INSTRUCTION MANUAL

Sensoray Model 322

PC104+ Video Graphics Adapter
Manual Revision B
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Limited Warranty

Sensoray Company, Incorporated (Sensoray) warrants the Model 322 hardware to be free from defects in material and workmanship and perform to applicable published Sensoray specifications for two years from the date of shipment to purchaser. Sensoray will, at its option, repair or replace equipment that proves to be defective during the warranty period. This warranty includes parts and labor.

The warranty provided herein does not cover equipment subjected to abuse, misuse, accident, alteration, neglect, or unauthorized repair or installation. Sensoray shall have the right of final determination as to the existence and cause of defect.

As for items repaired or replaced under warranty, the warranty shall continue in effect for the remainder of the original warranty period, or for ninety days following date of shipment by Sensoray of the repaired or replaced part, whichever period is longer.

A Return Material Authorization (RMA) number must be obtained from the factory and clearly marked on the outside of the package before any equipment will be accepted for warranty work. Sensoray will pay the shipping costs of returning to the owner parts that are covered by warranty.

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1. Special Handling Instructions

The Model 322 circuit board contains CMOS circuitry that is sensitive to Electrostatic Discharge (ESD).
Special care should be taken in handling, transporting, and installing the Model 322 to prevent ESD damage to the board. In particular:

- Do not remove the circuit board from its protective anti-static bag until you are ready to configure the board for installation.
- Handle the circuit board only at grounded, ESD protected stations.
- Remove power from the PCI system before installing or removing the circuit board.

2. Introduction

2.1 General description

The Sensoray Model 322 is a compact, rugged, and low cost PC104+ Video Graphics Adapter that combines the functionality of a high-powered desktop graphics adapter to provide a powerful graphics solution for embedded applications. The 322 is suitable for high bandwidth video and multimedia embedded applications taking full advantage of the PCI bus throughput, very wide video buffer memory, and multiple onboard video engines. Using the very latest in single chip video graphics controller, lower power consumption, enhanced reliability and ruggedness are characteristics of the 322. The 322 is compatible with any PC/104+ complaint CPU board such as the Sensoray Model 1101.

Outputs for a CRT monitor (RGB), a LCD flat panel display (DSTN and TFT), and a TV (NTSC and PAL) are available on the 322. Both composite and S-Video connectors are provided for TV output. The 322 allows for the LCD and CRT display devices to be used simultaneously. In addition, using Dual View capabilities, two different applications can be displayed on different devices or a portion of the primary display on the secondary display.

The 322 is fully VGA register compatible and can be used with any operating system that has a VGA drivers. A fully compliant VGA BIOS provides full compatibility with PC based systems. Enhanced drivers, available for Microsoft Windows 95, Windows 98, Windows 2000, Windows NT and LINUX, extend the functionality of the 322 by using the high performance capabilities of the video graphics controller (the advanced user can access the higher capabilities of the 322 in other operating systems by writing an appropriate driver that accesses the graphic controller's registers. Additional drivers may be available from Sensoray in the future.)

2.2 Features

2.2.1 VGA Core

The 322 has a high performance 32-bit VGA core which is 100% IBM VGA compatible. The core provides all standard VGA functions. The 322 has a fully IBM PC compatible VGA BIOS.

2.2.2 Video Memory System

The Model 322 comes standard with 2.5MB of high speed video memory on a 128-bit memory bus embedded in the controller chip. With 2.5MB full color (24-bit) can be displayed at a maximum resolution of 1024x768 pixels.

2.2.3 CRT Interface

The 322 has a high speed, up to 135MHz, pixel clock for CRT displays. This allows for very high resolution at high vertical refresh rates. For example a vertical refresh rate of 75Hz at 1024x768 resolution or 85Hz at 640x480. At 1600x1280 a refresh rate of 60Hz is achieved.

2.2.4 TV Output

The 322 has both composite and S-Video TV outputs. Both NTSC and PAL standards are supported. A high quality BNC connector, for the composite signal, and a standard S-Video are provided onboard.

2.2.5 LCD Controller

The 322's LCD controller supports both color dual scan STN (passive) and color TFT (active) LCD panels. It can also support color TFT panel with RGB interface. The 322 has support for 16-bit color DSTN panels with resolution of up to 1280x1024. For color TFT panels, the 322 supports 9, 12, and 18-bit interfaces at single pixel per clock timing at up to 1280x1024 resolutions. The 322 also includes various features such as: LCD auto-centering, LCD screen expansion (including XY interpolation screen expansion), virtual refresh, and special dithering engines for TFT and DSTN flat panels. The LCD interface uses 3.3V voltage levels compatible with most low power LCD flat panels.

2.2.6 Graphics and Video Engines

A set of powerful graphics engines designed to accelerate 2D and 3D graphics. These engines include an IEEE floating point setup unit, a full featured 3D rendering engine, a 128-bit 2D drawing engine, a motion compensation block, and a video processor block. The drawing engine supports key GUI functions such as 3 operand ALU with 256 raster operations, pattern BLT, color expansion, trapezoid fill, and line draw. The IEEE Floating Point Setup and 3D rendering engines combine to

give high end 3D graphics performance to embedded computer systems with such features as Mip Mapping, Alpha Blending, Anti-Aliasing, Specular Highlights, and Fog, supported. For MPEG decoding, the motion compensation engine can significantly reduce CPU overhead. The video processor block manages the video of different video data formats and can perform such conversion as YUV to RGB and perform flicker reduction and adjustable overscan/underscan for TV display.

The 322's graphics and engines are designed to accelerate 2D and 3D graphics primarily through API's such as Microsoft Direct Draw and Direct3D. Some of the features can, however, be used by simply accessing on board registers; Silicon Motion Inc. documentation is required. The drawing/3D engine pipeline runs at a single clock per cycle at speeds up to 100MHz. If the customer is interested in developing their own API's, he/she should contact Silicon Motion Inc. for further information on the subject.

3. Specifications

This section lists the technical specifications of the Model 322 graphics adapter module.

3.1 Bus Specifications

PC/104-*plus* Specification Version 1.1 compliant
PCI Revision 2.1 compliant
PC/104 (ISA) compliant (see PC/104 specification V2.3)
Slot selection jumpers provided (Because of the stack through nature of the bus)

3.2 Video modes

All IBM compatible VGA modes are supported by the 322 BIOS. In addition, several extended modes are available including support for 132 columns, 1280x1024, 1024x768 and 800x600 resolutions, and higher color depths.
Notes on BIOS support for extended modes:
Bios support for all non-IBM standard VGA modes consists only of the ability to set the mode. Other BIOS calls such as write character, scrolling, write pixel etc., are not supported. Software applications and drivers should not expect the BIOS to do anything other than setting the mode.

3.2.1 Standard IBM Compatible VGA Modes

Table 1 Standard IBM Compatible VGA Modes

Mode# (Hex)	Type	Colors	Alpha	Resolution	Font	Clock (MHz)	Hsync (KHz)	Vsync (Hz)	Memory (Min)	Buffer Start	Page 1
0,1	TXT	16	40x25	320x200	8x8	25.175	31.55	70.3	256K	B8000	8
0,1*	TXT	16	40x25	320x350	8x14	25.175	31.55	70.3	256K	B8000	8
0,1+	TXT	16	40x25	360x400	9x16	28.322	31.34	69.8	256K	B8000	8
2,3	TXT	16	80x25	640x200	8x8	25.175	31.55	70.3	256K	B8000	8
2,3*	TXT	16	80x25	640x350	8x14	25.175	31.55	70.3	256K	B8000	8
2,3+	TXT	16	80x25	720x400	9x16	28.322	31.34	69.8	256K	B8000	8
4,5	Gr	4	40x25	320x200	8x8	25.175	31.55	70.3	256K	B8000	1
6	Gr	2	80x25	640x200	8x8	25.175	31.55	70.3	256K	B8000	1
7	TXT	Mono	80x25	720x350	9x14	28.322	31.34	69.8	256K	B8000	8
7+	TXT	Mono	80x25	720x400	9x16	28.322	31.34	69.8	256K	B8000	8
D	Gr	16	40x25	320x200	8x8	25.175	31.55	70.3	256K	A0000	8
E	Gr	16	80x25	640x200	8x8	25.175	31.55	70.3	256K	A0000	4
F	Gr	Mono	80x25	640x350	8x14	25.175	31.55	70.3	256K	A0000	2
10	Gr	16	80x25	640x350	8x14	25.175	31.55	70.3	256K	A0000	2
11	Gr	2	80x30	640x480	8x16	25.175	31.55	60.1	256K	A0000	1
12	Gr	16	80x30	640x480	8x16	25.175	31.55	60.1	256K	A0000	1
13	Gr	256	40x25	320x200	8x8	25.175	31.55	70.3	256K	A0000	1

(Note: For modes 3 and 7, 8-dot fonts are used on the LCD)

3.2.2 Vesa Super VGA Modes

Vesa extended video modes are supported by the 322 BIOS (subject to the constrains of the video subsystem hardware) as follows:

Table 2 VESA Super VGA Modes

Mode# (Hex)	Extended Mode	Type	Colors	Alpha	Resolution	Font	Memory (Min)	Vsync (Hz)
101	50	Gr	256	80x30	640x480	8x16	512K	A0000
102	6A	Gr	16	100x75	800x600	8x8	256K	A0000
103	55	Gr	256	100x75	800x600	8x8	512K	A0000
104	6B	Gr	16	128x48	1024x768	8x16	512K	A0000
105	60	Gr	256	128x48	1024x768	8x16	1M	A0000
107	65	Gr	256	160x64	1280x1024	8x16	2M	A0000
111	52	Gr	64K	80x30	640x480	8x16	1M	A0000
112	53	Gr	16M	80x30	640x480	8x16	1M	A0000
114	57	Gr	64K	100x75	800x600	8x8	1M	A0000
115	58	Gr	16M	100x75	800x600	8x8	2M	A0000
117	62	Gr	64K	128x100	1024x768	8x8	2M	A0000
118	63	Gr	16M	128x100	1024x768	8x8	4M	A0000
11A	67	Gr	64K	160x128	1280x1024	8x8	4M	A0000
11B	68	Gr	16M	160x128	1280x1024	8x8	4M	A0000

3.2.3 Extended Modes

The 322 BIOS supports NTSC and PAL modes for TV as well as extended graphics modes.
Resolutions of the extended graphics modes start from 320x200 up to 1280x1024. In addition, the BIOS supports hi-color modes with resolutions up to 1280x1024, and 16M colors with resolutions up to 1280x1024.

3.2.4 NTSC and PAL TV Modes

The 322 displays both NTSC and PAL interlaced and at a resolution of 640x480. Note that all TV modes are used by the BIOS and Windows driver internally to support TV features. Unexpected results may occur if users try to call these modes through the BIOS.

3.2.5 Low Resolution Modes

The 322 BIOS supports low resolution modes from 320x200 to 640x400 in 8/16-bit colors for DirectDraw. The low resolution modes are defined as follows:

Table 3 Low Resolution Modes

Mode# (Hex)	Type	Colors	Resolutions	Vsync (Hz)	Video Memory	Buffer Start
40	Gr	256	320x200	70	1MB	A0000
41	Gr	64K	320x200	70	1MB	A0000
42	Gr	256	320x240	75/60	1MB	A0000
43	Gr	64K	320x240	75/60	1MB	A0000
44	Gr	256	400x300	75/60	1MB	A0000
45	Gr	64K	400x300	75/60	1MB	A0000
46	Gr	256	512x384	75	1MB	A0000
47	Gr	64K	512x384	75	1MB	A0000
48	Gr	256	640x400	70	1MB	A0000
49	Gr	64K	640x400	70	1MB	A0000

(Note: For modes 3 and 7, 8-dot fonts are used on the LCD.)

3.2.6 640x480 Extended Modes

Table 4 640x480 Extended Modes										
Mode# (Hex)	VESA Mode# (Hex)	Type	Colors	Alpha Format	Font	VCLK (MHz)	Hsync +/- (KHz)	Vsync +/- (Hz)	Video Memory	Buffer Start
50	101	Gr	256	80x30	8x16	25.0	31.5	60	512KB	A0000
						31.5	37.5	75		
						36.0	43.3	85		
52	111	Gr	64K (16-bit)	80x30	8x16	25.0	31.5	60	1MB	A0000
						31.5	37.5	75		
						36.0	43.3	85		
53	112	Gr	16M (24-bit)	80x30	8x16	25.0	31.5	60	1MB	A0000
						31.5	37.5	75		
						36.0	43.3	85		
54		Gr	16M (32-bit)	80x30	8x16	25.0	31.5	60	2MB	A0000
						31.5	37.5	75		
						36.0	43.3	85		

3.2.7 800x600 Resolution Modes

Table 5 800x600 Resolution Modes										
Mode# (Hex)	VESA Mode# (Hex)	Type	Colors	Alpha Format	Font	VCLK (MHz)	Hsync +/- (KHz)	Vsync +/- (Hz)	Video Memory	Buffer Start
6A	6A	Gr	16	100x75	8x8	40.0	37.9	60	256KB	A0000
55	103	Gr	256	100x75	8x8	40.0	37.9	60	512KB	A0000
						49.5	46.9	75		
						56.25	53.7	85		
57	114	Gr	64K (16-bit)	100X75	8X8	40.0	37.9	60	1MB	A0000
						49.5	46.9	75		
						56.25	53.7	85		
58	115	Gr	16M (16-bit)	100X75	8X8	40.0	37.9	60	2MB	A0000
						49.5	46.9	75		
						56.25	53.7	85		
59		Gr	16M (24-bit)	100X75	8X8	40.0	37.9	60	2MB	A0000
						49.5	46.9	75		
						56.25	53.7	85		

3.2.8 1024x768 Extended Resolution Modes

Table 6 1024x768 Extended Resolution Modes										
Mode# (Hex)	VESA Mode# (Hex)	Type	Colors	Alpha Format	Font	VCLK (MHz)	Hsync +/- (KHz)	Vsync +/- (Hz)	Video Memory	Buffer Start
6B	104	Gr	16	128x48	8x16	65.0	48.4	60	512KB	A0000
60	105	Gr	256	128x48	8x16	65.0	48.4	60	1MB	A0000
						78.75	60.0	75		
						94.5	68.7	85		
62	117	Gr	64K (16-bit)	128x48	8x16	65.0	48.4	60	2MB	A0000
						78.75	60.0	75		
						94.5	68.7	85		
63	118	Gr	16M (24-bit)	128x48	8x16	65.0	48.4	60	4MB	A0000
						78.75	60.0	75		
						94.5	68.7	85		
64		Gr	16M (32-bit)	128x48	8x16	65.0	48.4	60	4MB	A0000
						78.75	60.0	75		
						94.5	68.7	85		

NOTE: For the above resolutions, the refresh rate for LCD and Simul mode is 60Hz.

3.2.9 1280x1024 Resolution Modes for CRT only

Table 7 1280x1024 Resolution Modes for CRT only										
Mode# (Hex)	VESA Mode# (Hex)	Type	Colors	Alpha Format	Font	VCLK (MHz)	Hsync +/- (KHz)	Vsync +/- (Hz)	Video Memory	Buffer Start
65	107	Gr	256	160x64	8x16	78.75	47	43(I)	2MB	A0000
67	11A	Gr	64K	160x64	8x16	78.75	47	43(I)	4MB	A0000
68	11B	Gr	16M (24-bit)	160x64	8x16	78.75	47	43(I)	4MB	A0000

3.2.10 1280x1024 Extended Modes for LCD only

Table 8 1280x1024 Extended Modes for LCD only										
Mode# (Hex)	VESA Mode# (Hex)	Type	Colors	Alpha Format	Font	VCLK (MHz)	Hsync +/- (KHz)	Vsync +/- (Hz)	Video Memory	Buffer Start
65	107	Gr	256	160x64	8x16	85	50.3	47	2MB	A0000
67	11A	Gr	64K	160x64	8x16	85	50.3	47	4MB	A0000
68	11B	Gr	16M (24-bit)	160x64	8x16	85	50.3	47	4MB	A0000

Note that Simul mode is not supported for 1280x1024 as well as interlaced modes.

3.2.11 1280x1024 Extended Modes

Table 9 1280x1024 Extended Modes										
Mode# (Hex)	VESA Mode# (Hex)	Type	Colors	Alpha Format	Font	VCLK (MHz)	Hsync +/- (KHz)	Vsync +/- (Hz)	Video Memory	Buffer Start
65	107	Gr	256	160x64	8x16	78.75	47	43(I)	2MB	A0000
						108	64	60		
						135	79.98	75		
67	11A	Gr	64K (16-bit)	160x64	8x16	78.75	47	43(I)	4MB	A0000
						108	64	60		
						135	79.98	75		
68	11B	Gr	16M (24-bit)	160x64	8x16	78.75	47	43(I)	4MB	A0000
						108	64	60		
						135	79.98	75		

3.3 Driver support

MS-DOS using VGA BIOS
MS Windows 95
MS Windows 98
MS Windows 2000
MS Windows NT
LINUX

3.4 Board Size

Size 4.5 x 3.8 x 0.6 inches (114 x 97 x 15 mm)
Compatible with the PC/104+ specification, slightly wider to accommodate connectors.
Weight Adapter only: 3.5 oz. (100 gm)

3.5 Power Specifications

Power consumption: 3.75W, typical @ 5Vdc ±5%.
This value will depend on the displays selected and the resolution being used.

3.6 Operating Environment

Operating Temperature Range: 0°C to 70°C.
Humidity: 5 to 95% relative humidity (non-condensing).
Storage temperature: -55°C to +85°C.

3.7 Power On Configuration

The 322 is configured to boot with the CRT display enabled and all other displays disabled.
The default LCD type is set to 800x600 TFT. Contact Sensoray for other resolutions or for DSTN.

3.8 Supported LCD flat panels

3.8.1 Supported XGA Panels 1024x768

Table 10 Supported XGA Panels 1024x768

Manufacturer	Panel Type	Interface type	Model Number
Sharp	DSTN	24-bit	LM1577 (300ms)
Sharp	DSTN	24-bit	LM13X32
Torisan (Sanyo)	DSTN	24-bit	LM-GD53-22NAZ (300ms)
NEC	TFT	12-bit x 2	NL10276AC24-01
Hitachi	TFT	18-bit	TX31D61VC1CBD (Single chip 65MHz LVDS)
Hitachi	TFT	18-bit	TX34D68VC1CCA
Hyundai	TFT	18-bit	HT14X11-101
Torisan	TFT	18-bit	TM133XG-02L02

3.8.2 Supported SVGA Panels 800x600

Table 11 Supported SVGA Panels 800x600			
Manufacturer	Panel Type	Interface type	Model Number
Hitachi	DSTN	16-bit	LMG9982ZWCC (300ms)
Hitachi	DSTN	16-bit	LMG9980ZWCC-02 (300ms)
Hitachi	DSTN	16-bit	SX31S002
Sanyo	DSTN	16-bit	FE53-22WTK (300ms)
Sanyo	DSTN	16-bit	LM-JK63-22NTR (150ms)
Advanced Display Inc.	TFT	18-bit	AA121SJ01
HITACHI	TFT	18-bit	TX31D27VC1CCAA
IBM	TFT	18-bit	ITSV53L
National/Panasonic	TFT	18-bit	EDTCB11QEF
NEC	TFT	18-bit	NL8060AC26
Samsung	TFT	18-bit	LT12151-153
Sharp	TFT	18-bit	LQ11S42
Sharp	TFT	18-bit	LQ12S31

3.8.3 Supported VGA Panels 640x480

Table 12 Supported VGA Panels 640x480			
Manufacturer	Panel Type	Interface type	Model Number
Tottori Sanyo	DSTN	16-bit	LM-DD53-22NEK
Sharp	TFT	18-bit	LQ10D421/LQ104V1DG11
NEC	TFT	18-bit	NL6448BC33
Panasonic	TFT	18-bit	EDTCB07QLF

3.9 Connector Information

3.9.1 CRT VGA Connector (J6)

Any industry standard DB 15 male connector will plug into this connector. For pin outs see Table 15 Page 9

3.9.2 Composite Video connector (J3)

Any industry standard male RCA type video (phone) jack will plug into this connector.

3.9.3 S-Video connector (J1)

Any industry standard 4 pin male Mini Din connector will plug into this connector. For pin outs see Table 17 Page 16.
Example: Digikey part# 2751029ND

3.9.4 Mixed Signal Header (J2)

The connector mounted on the board is a 20 pin, shrouded, 2mm header. For pin outs see Table 16 Page 16.
Molex part # 87331-2020.
Consult Molex to find an IDC ribbon cable connector that will mate with this connector.
Note When selecting a connector/cable combination for this connector make sure that the cable exits the connector in the correct direction so that it does not exit into the CRT VGA connector (J6).

3.9.5 LCD flat panel connector (J4)

The connector mounted on the board is a 30 pin, shrouded, 2mm right angled header. For pin outs see Table 19 Page 17.
Molex part# 87333-3020.
Consult Molex to find an IDC ribbon cable connector that will mate with this connector.

4. Installation

4.1 Introduction

This chapter describes how to configure, connect and install the Sensoray Model 322 PC104+ Video Graphics Adapter.

4.2 PCI Slot and Interrupt Jumper Configuration

All PCI based systems require unique signal lines to be routed to each PCI slot. Because a PC/104+ system's cards are stacked and all the PCI signals are bussed, the PCI slot is selected on the individual expansion card. There is a set of jumpers on the 322 for PCI slot selection. Each PC/104+ card must have a unique slot number selected in order to avoid address conflicts.
NOTE: The 322 cannot behave as a PCI bus master when setup for slot 3. This is because the PCI signals, GNT and REQ, are not connected for this slot.

4.2.1 PCI Slot Selection

Check the legend printed on the printed circuit board alongside the slot selection jumpers (JP2, JP3, JP5, JP6) to determine the physical position of the jumper for the position shown in Table 13 above.

Table 13 PCI Slot Selection

Slot number	Jumper position (Must be set the same on JP2, JP3, JP5, JP6)
0	2-4
1	4-6
2	1-3
3	3-5

4.2.2 PCI Interrupt Selection

The PCI interrupt that will be routed to the 322 is selected using JP4.

Table 14 PCI Interrupt

Interrupt	JP4 jumper position.
A	2-4
B	4-6
C	1-3
D	3-5

4.3 CRT interfacing

The 322 has a standard 15-pin DB style VGA connector (J6) for easy CRT monitor interfacing. These signals are also available on the mixed signal header 20 pin 2mm metric header (J2). Only analog monitors are supported. The 322 supports nearly all compatible multi-frequency VGA type monitors. A pinout summary of the DB15 connector is given in Table 15 and of the Mixed signal header in Table 16.
The CRT output signals are conditioned with ferrite beads on the board to minimize EMI (electromagnetic interference). Still, care should be taken to shield the embedded system and the video output cables to keep RF emissions as low as possible. FCC RF emissions regulations may apply to systems built with the 322. It is the responsibility of the customer to make their systems compliant with FCC regulations.

Table 15 CRT DB15 (J6) pinout

Pin	Function
1	Red
2	Green
3	Blue
4	N/C
5	Ground
6	Signal Ground
7	Signal Ground
8	Signal Ground
9	N/C
10	Ground
11	Ground
12	N/C
13	Horizontal Sync
14	Vertical Sync
15	N/C

Table 16 Mixed Header (J2) pinout

Pin	Function
1	Signal Ground
2	
3	Signal Ground
4	
5	Signal Ground
6	Signal Ground
7	Red
8	Signal Ground
9	Green
10	Signal Ground
11	Blue
12	Signal Ground
13	Ground
14	Horizontal Sync
15	Ground
16	Vertical Sync
17	Ground
18	Signal Ground
19	Composite Video
20	Signal Ground

4.4 TV Interfacing

The 322 has two TV outputs: A composite and a S-video output. A BNC, J3, is provided for the composite signals and a standard 4-pin Mini-DIN connector, J1, for the S-video signal. Standard video cables can be used to connect the 322 to either a NTSC or PAL TV monitor. Both of these sets of signals are also available on the mixed signal header J2. (See Table 16 P16).

Table 17 S-Video (J1) pinout

Pin	Function
1	Y-Out
2	C-Out
3	Signal ground
4	Signal ground

4.5 LCD interfacing

4.5.1 LCD Type Selection

Prior to connecting the LCD panel jumpers JP7, JP8, JP9, JP10 must be set for either DSTN or TFT type panels.

Table 18 LCD Type Selection Jumpers

Type	JP7, JP8, JP9, JP10 jumper positions.
DSTN	1-2
TFT	2-3

All the signals needed for a variety of DSTN (16-bit) or TFT (9/12/18-bit) color LCD flat panels are provided on J4. The 322 uses 3.3V signaling and has CMOS outputs. Cable lengths should be kept short, if longer cables are required external buffering should be used.

WARNING: Standard CMOS precautions should be observed with the 322 LCD outputs.

4.5.2 LCD Connector and Pinouts

The flat panel interface signals appear at the 30-pin 2mm metric header connector, J4, as shown in Table 19. Signal names are different for DSTN and TFT displays and there is no generally agreed upon standard among flat panel manufacturers. The names we use and the descriptions of the signal should provide enough information to connect either a DSTN or TFT flat panel.

Signal descriptions

R0-R5 - TFT red signal bits.
G0-G5 - TFT green signal bits.
B0-B5 - TFT blue signal bits.
LD0-UD7 - Lower 8-bits of a 16-bit DSTN display.
UD0-UD7 - Upper 8-bits of a 16-bit DSTN display.
HSYNC - Horizontal Sync pulse for TFT displays.
VSYNC - Vertical Sync pulse for TFT displays.
LP - Load Pulse. A DSTN equivalent of HSYNC.
XCK, CK - Flat panel shift clock. This is the pixel clock for flat panel data.
FP - Frame Load Pulse. A DSTN equivalent of VSYNC.
ENABLE - Display Enable. This signal is used to indicate the active horizontal display time.
FPEN - Flat Panel enable. This signal needs to become active after all panel voltages, clocks, and data are supplied. This signal also needs to become inactive before any panel voltages or control signals are removed.
VEE_EN - Panel Enable VEE. This is one of the two power sequencing signals that are used to control power lines connected to an LCD flat panel. This one is designed to properly control the VEE supply to the panel. See the following section for details.
VDD_EN - Panel Enable VDD. This is one of the two power sequencing signals that are used to control power lines connected to an LCD flat panel. This one is designed to properly control the main power to the panel. See the following section for details.

Table 19 LCD connector (J4)

Pin	Color DSTN	Color TFT (1 pix/clk)		
	16-Bit	9-Bit	12-Bit	18-Bit
1	Ground	Ground	Ground	Ground
2	Ground	Ground	Ground	Ground
3	LD0	B0	B0	B0
4	LD1	B1	B1	B1
5	LD2	B2	B2	B2
6	LD3	Not used	B3	B3
7	LD4	Not used	Not used	B4
8	LD5	Not used	Not used	B5
9	LD6	G0	G0	G0
10	LD7	G1	G1	G1
11	Ground	Ground	Ground	Ground
12	UD2	G2	G2	G2
13	UD3	Not used	G3	G3
14	UD0	Not used	Not used	G4
15	UD1	Not used	Not used	G5
16	UD4	R0	R0	R0
17	UD5	R1	R1	R1
18	UD6	R2	R2	R2
19	UD7	Not used	R3	R3
20	Ground	Ground	Ground	Ground
21	Not used	Not used	Not used	R4
22	Not used	Not used	Not used	R5
23	LP	HSYNC	HSYNC	HSYNC
24	FP	VSYNC	VSYNC	VSYNC
25	Not used	ENABLE	ENABLE	ENABLE
26	FPEN	FPEN	FPEN	FPEN
27	XCK	CK	CK	CK
28	VDD_EN	VDD_EN	VDD_EN	VDD_EN
29	Ground	Ground	Ground	Ground
30	VEE_EN	VEE_EN	VEE_EN	VEE_EN

4.5.3 LCD Power Sequencing

Most LCD panels are sensitive to the order in which power and control signals are applied during start up and how they are removed during shut down. LCD panel manufacturers warn of damaging panels or limiting their life span unless proper precautions are taken. If an LCD display is used, you will need to provide power-switching circuits. Power sequencing requirements can vary from panel to panel. In general, however, the startup sequence is:

1. Apply VDD to the panel
2. Apply control and data signals
3. Apply VEE to the panel
4. Set FPEN active

Similarly, when powering down the sequence is:

1. Set FPEN inactive
2. Remove VEE from the panel
3. Remove control and data signals
4. Remove VDD from the panel

The 322 provides signaling for power sequencing that is compatible with most flat panels. The signals VEE_EN and VDD_EN are usually used to drive external power switches. The switch circuitry design depends on the requirements of the specific LCD display. Contact the display manufacturer for the required information.

4.6 Drivers

Once the Sensoray 322 board is physically installed. Boot the operating system and choose to upgrade or install with one of the display device drivers provided by Sensoray.
If any of the advanced features like rotation, display switching etc are to be used then download the control panel application. The same control panel install program is used for all the Windows products supported.
This will integrate into the desktop display settings and allow the user to switch displays and exercise various other functions of the 322 board.
Download the control panel from: (Approximately 10M).

5. BIOS

5.1 Overview

This section discusses the 322 BIOS functionality. The Bios includes all IBM standard VGA modes as well as extended VGA modes ranging from 640x480 up to 1280x1024 and VESA compatible modes. The BIOS also provides extended BIOS function calls for implementing various features of the 322.

5.2 BIOS Size and Format

The 322 is supplied with a version of the BIOS burnt into about 48K of a 64K EPROM.
The BIOS is also available as a RAM BIOS, which is a TSR version of the EPROM version. Contact Sensoray for further information.

5.3 Bios Features

5.3.1 Flat Panel Expansion

A 1024x768 panel is expanded to 960x750 except for 640x480 resolution which is expanded to 960x720 for better display quality. For text expansion when using a 1024x768 panel, there is an option that if GPR0[7]=1, the BIOS expands text mode to 800x600 and centers the display.

5.3.2 NTSC/PAL TV Support

The 322 is capable of driving a NTSC/PAL TV from an integrated TV encoder with Macrovision. The following items should be noted regarding the operation of this feature:

1. The display is interlaced because of TV requirement.
2. TV enable bit must be set.
3. The resolution for both NTSC and PAL is 640x480.
4. The CRT should not be driven when TV is driven.
5. TV only mode is supported.

Two sets of new video modes (i.e., one for NTSC and one for PAL) are created to interface with this feature.

5.3.3 Display Switching

The 322 supports various display settings that users can switch between. The video BIOS supports an INT 10h call to enable display switching and must determine whether the hardware necessary is available.
Display switching can be from LCD, CRT, or Simul mode (LCD & CRT) to TV mode or from TV mode to LCD, CRT, or Simul mode.

5.3.3.1 Panel Power Sequencing

The 322 supports flat panel power sequencing control in both hardware and software, which is defined by FPR34[7]

5.3.3.2 Hardware Panel Power Sequencing Control

The 322 power-on setting selects hardware for panel power sequencing control with FPR34[7] =1. Panel power on/off is done by simply programming FPR31[0] from 0 to 1 to turn on panel display or from 1 to 0 to turn off panel display. Register FPR33[3:2] allows adjustment of the time interval between each panel control signal.

FPR33[3:2]	Power On/Off Sequencing Time Select
00	1 vertical frame
01	2 vertical frames
10	4 vertical frames
11	8 vertical frames

5.3.3.3 Software Panel Power Sequencing Control

The software panel power sequencing control is set by FPR34[7] = 0.
The example below assumes FPR33[3:2] = 00.

To turn on flat panel:

- set FPR31[0] = 1 - enable LCD display
- wait 1 vertical frame period, set PDR22[0] = 1 - turn on FPVDD
- wait 1 vertical frame period, set PDR22[1] = 1 - enable flat panel interface outputs
- wait 1 vertical frame period, set PDR22[2] = 1 - turn on panel bias voltage
- wait 1 vertical frame period, set PDR22[3] = 1 - turn on FPEN output

To turn off flat panel:

- set PDR22[3] = 0 - turn off FPEN output
- wait 1 vertical frame period, set PDR22[2] = 0 - turn off panel bias voltage
- wait 1 vertical frame period, set PDR22[1] = 0 - disable flat panel interface outputs
- wait 1 vertical frame period, set PDR22[0] = 0 - turn off FPVDD
- set FPR31[0] = 1 - disable LCD display

5.4 Standard IBM VGA Compatible BIOS Functions

The Bios supports all of the following the standard IBM Compatible BIOS calls.
(Functions other than Set Mode are not supported in extended modes).

Table 20 Standard IBM VGA Compatible BIOS Functions

Call # ax =	Function
0x00xx	Set Mode
0x01xx	Set Cursor Type
0x02xx	Set Cursor Position
0x03xx	Read Cursor Position
0x05xx	Select Active Display Page
0x06xx	Scroll Active Page Up
0x07xx	Scroll Active Page Down
0x08xx	Read Attribute/Character at Cursor
0x09xx	Write Attribute/Character at Cursor
0x0Axx	Write Character Only at Cursor
0x0Bxx	Set Color Palette, Background, or Border
0x0Cxx	Write Pixel
0x0Dxx	Read Pixel
0x0Exx	Write TTY Character
0x0Fxx	Read Current Video State
0x1000	Set Individual Palette Register
0x1001	Set Overscan Register
0x1002	Set All Palette and Overscan Register
0x1003	Toggle Blink/Intensity Bit
0x1007	Read Individual Palette Register
0x1008	Read Overscan Register
0x1009	Read All Palette and Overscan Register
0x1010	Set Individual Color Register
0x1012	Set Block of Color Registers
0x1013	Select Color Page
0x1015	Read Individual Color Register
0x1017	Read Block of Color Registers
0x1018	Write Pixel Mask

0x1019	Read Pixel Mask
0x101A	Read Current Color Page Number
0x101B	Sum Color Values to Gray Scale
0x1100	User Alpha Load
0x1101	Load ROM 8x14 Monochrome Set
0x1102	Load ROM 8x8 Set
0x1103	Set Block Specifier
0x1104	Load ROM 8x16 Character Set
0x1110	User Alpha Load and Reprogram Controller
0x1111	Load ROM 8x14 Monochrome Set and Reprogram Controller
0x1112	Load ROM 8x8 Set and Reprogram Controller
0x1114	Load ROM 8x16 Set and Reprogram Controller
0x1120	User Graphics Characters INT 1FH 8x8
0x1121	User Graphics Characters
0x1122	Graphics Mode ROM 8x14 Character Set
0x1123	Graphics Mode ROM 8x8 Set Double Dot
0x1124	Graphics Mode ROM 8x16 Set
0x1130	Return Character Generator Information
0x1200 bl=0x10	Return Video Information
0x1200 bl=0x20	Select Alternate Print Screen Routine
0x1200 bl=0x30	Select Scan Lines for Alphanumeric Modes
0x1200 bl=0x31	Default Palette Loading During Mode Set
0x1200 bl=0x32	Video Enable/Disable
0x1200 bl=0x33	Summing to Gray Scales
0x1200 bl=0x34	Cursor Emulation
0x1200 bl=0x35	Display Switch
0x1200 bl=0x36	Video Screen On/Off
0x13xx	Write String of Characters
0x1Axx	Read/Write Display Combination Code
0x1Bxx	Return State Information
0x1Cxx	Save/Restore Video State

5.5 Extended BIOS Function Calls

Table 21 Extended BIOS Function Calls	
Call # ax =	Function
5F00h	Get Current VGA Information
5F05h	Set Panel On
5F06h	Set Panel Off
5F0Eh	Monitor Detection
5F10h BX=0	PopUp Icon Control
5F10h BX=1	PopUp Icon Size
5F10h BX=2	PopUp Icon Location
5F10h BX=3 CH=1	PopUp Icon Color1
5F10h BX=3 CH=2	PopUp Icon Color2
5F10h BX=3 CH=3	PopUp Icon Color3
5F10h BX=5	Load PopUp Icon Bitmap
5F12h	Display Switching Status
5F13h	Switch Display To LCD
5F14h	Switch Display To CRT (with monitor detection)
5F15h	Switch Display To Simul
5F16h	Switch Display To CRT (without monitor detection)
5F19h*	Set Text Exp./Graphics Exp./Stretch
5F20h	Set Extended Memory
5F21h	Switch from LCD to TV
5F22h	Switch from CRT to TV
5F23h	Switch from Simul to TV
5F24h	Switch from TV to LCD
5F25h	Switch from TV to CRT
5F26h	Switch from TV to Simul

5.5.1 Get Current VGA Information - 5F00h

Returns the current VGA information.

Input

AX 5F00h

Output

AX Return status
0=Success, 1=Fail
BX Chip ID
CH Revision number
CL Memory size in MB
DH Display type
01=LCD Only
10=CRT Only
11=CRT/LCD (Simultaneous)
DL Flat Panel type (FPR30)

5.5.2 Set Panel On - 5F05h

Sets the panel ON.

Input

AX	5F05h

Output

AX	Return status 0=Success, 1=Fail

5.5.3 Set Panel Off - 5F06h

Sets the panel OFF.

Input

AX	5F06h

Output

AX	Return status 0=Success, 1=Fail

5.5.4 Monitor Detection - 5F0Eh

Detects if there is a monitor attached.

Input

AX	5F0Eh

Output

AX	Return status 0=Success, 1=Fail
BX	1=Monitor attached 0=No monitor

5.5.5 PopUp Icon Control - 5F10h

Pups up the icon control on the screen. It is up to the user to define what the icon is.

Input

AX	5F10h
BX	0
CL	0-disable 1-enable

Output

NONE

5.5.6 PopUp Icon Size - 5F10h

Defines the size of the icon.

Input

AX	5F10h
BX	1
CL	0-64x64
	1-128x128

Output

NONE

5.5.7 PopUp Icon Location - 5F10h

Defines the location of the icon on the screen.

Input

AX	5F10h
BX	2
CX	X Start (Pop90[7:0] & Pop91[2:0})
DX	Y Start (Pop92[7:0] & POP93[2:0])

Output

NONE

5.5.8 PopUp Icon Color1 - 5F10h

Defines the first color of the icon.

Input

AX	5F10h
BX	3
CH	1 (POP84)
CL	[7:0] color value

Output

NONE

5.5.9 PopUp Icon Color2 - 5F10h

Defines the second color of icon.

Input

AX	5F10h
BX	3
CH	2 (POP85)
CL	[7:0] color value

Output

NONE

5.5.10 PopUp Icon Color3 - 5F10h

Defines the third color of icon.

Input

AX	5F10h
BX	3
CH	3 (POP86)
CL	[7:0] color value

Output

NONE

5.5.11 PopUp Icon Bitmap - 5F10h

Loads the bitmap file of icon.

Input

AX	5F10h
BX	5
ES:SI	Bitmap address (16 bit)

Output

NONE

5.5.12 Display Switching Status - 5F12h

Called before switching takes place and returns the switching allowed status. Switching is not allowed as long as virtual refresh is on. There is no support fro this function call when in Dual Monitor mode and in the SMI special modes (Stretch and rotation).

Input

AX	5F12h

Output

ABL	0=OK to switch
	1= Not allowed to switch

5.5.13 Switch Display to LCD - 5F13h

Switches display to LCD in standard refresh mode.

Input

AX	5F13h

Output

AX	0=Success
	1=Fail

5.5.14 Switch Display to CRT - 5F14h

Switches display to CRT in standard refresh mode by calling set mode routine.

Input
AX 5F14h

Output
AX 0=Success
1=Fail

5.5.15 Switch Display to Simul - 5F15h

Switches to simultaneous display of CRT and LCD for standard refresh only.

Input
AX 5F15h

Output
AX 0=Success
1=Fail

5.5.16 Switch Display to CRT only - 5F16h

Switches to the CRT display without detecting monitor.

Input
AX 5F16h

Output
AX 0=Success
1=Fail

5.5.17 Set Text Expansion/Graphics Expansion/Stretch - 5F19h

Sets DOS modes text and graphics expansion and extended modes in stretch.

Input

AX	5F19h	
BH	1-get stretch/text expansion/graphics expansion status	
	0-set stretch/text expansion/graphics expansion	
BL	Bit 0	0-text expansion off
		1-text expansion on
	Bit 1	0-graphics expansion off
		1-graphics expansion on
	Bit 2	0-stretch off
		1-stretch on
	Bit 3	0-stretc/graphics/text status depends on bit [2,1,0]
		1-stretch status overwrite DOS text and graphics mode

Output

AX	0=Success	
	1=Fail	
BL	Text expansion/graphics expansion/stretch status (get status only)	
	All bit [3:0] parameters need to be provided	
	Bit 0	0-text expansion off
		1-text expansion on
	Bit 1	0-graphics expansion off
		1-graphics expansion on
	Bit 2	0-stretch off
		1-stretch on
	Bit 3	0-stretch/graphics/text status depends on bit [2,1,0]
		1-stretch status overwrite DOS text and graphics mode

When bit 3 =1, the status of bit [2:0] needs to be set the same way (either all 0 or all 1)
When bit 3=0, the status of bit [2:0] can be set independently
Note that BL does not return status for set function.

5.5.18 Set Extended Memory - 5F20h

Sets the extended memory accessing environment for save/restore hotkey function.

Input

AX	5F20h

Output

NONE

5.5.19 Switch from LCD to TV display - 5F21h

Switches from LCD mode to TV display mode.

Input

AX	5F21h

Output

AX	0=Success
	1=Fail

5.5.20 Switch from CRT to TV display - 5F22h

Switches from CRT mode to TV display mode.

Input
AX 5F22h

Output
AX 0=Success
1=Fail

5.5.21 Switch from Simul to TV display - 5F23h

Switches from Simul mode to TV display mode.

Input
AX 5F23h

Output
AX 0=Success
1=Fail

5.5.22 Switch from TV to LCD display - 5F24h

Switches from TV mode to LCD display mode.

Input
AX 5F24h

Output
AX 0=Success
1=Fail

5.5.23 Switch from TV to CRT display - 5F25h

Switches from TV mode to CRT display mode.

Input
AX 5F25h

Output
AX 0=Success
1=Fail

5.5.24 Switch from TV to Simul display - 5F26h

Switches from TV only mode to Simul display made.

Input

AX	5F26h

Output

AX	0=Success 1=Fail

5.6 INT15 System BIOS Function Calls

The 322 BIOS contains a number of INT15 system BIOS function calls. Each one of them provides the system BIOS an opportunity to gain control in the different VGA BIOS areas.

Table 22 INT15 System BIOS function calls	
7F00h	VGA POST Initialization
7F01h	Get Panel ID
7F02h	Boot Display Device Override
7F03h	Do Expansion/Centering
7F04h	Normal Setmode/Special Setmode
7F05h	Select TV Format
7F06h	Get TV support status
7F07h	Set subsystem and subvendor IDs
7F08h	Set Text Exp./Graphics. Exp./Stretch initial status
7F09h	Get Dual Monitor Support Status
7F0Ah	Set TV DAC option
7F0Fh	VGA POST Completion Signal

5.6.1 VGA POST Initialization - 7F00h

Called prior to displaying VGA banner.

Input
AX 7F00h
Output
AX 007Fh Success
Else not supported

5.6.2 Get Panel ID - 7F01h

Gets the panel ID.

Input
AX 7F01h
Output
AX 007Fh Success
Else not supported
BL Panel ID (See below)

Note: There are 15 custom panel ID's specified by the BL register from 0 to 0eh. The value 0fh indicates the BIOS is using default panel timing.

Table 23 Panel ID	
00	640x480 TFT
01	640x480 DSTN
02	800x600 TFT
03	800x600 DSTN
04	1024x768 TFT
05	1024x768 DSTN
06	800x600 DSTN 75 Hz
07	Reserved
08	Reserved
09	Reserved
10	Reserved
11	Reserved
12	Reserved
13	Reserved
14	Reserved

5.6.3 Boot Display Device Override - 7F02h

Determines the type(s) of display device during system bootup. If this function fails then BIOS would set to the default setting.

Input
AX 7F02h
Output
AX 007Fh Success
Else not supported
BL Display type
01-LCD only
02-CRT only
03-LCD+CRT (Simultaneous)

5.6.4 Do Expansion or Centering - 7F03h

Determines whether display should be in Expansion or centering mode.

Input
AX 7F03h
Output
BL 0-Centering mode
1-Expansion mode

5.6.5 Normal Set Mode or Special Set Mode - 7F04h

Determines the set mode process is Normal or Special.

Input
AX 7F04h
Output
AX 007Fh-Normal Set mode
017fh-Special before 'Save to Disk' Set mode

5.6.6 Select TV Type - 7F05h

Determines the TV type is either NTSC or PAL.

Input
AX 7F05h
Output
AX 007fh-NTSC
017fh-PAL

5.6.7 Get TV Support Status - 7F06h

Determines if TV support is requested or not.

Input
AX 7F06h
Output
AX 007Fh-Need to check BL for TV support status
Else don't care (&F06h function not called)
BL 0-no TV support
1-TV supported

5.6.8 Set sub-vendor and sub-system ID's - 7F07h

Returns sub-vendor and sub-system ID.

Input
AX 7F07h
Output
AX 007Fh
BX Sub-system ID
CX Sub-vendor ID

5.6.9 Select Text Expansion/Graphic Expansion/Stretch initial status - 7F08h

Determines the power on initial status of expansion for text and graphics DOS modes and stretch for extended modes.

Input
AX 7F08h
Output
AX 007Fh Success
BL Text Expansio/Graphics Expansion/Stretch status
All Bit [3:0] parameters need to be provided
Bit 0 0-text expansion off
1-text expansion on
Bit 1 0-graphics expansion off
1-graphics expansion on
Bit 2 0-stretch off
1-stretch on
Bit 3 0-Stretch/Graphics/Text status depends on bit [2,1,0]
1-Stretch status overwrite DOS text graphics mode
When bit3=1, the status of bit [2:0} needs to be set the same way (Either all 0 or all 1).
When bit 3=0, the status of bit [2:0] can be set independently.

5.6.10 Get Dual Monitor Support Status - 7F09h

Gets the dual monitor support status.

Input
AX 7F09h
Output
AX 007Fh Success
BL 0-enable dual monitor support
1-disable dual monitor support

5.6.11 TV DAC Option - 7F0Ah

Selects the TV DAC option.

Input
AX 7F0Ah
Output
AX 007Fh Success
Else fail
BL[1:0] 00-SVHS off, CVBS off
01-SVHS off, CVBS on
10-SVHS on, CVBS off
11-SVHS on, CVBS on
Note: IF this function call is not used, the default is SVHS and CVBS DAC are both on. (BL[1:0]=11)

5.6.12 VGA POST Completion Signal - 7F0Fh

Notifies system BIOS that VGA finished its initialization.

Input

AX 7F0Fh

Output

NONE

5.7 VESA BIOS Functions

VESA BIOS calls 0-8, as defined in the VESA Extended BIOS Function Specification, version 1.2, are supported by the BIOS. In addition, this BIOS also supports VESA BIOS Extensions / Power Management (VBE/PM) 2.0 standard which is implemented as sub-function 10h and VESA Display Data Channel Standard version 2.0, which is implemented as sub-function 15h. The functionality of these VESA calls are as follows:

Table 24 VESA BIOS Function Calls

FUNCTION	INPUT	OUTPUT
Return Super VGA Information	AH= 4Fh AL= 00h ES:DI= Pointer to buffer	AX= Status
Return Mode Information	AH= 4Fh AL= 01h CX= Mode ES:DI= Pointer to buffer	AX= Status
Mode Set	AH= 4Fh AL= 02h BX= Video Mode D0:14= Video mode D15= Clear video memory flag 0=Clear video memory 1=Don't clear	AX= Status
Return Current Video Mode	AH= 4Fh AL= 03h	AX= Status BX= Current Video Mode
Save/Restore Super VGA Video State	AH= 4Fh AL= 04h DL= 00h: Return save/restore state buffer size CX Requested states Bit 0= Save/restore video hardware state Bit 1= Save/restore BIOS data state Bit 2= Save/restore video DAC state Bit 2= Save/restore Super VGA state	AX= Status BX= Number of 64 byte blocks to hold the state buffer
	AH= 4Fh AL= 04h DL= 01h: Save Super VGA video state CX= Requested states (see above) ES:BX= Pointer to buffer	AX= Status
	AH= 4Fh AL= 04h DL= 02h: Restore Super VGA video state CX= Requested states (see above) ES:BX= Pointer to buffer	AX= Status

Table 24 VESA BIOS Function Call - (Continued)		
FUNCTION	INPUT	OUTPUT
CPU Video Memory Window control	AH= 4Fh AL= 05h BH= 00h: Select window BL= Window Number 0=Window A 1=Window B DX= Window position (in granularity units)	AX= Status
	AH= 4Fh AL= 05h BH= 01h: Return window BL= Window Number 0=Window A 1=Window B	AX= Status DX= Window position (in granularity units)
Set/Get Logical Scan	AH= 4Fh AL= 06h BH= 00h: Select scan line length CX= Desired width in Pixels	AX= Status BX= Bytes per scan line CX= Actual picels per scan line DX= Maximum number of scan lines
	AH= 4Fh AL= 06hBX= BL= 01h: Return scan line length	AX= Status BX= Bytes per scan line CX= Actual pixels per scan line DX= Maximum # of scan lines
Set/Get Display Start	AH= 4Fh AL= 07h BH= 00h: Reserved and must be 0 BL= 00h: Select display start CX= First displayed pixel in scan line DX= First displayed scan line	AX= Status
	AH= 4Fh AL= 07h BL= 01h: Select display start	AX= Status BH= 00h Reserved and will be 0 CX= First displayed pixel in scan line DX= First displayed scan line
Set/Get DAC Palette Control	AH= 4Fh AL= 08h BL= 00h BH= Desired number of bits of color per primary (standard VGA=6)	AX= Status BH= Current number of bits of color per primary (Standard VGA=6)
	AH= 4Fh AL= 08h BL= 01h: Get DAC palette width	AX= Status BH= Current number of bits of color per primary (Standard VGA=6)

Table 24 VESA BIOS Function Call - (Continued)		
FUNCTION	INPUT	OUTPUT
Display Power Management Extensions	AH= 4Fh AL= 10h: VBE/PM Services BL= 00h: Report VBE/PM Capabilities CX= 00h: Controller unit number (00=primary controller) ES:DI= Null pointer, must be 0000:0000h in version 1.0	AX= Status BH= Power saving state signals supported by the controller 1=supported 0=not supported bit 0- Standby bit 1- Suspend bit 2- Off bit 3- Reduced On bit 4-7 reserved BL= VBE/PM Version number bit 0-3 Minor version # bit 4-7 Major version # CX= Unchanged DX= Unchanged
	AH= 4Fh AL= 10h: VBE/PM Services BL= 01h: Set display power state BH= Requested Power state bit 0- Standby bit 1- Suspend bit 2- Off bit 3- Reduced On bit 4-7 reserved CX= 00h: Controller unit number (00=primary controller)	AX= Status (if requested state is not available, AX will return 014Fh) BH= unchanged CX= unchanged
	AH= 4Fh AL= 10h: VBE/PM Services BL= 02h: Get display power state CX= 00h: Controller unit number (00=primary controller)	AX= Status (if function is not supported, AL=01) BH= Power state currently requested by the controller bit 0- Standby bit 1- Suspend bit 2- Off bit 3- Reduced On bit 4-7 reserved CX= unchanged

Table 24 VESA BIOS Function Call - (Continued)		
FUNCTION	INPUT	OUTPUT
Display identification extentions	AH= 4Fh AL= 15h: VBE/DDC Services BL= 00h: Report DDC Capabilities CX= 00h: Controller unit number (00-primary controller)	AX= Status BH= Approx. time in seconds, rounded up, to transfer one EDID block (128 byte) BL= DDC level supported Bit 0 =0 DDC1 not supported =1 DDC1 supported Bit 1 =0 DDC2 not supported =1 DDC2 supported Bit 2 =0 Screen not blanked during data transfer =1 Screen blanked during data transfer
	AH= 4Fh AL= 15h: VBE/DDC Services BL= 01h: Read EDID CX= 00h: Controller unit number (00-primary controller) DX= 00h: EDID block number ES:DI= Pointer to area in which the EDID block (128 bytes) shall be returned	AX= Status ES:DI= Pointer to area in which the EDID block is returned
	AH= 4Fh	AX= Status
	AL= 15h: VBE/DDC Services	ES:DI= Pointer to area in which the VDIF block is returned
	BL= 02h: Read VDIF block	
	CX= 00h: Controller unit number (00-primary controller)	
	DX= 00h: VDIF block number (64 bytes)	
	ES:DI= Pointer to area in which the VDIF block shall be returned	

5.8 BIOS Data Area Description

Table 25 BIOS Data Area Description			
Offset	Size	Description of Data	
0:410	2	Equipment (video) installed, Bits 4,5 define initial video mode	
		00 - Not used	
		01 - 40x25	
		10 - 80x25	
		11 - Monochrome	
0:449	1	Video mode currently set	
0:44A	2	Number of columns in current video mode	
0:44C	2	Length of video buffer in current mode	
0:44E	2	Start address of video memory	
0:450	10h	8 pairs of cursor locations (row, column)	
0:460	2	Cursor size	
0:462	1	Active video page	
0:463	2	Address of CRT controller - 3D4 or 3B4	
0:465	1	Mode register value	
0:466	1	Video palette	
0:484	1	Number of rows in current mode	
0:485	2	Character length	
0:487	1	EGA Status	
		Bit	Definition
		0	0 =Emulate cursor type
		1	1= Monochrome monitor attached
		2	1 =Wait for retrace in text output routine
		3	1 =VGA is the current monitor
		4	Reserved
		5,6	00= 64k
			01= 128k
			10= 192k
			11= 256k
		7	0 -Clear screen on mode change
0:488	1	EGA Status	
		Bit	Definition
		0-3	Switch settings
		4-7	Feature bits
0:489	1	VGA Status	
0:4A8	4	EGA/VGA environment pointer	

Appendix A: Manual Revision Notes

Date	Revised by	Description of changes
04/24/01	Dennis	Manual first draft.
06/01/01	Dennis	Added Software install information and a link to control panel on FTP site.

Appendix B: Technical Support

For Technical support contact Sensoray Company Inc.

322 technical support email: **322support@sensoray.com**
Home page: **www.sensoray.com**