FFH ; _ D_5F
                00 FF                                   203
                                                        204
0300  30 30 18 00 00 00                 205             DB      030H,030H,018H,000H,000H,000H,000H,000H ; ' D_60
                00 00                                   206
0308  00 00 78 0C 7C CC                 207             DB      000H,000H,078H,00CH,07CH,0CCH,076H,000H ; LOWER CASE A D_61
                76 00                                   208
0310  E0 60 60 7C 66 66                 209             DB      0E0H,060H,060H,07CH,066H,066H,0DCH,000H ; L.C. B D_62
                DC 00                                   210
0318  00 00 78 CC C0 CC                 211             DB      000H,000H,078H,0CCH,0C0H,0CCH,078H,000H ; L.C. C D_63
                78 00                                   212
0320  1C 0C 0C 7C CC CC                 213             DB      01CH,00CH,00CH,07CH,0CCH,0CCH,076H,000H ; L.C. D D_64
                76 00                                   214
0328  00 00 78 CC FC C0                 215             DB      000H,000H,078H,0CCH,0FCH,0C0H,078H,000H ; L.C. E D_65
                78 00                                   216
0330  38 6C 60 F0 60 60                 217             DB      038H,06CH,060H,0F0H,060H,060H,0F0H,000H ; L.C. F D_66
                F0 00                                   218
0338  00 00 76 CC CC 7C                 219             DB      000H,000H,076H,0CCH,0CCH,07CH,00CH,0F8H ; L.C. G D_67
                0C F8                                   220
0340  E0 60 6C 76 66 66                 221             DB      0E0H,060H,06CH,076H,066H,066H,0E6H,000H ; L.C. H D_68
                E6 00                                   222
0348  30 00 70 30 30 30                 223             DB      030H,000H,070H,030H,030H,030H,078H,000H ; L.C. I D_69
                78 00                                   224
0350  0C 00 0C 0C 0C CC                 225             DB      00CH,000H,00CH,00CH,00CH,0CCH,0CCH,078H ; L.C. J D_6A
                CC 78                                   226
0358  E0 60 66 6C 78 6C                 227             DB      0E0H,060H,066H,06CH,078H,06CH,0E6H,000H ; L.C. K D_6B
                E6 00                                   228
0360  70 30 30 30 30 30                 229             DB      070H,030H,030H,030H,030H,030H,078H,000H ; L.C. L D_6C
                78 00                                   230
0368  00 00 CC FE FE D6                 231             DB      000H,000H,0CCH,0FEH,0FEH,0D6H,0C6H,000H ; L.C. M D_6D
                C6 00                                   232
0370  00 00 F8 CC CC CC                 233             DB      000H,000H,0F8H,0CCH,0CCH,0CCH,0CCH,000H ; L.C. N D_6E
                CC 00                                   234
0378  00 00 78 CC CC CC                 235             DB      000H,C00H,078H,0CCH,0CCH,0CCH,078H,000H ; L.C. O D_6F
                78 00                                   236
                                                        237
0380  00 00 DC 66 66 7C                 238             DB      000H,000H,0DCH,066H,066H,07CH,060H,0F0H ; L.C. P D_70
                60 F0                                   239
0388  00 00 76 CC CC 7C                 240             DB      000H,000H,076H,0CCH,0CCH,07CH,00CH,01EH ; L.C. Q D_71
                0C 1E                                   241
0390  00 00 DC 76 66 60                 242             DB      000H,000H,0DCH,076H,066H,060H,0F0H,000H ; L.C. R D_72
                F0 00                                   243
0398  00 00 7C C0 78 0C                 244             DB      000H,000H,07CH,0C0H,078H,00CH,0F8H,000H ; L.C. S D_73
                F8 00                                   245
03A0  10 30 7C 30 30 34                 246             DB      010H,030H,07CH,030H,030H,034H,018H,000H ; L.C. T D_74
                18 00                                   247
03A8  00 00 CC CC CC CC                 248             DB      000H,000H,0CCH,0CCH,0CCH,0CCH,076H,000H ; L.C. U D_75
                76 00                                   249
03B0  00 00 CC CC CC 78                 250             DB      000H,000H,0CCH,0CCH,0CCH,078H,030H,000H ; L.C. V D_76
                30 00                                   251
03B8  00 00 C6 D6 FE FE                 252             DB      000H,000H,0C6H,0D6H,0FEH,0FEH,06CH,000H ; L.C. W D_77
                6C 00                                   253
03C0  00 00 C6 6C 38 6C                 254             DB      000H,000H,0C6H,06CH,038H,06CH,0C6H,000H ; L.C. X D_78
                C6 00                                   255
03C8  00 00 CC CC CC 7C                 256             DB      000H,000H,0CCH,0CCH,0CCH,07CH,00CH,0F8H ; L.C. Y D_79
                0C F8                                   257
03D0  00 00 FC 98 30 64                 258             DB      000H,000H,0FCH,098H,030H,064H,0FCH,000H ; L.C. Z D_7A
                FC 00                                   259
03D8  1C 30 30 E0 30 30                 260             DB      01CH,030H,030H,0E0H,030H,030H,01CH,000H ; L BRAK D_7B
                1C 00                                   261
03E0  18 18 18 00 18 18                 262             DB      018H,018H,018H,000H,018H,018H,018H,000H ; | D_7C
                18 00                                   263
03E8  E0 30 30 1C 30 30                 264             DB      0E0H,030H,030H,01CH,030H,030H,0E0H,000H ; R BRAK D_7D
                E0 00                                   265
03F0  76 DC 00 00 00 00                 266             DB      076H,0DCH,000H,000H,000H,000H,000H,000H ; TILDE D_7E
                00 00                                   267
03F8  00 10 38 6C C6 C6                 268             DB      000H,010H,038H,06CH,0C6H,0C6H,0FEH,000H ; DELTA D_7F
                FE 00                                   269
                                                        270
0400                                    271     INT_1F_1        LABEL   BYTE
                                                        272
0400  78 CC C0 CC 78 18                 273             DB      078H,0CCH,0C0H,0CCH,078H,018H,00CH,078H ;  D_80
                0C 78                                   274
0408  00 CC 00 CC CC CC                 275             DB      000H,0CCH,000H,0CCH,0CCH,0CCH,07EH,000H ;  D_81
                7E 00                                   276
0410  1C 00 78 CC FC C0                 277             DB      01CH,000H,078H,0CCH,0FCH,0C0H,078H,000H ;  D_82
                78 00                                   278
0418  7E C3 3C 06 3E 66                 279             DB      07EH,0C3H,03CH,006H,03EH,066H,03FH,000H ;  D_83
                3F 00                                   280
0420  CC 00 78 0C 7C CC                 281             DB      0CCH,000H,078H,00CH,07CH,0CCH,07EH,000H ;  D_84
                7E 00                                   282
0428  E0 00 78 0C 7C CC                 283             DB      0E0H,000H,078H,00CH,07CH,0CCH,07EH,000H ;  D_85
                7E 00                                   284
0430  30 30 78 0C 7C CC                 285             DB      030H,030H,078H,00CH,07CH,0CCH,07EH,000H ;  D_86
                7E 00                                   286
0438  00 00 78 C0 C0 78                 287             DB      000H,000H,078H,0C0H,0C0H,078H,00CH,038H ;  D_87
                0C 38                                   288
0440  7E C3 3C 66 7E 60                 289             DB      07EH,0C3H,03CH,066H,07EH,060H,03CH,000H ;  D_88
                3C 00                                   290
0448  CC 00 78 CC FC C0                 291             DB      0CCH,000H,078H,0CCH,0FCH,0C0H,078H,000H ;  D_89
                78 00                                   292
0450  E0 00 78 CC FC C0                 293             DB      0E0H,000H,078H,0CCH,0FCH,0C0H,078H,000H ;  D_8A
                78 00                                   294
0458  CC 00 70 30 30 30                 295             DB      0CCH,000H,070H,030H,030H,030H,078H,000H ;  D_8B
                78 00                                   296
0460  7C C6 38 18 18 18                 297             DB      07CH,0C6H,038H,018H,018H,018H,03CH,000H ;  D_8C
                3C 00                                   298
0468  E0 00 70 30 30 30                 299             DB      0E0H,000H,070H,030H,030H,030H,078H,000H ;  D_8D
                78 00                                   300
0470  C6 38 6C C6 FE C6                 301             DB      0C6H,038H,06CH,0C6H,0FEH,0C6H,0C6H,000H ;  D_8E
                C6 00                                   302
0478  30 30 00 78 CC FC                 303             DB      030H,030H,000H,078H,0CCH,0FCH,0CCH,000H ;  D_8F
                CC 00                                   304
                                                        305
0480  1C 00 FC 60 78 60                 306             DB      01CH,000H,0FCH,060H,078H,060H,0FCH,000H ;  D_90
                FC 00                                   307
0488  00 00 7F 0C 7F CC                 308             DB      000H,000H,07FH,00CH,07FH,0CCH,07FH,000H ;  D_91
```

```
                7F 00                                   309
0490    3E 6C CC FE CC CC               DB      03EH,06CH,0CCH,0FEH,0CCH,0CCH,0CEH,000H ;  D_92
                CE 00                                   311
0498    78 CC 00 78 CC CC               DB      078H,0CCH,000H,078H,0CCH,0CCH,078H,000H ;  D_93
                78 00                                   313
04A0    00 CC 00 78 CC CC               DB      000H,0CCH,000H,078H,0CCH,0CCH,078H,000H ;  D_94
                78 00                                   315
04A8    00 E0 00 78 CC CC               DB      000H,0E0H,000H,078H,0CCH,0CCH,078H,000H ;  D_95
                78 00                                   317
04B0    78 CC 00 CC CC CC               DB      078H,0CCH,000H,0CCH,0CCH,0CCH,07EH,000H ;  D_96
                7E 00                                   319
04B8    00 E0 00 CC CC CC               DB      000H,0E0H,000H,0CCH,0CCH,0CCH,07EH,000H ;  D_97
                7E 00                                   321
04C0    00 CC 00 CC CC 7C               DB      000H,0CCH,000H,0CCH,0CCH,07CH,00CH,0F8H ;  D_98
                0C F8                                   323
04C8    C3 18 3C 66 66 3C               DB      0C3H,018H,03CH,066H,066H,03CH,018H,000H ;  D_99
                18 00                                   325
04D0    CC 00 CC CC CC CC               DB      0CCH,000H,0CCH,0CCH,0CCH,0CCH,078H,000H ;  D_9A
                78 00                                   327
04D8    18 18 7E C0 C0 7E               DB      018H,018H,07EH,0C0H,0C0H,07EH,018H,018H ;  D_9B
                18 18                                   329
04E0    38 6C 64 F0 60 E6               DB      038H,06CH,064H,0F0H,060H,0E6H,0FCH,000H ;  D_9C
                FC 00                                   331
04E8    CC CC 78 FC 30 FC               DB      0CCH,0CCH,078H,0FCH,030H,0FCH,030H,030H ;  D_9D
                30 30                                   333
04F0    F8 CC CC FA C6 CF               DB      0F8H,0CCH,0CCH,0FAH,0C6H,0CFH,0C6H,0C7H ;  D_9E
                C6 C7                                   335
04F8    0E 1B 18 3C 18 18               DB      00EH,01BH,018H,03CH,018H,018H,0D8H,070H ;  D_9F
                D8 70                                   337
                                                        338
0500    1C 00 78 0C 7C CC               DB      01CH,000H,078H,00CH,07CH,0CCH,07EH,000H ;  D_A0
                7E 00                                   340
0508    38 00 70 30 30 30               DB      038H,000H,070H,030H,030H,030H,078H,000H ;  D_A1
                78 00                                   342
0510    00 1C 00 78 CC CC               DB      000H,01CH,000H,078H,0CCH,0CCH,078H,000H ;  D_A2
                78 00                                   344
0518    00 1C 00 CC CC CC               DB      000H,01CH,000H,0CCH,0CCH,0CCH,07EH,000H ;  D_A3
                7E 00                                   346
0520    00 F8 00 F8 CC CC               DB      000H,0F8H,000H,0F8H,0CCH,0CCH,0CCH,000H ;  D_A4
                CC 00                                   348
0528    FC 00 CC EC FC DC               DB      0FCH,000H,0CCH,0ECH,0FCH,0DCH,0CCH,000H ;  D_A5
                CC 00                                   350
0530    3C 6C 6C 3E 00 7E               DB      03CH,06CH,06CH,03EH,000H,07EH,000H,000H ;  D_A6
                00 00                                   352
0538    38 6C 6C 38 00 7C               DB      038H,06CH,06CH,038H,000H,07CH,000H,000H ;  D_A7
                00 00                                   354
0540    30 00 30 60 C0 CC               DB      030H,000H,030H,060H,0C0H,0CCH,078H,000H ;  D_A8
                78 00                                   356
0548    00 00 00 FC C0 C0               DB      000H,000H,000H,0FCH,0C0H,0C0H,000H,000H ;  D_A9
                00 00                                   358
0550    00 00 00 FC 0C 0C               DB      000H,000H,000H,0FCH,00CH,00CH,000H,000H ;  D_AA
                00 00                                   360
0558    C3 C6 CC DE 33 66               DB      0C3H,0C6H,0CCH,0DEH,033H,066H,0CCH,00FH ;  D_AB
                CC 0F                                   362
0560    C3 C6 CC DB 37 6F               DB      0C3H,0C6H,0CCH,0DBH,037H,06FH,0CFH,003H ;  D_AC
                CF 03                                   364
0568    18 18 00 18 18 18               DB      018H,018H,000H,018H,018H,018H,018H,000H ;  D_AD
                18 00                                   366
0570    00 33 66 CC 66 33               DB      000H,033H,066H,0CCH,066H,033H,000H,000H ;  D_AE
                00 00                                   368
0578    00 CC 66 33 66 CC               DB      000H,0CCH,066H,033H,066H,0CCH,000H,000H ;  D_AF
                00 00                                   370
                                                        371
0580    22 88 22 88 22 88               DB      022H,088H,022H,088H,022H,088H,022H,088H ;  D_B0
                22 88                                   373
0588    55 AA 55 AA 55 AA               DB      055H,0AAH,055H,0AAH,055H,0AAH,055H,0AAH ;  D_B1
                55 AA                                   375
0590    DB 77 DB EE DB 77               DB      0DBH,077H,0DBH,0EEH,0DBH,077H,0DBH,0EEH ;  D_B2
                DB EE                                   377
0598    18 18 18 18 18 18               DB      018H,018H,018H,018H,018H,018H,018H,018H ;  D_B3
                18 18                                   379
05A0    18 18 18 18 F8 18               DB      018H,018H,018H,018H,0F8H,018H,018H,018H ;  D_B4
                18 18                                   381
05A8    18 18 F8 18 F8 18               DB      018H,018H,0F8H,018H,0F8H,018H,018H,018H ;  D_B5
                18 18                                   383
05B0    36 36 36 36 F6 36               DB      036H,036H,036H,036H,0F6H,036H,036H,036H ;  D_B6
                36 36                                   385
05B8    00 00 00 00 FE 36               DB      000H,000H,000H,000H,0FEH,036H,036H,036H ;  D_B7
                36 36                                   387
05C0    00 00 F8 18 F8 18               DB      000H,000H,0F8H,018H,0F8H,018H,018H,018H ;  D_B8
                18 18                                   389
05C8    36 36 F6 06 F6 36               DB      036H,036H,0F6H,006H,0F6H,036H,036H,036H ;  D_B9
                36 36                                   391
05D0    36 36 36 36 36 36               DB      036H,036H,036H,036H,036H,036H,036H,036H ;  D_BA
                36 36                                   393
05D8    00 00 FE 06 F6 36               DB      000H,000H,0FEH,006H,0F6H,036H,036H,036H ;  D_BB
                36 36                                   395
05E0    36 36 F6 06 FE 00               DB      036H,036H,0F6H,006H,0FEH,000H,000H,000H ;  D_BC
                00 00                                   397
05E8    36 36 36 36 FE 00               DB      036H,036H,036H,036H,0FEH,000H,000H,000H ;  D_BD
                00 00                                   399
05F0    18 18 F8 18 F8 00               DB      018H,018H,0F8H,018H,0F8H,000H,000H,000H ;  D_BE
                00 00                                   401
05F8    00 00 00 00 F8 18               DB      000H,000H,000H,000H,0F8H,018H,018H,018H ;  D_BF
                18 18                                   403
                                                        404
0600    18 18 18 18 1F 00               DB      018H,018H,018H,018H,01FH,000H,000H,000H ;  D_C0
                00 00                                   406
0608    18 18 18 18 FF 00               DB      018H,018H,018H,018H,0FFH,000H,000H,000H ;  D_C1
                00 00                                   408
0610    00 00 00 00 FF 18               DB      000H,000H,000H,000H,0FFH,018H,018H,018H ;  D_C2
                18 18                                   410
0618    18 18 18 18 1F 18               DB      018H,018H,018H,018H,01FH,018H,018H,018H ;  D_C3
                18 18                                   412
0620    00 00 00 00 FF 00               DB      000H,000H,000H,000H,0FFH,000H,000H,000H ;  D_C4
                00 00                                   414
0628    18 18 18 18 FF 18               DB      018H,018H,018H,018H,0FFH,018H,018H,018H ;  D_C5
                18 18                                   416
0630    18 18 1F 18 1F 18               DB      018H,018H,01FH,018H,01FH,018H,018H,018H ;  D_C6
                18 18                                   418
0638    36 36 36 36 37 36               DB      036H,036H,036H,036H,037H,036H,036H,036H ;  D_C7
                36 36                                   420
0640    36 36 37 30 3F 00               DB      036H,036H,037H,030H,03FH,000H,000H,000H ;  D_C8
                00 00                                   422
0648    00 00 3F 30 37 36               DB      000H,000H,03FH,030H,037H,036H,036H,036H ;  D_C9
                36 36                                   424
0650    36 36 F7 00 FF 00               DB      036H,036H,0F7H,000H,0FFH,000H,000H,000H ;  D_CA
                00 00                                   426
0658    00 00 FF 00 F7 36               DB      000H,000H,0FFH,000H,0F7H,036H,036H,036H ;  D_CB
                36 36                                   428
0660    36 36 37 30 37 36               DB      036H,036H,037H,030H,037H,036H,036H,036H ;  D_CC
                36 36                                   430
0668    00 00 FF 00 FF 00               DB      000H,000H,0FFH,000H,0FFH,000H,000H,000H ;  D_CD
                00 00                                   432
0670    36 36 F7 00 F7 36               DB      036H,036H,0F7H,000H,0F7H,036H,036H,036H ;  D_CE
                36 36                                   434
```

```
0678  18 18 FF 00 FF 00 00 00      435                DB      018H,018H,0FFH,000H,0FFH,000H,000H,000H ;  D_CF
                                   436
                                   437
0680  36 36 36 36 FF 00 00 00      438                DB      036H,036H,036H,036H,0FFH,000H,000H,000H ;  D_D0
                                   439
0688  00 00 FF 00 FF 18 18 18      440                DB      000H,000H,0FFH,000H,0FFH,018H,018H,018H ;  D_D1
                                   441
0690  00 00 00 00 FF 36 36 36      442                DB      000H,000H,000H,000H,0FFH,036H,036H,036H ;  D_D2
                                   443
0698  36 36 36 36 3F 00 00 00      444                DB      036H,036H,036H,036H,03FH,000H,000H,000H ;  D_D3
                                   445
06A0  18 18 1F 18 1F 00 00 00      446                DB      018H,018H,01FH,018H,01FH,000H,000H,000H ;  D_D4
                                   447
06A8  00 00 1F 18 1F 18 18 18      448                DB      000H,000H,01FH,018H,01FH,018H,018H,018H ;  D_D5
                                   449
06B0  00 00 00 00 3F 36 36 36      450                DB      000H,000H,000H,000H,03FH,036H,036H,036H ;  D_D6
                                   451
06B8  36 36 36 36 FF 36 36 36      452                DB      036H,036H,036H,036H,0FFH,036H,036H,036H ;  D_D7
                                   453
06C0  18 18 FF 18 FF 18 18 18      454                DB      018H,018H,0FFH,018H,0FFH,018H,018H,018H ;  D_D8
                                   455
06C8  18 18 18 18 F8 00 00 00      456                DB      018H,018H,018H,018H,0F8H,000H,000H,000H ;  D_D9
                                   457
06D0  00 00 00 00 1F 18 18 18      458                DB      000H,000H,000H,000H,01FH,018H,018H,018H ;  D_DA
                                   459
06D8  FF FF FF FF FF FF FF FF      460                DB      0FFH,0FFH,0FFH,0FFH,0FFH,0FFH,0FFH,0FFH ;  D_DB
                                   461
06E0  00 00 00 00 FF FF FF FF      462                DB      000H,000H,000H,000H,0FFH,0FFH,0FFH,0FFH ;  D_DC
                                   463
06E8  F0 F0 F0 F0 F0 F0 F0 F0      464                DB      0F0H,0F0H,0F0H,0F0H,0F0H,0F0H,0F0H,0F0H ;  D_DD
                                   465
06F0  0F 0F 0F 0F 0F 0F 0F 0F      466                DB      00FH,00FH,00FH,00FH,00FH,00FH,00FH,00FH ;  D_DE
                                   467
06F8  FF FF FF FF 00 00 00 00      468                DB      0FFH,0FFH,0FFH,0FFH,000H,000H,000H,000H ;  D_DF
                                   469
                                   470
0700  00 00 76 DC C8 DC 76 00      471                DB      000H,000H,076H,0DCH,0C8H,0DCH,076H,000H ;  D_E0
                                   472
0708  00 78 CC F8 CC F8 C0 C0      473                DB      000H,078H,0CCH,0F8H,0CCH,0F8H,0C0H,0C0H ;  D_E1
                                   474
0710  00 FC CC C0 C0 C0 C0 00      475                DB      000H,0FCH,0CCH,0C0H,0C0H,0C0H,0C0H,000H ;  D_E2
                                   476
0718  00 FE 6C 6C 6C 6C 6C 00      477                DB      000H,0FEH,06CH,06CH,06CH,06CH,06CH,000H ;  D_E3
                                   478
0720  FC CC 60 30 60 CC FC 00      479                DB      0FCH,0CCH,060H,030H,060H,0CCH,0FCH,000H ;  D_E4
                                   480
0728  00 00 7E D8 D8 D8 70 00      481                DB      000H,000H,07EH,0D8H,0D8H,0D8H,070H,000H ;  D_E5
                                   482
0730  00 66 66 66 66 7C 60 C0      483                DB      000H,066H,066H,066H,066H,07CH,060H,0C0H ;  D_E6
                                   484
0738  00 76 DC 18 18 18 18 00      485                DB      000H,076H,0DCH,018H,018H,018H,018H,000H ;  D_E7
                                   486
0740  FC 30 78 CC CC 78 30 FC      487                DB      0FCH,030H,078H,0CCH,0CCH,078H,030H,0FCH ;  D_E8
                                   488
0748  38 6C C6 FE C6 6C 38 00      489                DB      038H,06CH,0C6H,0FEH,0C6H,06CH,038H,000H ;  D_E9
                                   490
0750  38 6C C6 C6 6C 6C EE 00      491                DB      038H,06CH,0C6H,0C6H,06CH,06CH,0EEH,000H ;  D_EA
                                   492
0758  1C 30 18 7C CC CC 78 00      493                DB      01CH,030H,018H,07CH,0CCH,0CCH,078H,000H ;  D_EB
                                   494
0760  00 00 7E DB DB 7E 00 00      495                DB      000H,000H,07EH,0DBH,0DBH,07EH,000H,000H ;  D_EC
                                   496
0768  06 0C 7E DB DB 7E 60 C0      497                DB      006H,00CH,07EH,0DBH,0DBH,07EH,060H,0C0H ;  D_ED
                                   498
0770  38 60 C0 F8 C0 60 38 00      499                DB      038H,060H,0C0H,0F8H,0C0H,060H,038H,000H ;  D_EE
                                   500
0778  78 CC CC CC CC CC CC 00      501                DB      078H,0CCH,0CCH,0CCH,0CCH,0CCH,0CCH,000H ;  D_EF
                                   502
                                   503
0780  00 FC 00 FC 00 FC 00 00      504                DB      000H,0FCH,000H,0FCH,000H,0FCH,000H,000H ;  D_F0
                                   505
0788  30 30 FC 30 30 00 FC 00      506                DB      030H,030H,0FCH,030H,030H,000H,0FCH,000H ;  D_F1
                                   507
0790  60 30 18 30 60 00 FC 00      508                DB      060H,030H,018H,030H,060H,000H,0FCH,000H ;  D_F2
                                   509
0798  18 30 60 30 18 00 FC 00      510                DB      018H,030H,060H,030H,018H,000H,0FCH,000H ;  D_F3
                                   511
07A0  0E 1B 1B 18 18 18 18 18      512                DB      00EH,01BH,01BH,018H,018H,018H,018H,018H ;  D_F4
                                   513
07A8  18 18 18 18 18 D8 D8 70      514                DB      018H,018H,018H,018H,018H,0D8H,0D8H,070H ;  D_F5
                                   515
07B0  30 30 00 FC 00 30 30 00      516                DB      030H,030H,000H,0FCH,000H,030H,030H,000H ;  D_F6
                                   517
07B8  00 76 DC 00 76 DC 00 00      518                DB      000H,076H,0DCH,000H,076H,0DCH,000H,000H ;  D_F7
                                   519
07C0  38 6C 6C 38 00 00 00 00      520                DB      038H,06CH,06CH,038H,000H,000H,000H,000H ;  D_F8
                                   521
07C8  00 00 00 18 18 00 00 00      522                DB      000H,000H,000H,018H,018H,000H,000H,000H ;  D_F9
                                   523
07D0  00 00 00 00 18 00 00 00      524                DB      000H,000H,000H,000H,018H,000H,000H,000H ;  D_FA
                                   525
07D8  0F 0C 0C 0C EC 6C 3C 1C      526                DB      00FH,00CH,00CH,00CH,0ECH,06CH,03CH,01CH ;  D_FB
                                   527
07E0  78 6C 6C 6C 6C 00 00 00      528                DB      078H,06CH,06CH,06CH,06CH,000H,000H,000H ;  D_FC
                                   529
07E8  70 18 30 60 78 00 00 00      530                DB      070H,018H,030H,060H,078H,000H,000H,000H ;  D_FD
                                   531
07F0  00 00 3C 3C 3C 3C 00 00      532                DB      000H,000H,03CH,03CH,03CH,03CH,000H,000H ;  D_FE
                                   533
07F8  00 00 00 00 00 00 00 00      534                DB      000H,000H,000H,000H,000H,000H,000H,000H ;  D_FF
                                   535
0800                               536  CODE          ENDS
                                   537                END


                                   1                  PAGE,120
                                   2                  SUBTTL  END ADDRESS
0000                               3  CODE            SEGMENT PUBLIC
                                   4                  PUBLIC  END_ADDRESS
0000                               5  END_ADDRESS     LABEL   BYTE
0000                               6  CODE            ENDS
                                   7                  END
```

Index

A

B

C

D

E

F

G

H

I

L

M

O

P

R

S

U

V