Personal Computer

PC 10
PC 20

ADVANCED GRAPHICS ADAPTER

C commodore
COMPUTER®

First Edition (January 1986)

The contents of this manual are subject to change without notice and shall not be regarded as a warranty.

ADVANCED GRAPHICS ADAPTER

PREFACE

The Advanced Graphics Adapter (AGA) you just bought is a multi-application video adapter. It is designed to be both powerful and flexible and has the ability to behave like 4 different video adapters. It can behave like either 1) an IBM Color/Graphics adapter, 2) a Plantronics ColorPlus adapter, 3) a Hercules Monochrome Graphics adapter, or 4) it can emulate a Color/Graphics adapter on a monochrome monitor.

The Advanced Graphics Adapter is designed with state of the art CMOS VLSI gate array technology. As a result it packs more compatibility and display modes into less volume.

Happy computing,

COMMODORE

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1.0 INTRODUCTION

The Advanced Graphics Adapter is a multi-application video adapter that combines the video functions of the IBM Color/Graphics Adapter, the IBM Monochrome/Printer Adapter, the Hercules Graphics Card, and the Plantronics ColorPlus Adapter on a single card. The Advanced Graphics Adapter can also run color software on a monochrome monitor in full screen and without preboot software. It offers 132-column text in both color and monochrome modes as well as 640 X 200 resolution in 16 colors.

The following functions are provided by the Advanced Graphics Adapter:

1) **PC 10/20 Monochrome and Hercules Compatible Monochrome Graphics** - It runs high resolution Hercules compatible monochrome graphics software and the high quality monochrome character set on the monochrome monitor.

2) **Color/Graphics Emulation** - It runs color software in 16 shades on the monochrome monitor in full screen and without preboot software.

3) **Color/Graphics** - It runs all standard PC Color/Graphics software.

4) **Plantronics Compatible Color/Graphics** - It runs all Plantronics compatible color graphics software. Displays up to 16 colors in 640 X 200 resolution.

5) **16 Colors in High Resolution** - It runs 16 colors in 640 X 200 resolution.

6) **132 Columns** - 132-column text in either color or monochrome.

7) **Fast Flicker Free Scrolling.**

8) **Monitor Compatibility** - Drives a PC 10/20 equivalent TTL direct drive monochrome monitor, a PC equivalent RGB color monitor, a composite NTSC color monitor or a composite monochrome monitor.

9) **Composite Output** - Not only will it display color, but the signal can be converted into 16 shades on composite monochrome monitor for very clear reverse video.

Diagram 1 is a block diagram of the Advanced Graphics Adapter showing its major features and their approximate locations on the board.

The AGA is designed to be completely compatible with the COMMODORE PC 10/20, IBM PC, XT, or AT. It uses state of the art CMOS VLSI gate array technology to give you years of reliable operation with minimum of power consumption. Each board is constructed with high quality components, has been burned in and thoroughly tested to ensure its reliability.

Light Pen Connector

Output for RF Modulator

Composite Video Output

Video Output Connector

Dip Switch

Character Generator

Custom VLSI Video Timing Generator
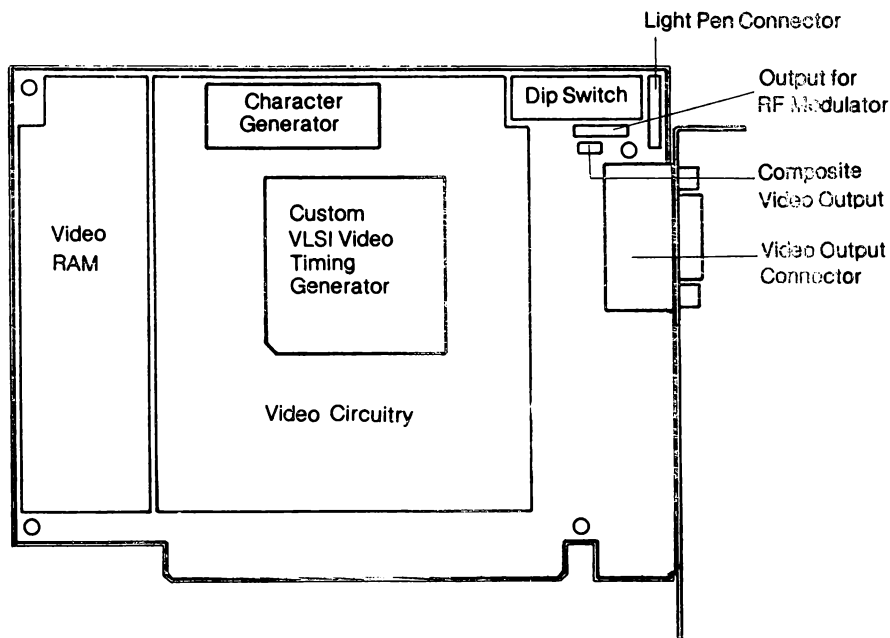
Video RAM

Video Circuitry

Diagram 1
AGA Block Diagram

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1.1 Packing List

In your package you should have:

    1) an Advanced Graphics Adapter
    2) a Composite Interface Connector
    3) a Softwarediskette
    4) a User's manual

2.0 GETTING STARTED

The video default mode is the video mode that your computer will automatically power up to when you turn it on. Three video default modes exist. Emulation mode runs PC10/20 Color/Graphics or Plantronics Enhanced Graphics software on the PC monochrome monitor. Monochrome Graphics mode runs PC or Hercules compatible monochrome graphics software on a monochrome monitor. Color/Graphics mode runs PC Color/Graphics or Plantronics Enhanced Graphics software on RGB or composite monitor. Before you install the Advanced Graphics Adapter you must determine the video default mode you require relevant to your application. Descriptions of video modes are found in Section 4.2.

WARNING

Your Advanced Graphics Adapter has been factory preset to the Mono mode. If you intend to use your AGA on a RGB color monitor, or on a composite color or monochrome monitor, you must change your video default to the Color/Graphics mode (see Table 1 below). Otherwise, damage could result to your monitor that is not covered by our warranty.

2.1 Installation Instructions

1) Turn off your computer and unplug its power cord. Otherwise, damage could result to both your AGA and computer that is not covered by warranty.

2) Set the 8 postion dip switch located at the top of your card (see Diagram 1) for the video mode you require. It is preset for the Emulation mode. Video mode settings are outlined in Diagram 2 below. A description of the possible video modes is given in Section 4.2.

Note: If you are installing two video adapters in your system, please refer to section 5 for possible configurations.

3) To open unit, remove 7 screws (5 at back, 1 at each side) and slide back Top Cover by approx. 1/4 ". Cover can then be lifted off.

4) Set the switches on your PC 10/20 for the video mode setting of your Advanced Graphics Adapter.

Default Display Mode		
Mono	OFF	ON
Color	ON	OFF
Emulation	OFF	OFF

Monitor Type :		
Composite nposite	ON	OFF
Monochrome or RGB	OFF	ON
IBM Enhanced	OFF	OFF

Composite Monitor	
Color	ON
Monochrome	OFF

ALWAYS OFF

ALWAYS ON
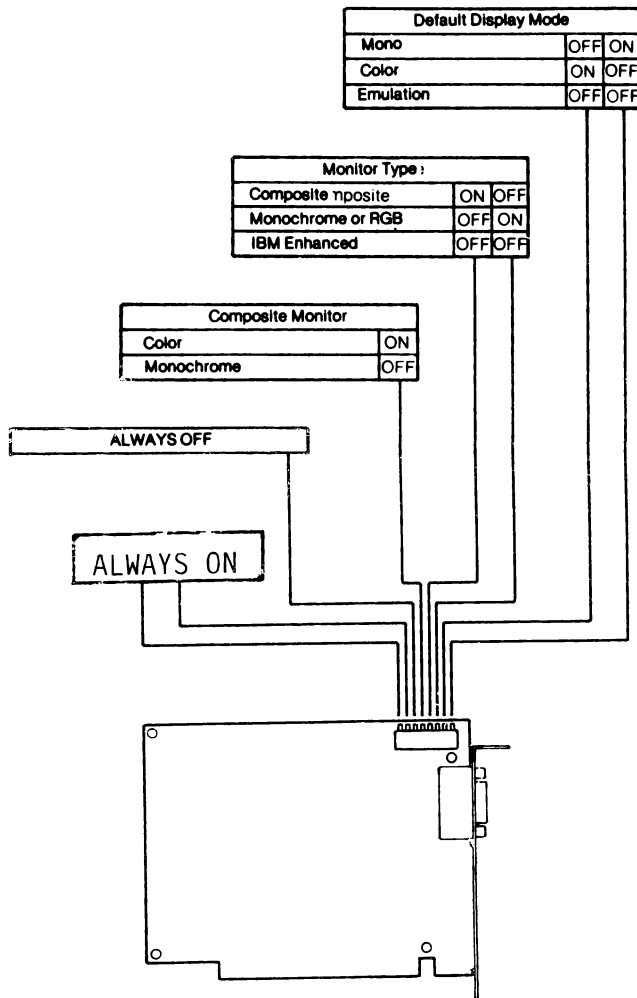
Diagram 2
AGA Switch Settings

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Advanced Graphics Adapter	DIP - Switch	
Default Video Mode	SW5	SW6
Emulation Mode	ON	OFF
Color/Graphics	ON	OFF
Monochrome	OFF	OFF

Table 1
PC 10/20 Switch Settings

Composite Video Connector

Data Cable from Composite Video Monitor

Data Cable Socket

Data Cable from RGB or Monochrome Monitor
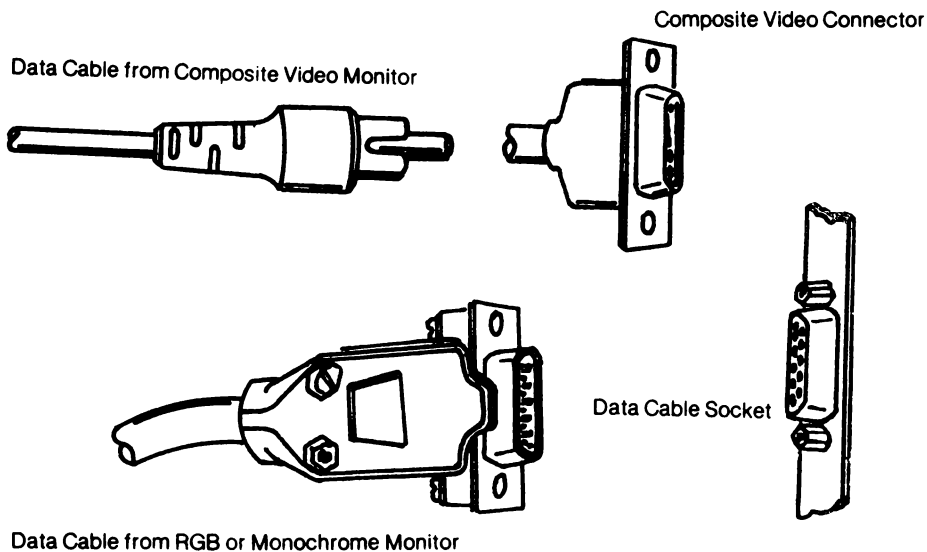
Diagram 3
Connecting Your Monitor

5) Hold the AGA by its top corners and slide it into
   the System Unit.

6) Firmly press the card's gold finger into the
   system's expansion port.

7) Insert the screw that you removed with expansion
   slot cover earlier into the hole at the top of the
   Advanced Graphics Adapter retaining bracket and
   tighten it.

8) Replace the System Unit cover fasten the screws.

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9) Plug your monitor data cable into the 9-pin socket
   mounted on the bracket of your AGA (see Diagram 3).
   To connect a composite video monitor, plug the
   composite interface connector into the 9-pin socket
   and then plug your display's data cable into the
   connector (see Diagram 3).

MONITOR WARNING

   Do not plug an IBM monochrome monitor into an
   Advanced Graphics Adapter configured as a
   Color/Graphics adapter. Likewise, do not plug
   an RGB or composite monitor into an AGA set to
   monochrome or emulation mode. Otherwise,
   damage could result to your monitor that is
   not covered by our warranty.

10)Plug in your computer's power cord. You are now able
   to use your computer.

3.0 SOFTWARE

3.1 Diskette Contents

Your Advanced Graphics Adapter diskette contains the following software:

1) Mode switching software
2) Diagnostics software

3.2 Mode Switching Software

Software is included with your AGA to allow you to switch between video modes while operating your computer and without opening your computer chassis to reset switches. The different modes available to you and their applications are described in Section 4.2.

The mode switching software is menu driven. Thus everything you need to know about operating the Video Setup program (VSET) will be shown on a menu after you type

                A ° VSET (return)

the computer will then display the following screen:

Advanced Graphics Adapter Video Setup   Keywords

1.   Monochrome Text 80 X 25   - MT
2.   Monochrome Text 132 X 25   - M25
3.   Monochrome Text 132 X 44   - M44
4.   Monochrome Graphics 1 page   - MG1
5.   Monochrome Graphics 2 page   - MG2
6.   Emulation Text   - E80
7.   Color Text 80 X 25   - C80
9.   Exit to DOS
10. Monochrome 132 columns screen adjustment
11. Color 132 columns screen adjustment

Fnter option:

                    Diagram 4
                Mode Switching Menu
                        13

Select the video mode you require by entering a number
(1-11) for the mode desired.

If you are switching from a monochrome mode to a color
mode, or vice versa, the program will remind you to
check if you have the correct monitor connected to the
Advanced Graphics Adapter. It is important that you
follow the directions carefully, otherwise, damage
could result to your monitor that is not covered by our
warranty.

If you are switching to a 132-column mode and are
planing to run an application program in this mode you
must make sure that the application program itself
supports our 132-column mode.

After   becoming familiar with the Mode   Switching
program, you may wish to skip the menu. To do this
enter

            A> VSET (keyword) (return)

You can find the keyword of your choice from Diagram 4,
or from the menu.

3.3 Special Note For Using The Monochrome Graphics Mode

If you plan to use your AGA in the Monochrome Graphics
mode, a utility program must be run to allocate 1 or 2
pages of memory for graphics. Since this utility must
be used in order to perform graphics, you should create
a file which will enter it automatically every time you
boot-up. To do this:

1) Place your AGA Software Disk in Drive B and your DOS
   diskette in Drive A.

2) Copy the Video Setup program onto your DOS diskette
   by typing

            A> COPY B:VSET.* (return)

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3) Create an autoexec.bat file by typing

            A> COPY CON:AUTOEXEC.BAT (return)
               VSET (keyword) (return)

    Press F6 and then press "return"

Possible keywords are:

MT - This disables graphics making the video function
identical to the PC 10/20 Monochrome Adapter.

MG1 - Allocates memory for single page graphics. This
allows the presence or use of another video adapter
such as the IBM Color/Graphics Adapter.

MG2 - This command allocates 2 pages of memory to
graphics. This is the option you must use to run Lotus
and most monochrome graphics programs. If you run Lotus
you must also configure the Lotus video driver for the
Hercules board.

3.4 Configuring Your Application Software

This section is designed to help you to configure your
application software (such as Lotus 123) for the video
mode you are using.

Emulation Mode

If your software has a Plantronics driver (such as
Lotus Symphony), it is the driver we recommend that you
install when operating under the emulation   mode.
Otherwise, install the Color/Graphics driver.

Monochrome Graphics Mode

If your monochrome software has a Hercules driver, it
is the driver that we recommend you install when
operating under the monochrome graphics mode. Refer to
your application software's manual for details of
Hercules driver installation. Otherwise, install the
monochrome driver or you can configure your AGA to the
emulation mode and install the Color/Graphics drivers

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on your application software. Either way your graphics software will run on your PC 10/20 monochrome monitor.

MS, MT, MG1, and MG2 utility commands on your Advanced Graphics Adapter diskette are equivalent to the DIAG, HALF, and FULL utilities respectively that are available on the Hercules diskette. MT disables monochrome graphics, MG1 allows for 1 page of graphics, and MG2 allows for 2 pages of graphics. MG2 is usually required for most monochrome graphics programs such as Lotus. MG1 allows for co-existence with a Color/Graphics adapter.

Color/Graphics Mode

If your Color/Graphics software has a Plantronics driver (such as Lotus Symphony), it is the driver we recommend that you install when operating under the Color/Graphics mode. Otherwise, install the Color/Graphics driver.

3.5 Running WordStar in 132 Column Mode

To run WordStar in 132 column mode, you need to modify the WS.COM file on your WordStar Diskette. Follow these simple steps:

    Type DEBUG WS.COM (return)

    Type E cs:248 (return)

    Type 2B (return)

    Type E cs:249 (return)

    Type 84 (return)

    Type W (return)

3.6 Diagnostics

A diagnostics program has been supplied to help you
determine if your Advanced Graphics Adapter is working
properly. Details on the operation of this program are
outlined in Appendix B - Diagnostics and
Troubleshooting.

4.0 DESCRIPTION

This section is provided to give you a brief description of the card's features. For specific information on installation, see Section 2 and for operation see Section 6.

4.1 The Advanced Graphics Adapter

The Advanced Graphics Adapter is a multi-application video adapter designed to allow the attachment of all kinds of PC 10/20 or compatible monitors including RGB, direct drive high resolution monochrome, composite monochrome or composite NTSC color. This is achieved via the:

> DB9 connector - This socket is mounted on the card's bracket for the attachment of RGB color monitor or direct drive TTL monitor.

A 6-pin header located at the top right-hand corner of the card is provided for the attachment of a light pen.

Finally the AGA has a switch with 8 levers located at its top right-hand corner. This switch allows you to set the video default mode.

4.2 Modes

This section explains the various video modes available to you and their respective applications.The Advanced Graphics Adapter allows you to switch back and forth between these possible modes using the menu driven software included. However, you still need to determine your default video mode.

a) Emulation Mode

Monitor - PC 10/20 or equivalent monochrome monitor

This mode is called an emulation mode because it drives a monochrome monitor and yet appears to your PC as a Color/Graphics Adapter. It runs all Color/Graphics software without modification on a monochrome monitor

by automatically converting the color signal into
shades of gray. The emulation mode displays the high
quality monochrome character set, has full screen
graphics and does not require preboot drivers.

b) Monochrome Graphics Mode

Monitor - PC 10/20 or equivalent monochrome monitor

This mode displays the high quality monochrome
character set on an monochrome monitor and runs high
resolution Hercules compatible monochrome graphics
software. Graphics software written for the IBM
Color/Graphics Adapter will not run under this mode.

c) Color/Graphics Mode

Monitor - RGBI color monitor,
- Composite NTSC color monitor, or
- Composite monochrome monitor

This mode allows for graphics in up to 16 colors in 320
X 200 resolution or 4 colors in 640 X 200 resolution.
It runs all normal Color/Graphics programs as well as
graphics packages that have a Plantronics ColorPlus
driver.

In this mode the Advanced Graphics Adapter can also
display up to 16 colors in 640 X 200 screen resolution.
Advanced users may wish to program their own software
and information needed to do so is supplied in
Section 6.

Switching between Color/Graphics and Plantronics modes
is done automatically by your application software. All
you need to do is set your AGA for Color/Graphics mode.

5.0 CO-EXISTENCE WITH OTHER VIDEO ADAPTERS

The Advanced Graphics Adapter can be used for applications that require both color and monochrome monitors. It can co-exist with another Advanced Graphics Adapter, the PC 10/20 Monochrome Adapter, the IBM Monochrome/Printer Adapter, the IBM Color/Graphics Adapter, the Hercules Graphics Card and most other compatible video adapters. One adapter would control the monochrome display while the other controls the color display. Possible Twin Video Configurations are summarized in Table 2.

Table 2
Twin Video Configurations

Advanced Graphics Adapter as	Co-exists with	Conflicts with
Monochrome Adapter	AGA as CGA Color/Emulat. Adapt. IBM CGA	PC 10/20 MA IBM MA Hercules Gr.
Monochrome Graphics	AGA as CGA Color/Emulat. Adapt. Hercules Color	PC 10/20 MA IBM MA Hercules Gr.
Color/Graphics or Emulation or Plantronics	AGA as MGA PC 10/20 MA IBM MA Hercules Graphics IBM EGA	IBM CGA Color/Emulat. Adapter Hercules Col.
640 X 200 16 colors	nothing	everything

CGA - Color/Graphics Adapter
MA - Monochrome Adapter
MGA - Monochrome Graphics Adapter
EGA - Enhanced Graphics Adapter

For systems configured with two video cards, the switch settings in Table 1 will determine the primary display adapter when you power up your PC. For example, if your

PC is set up for Color/Graphics adapter, it will use
the Color/Graphics adapter on power up, and the mono-
chrome adapter will be idle. Use the MODE command
provided with your MS-DOS to change the active display
adapter.

6.0 FOR ADVANCED USERS

The Advanced Graphics Adapter is designed to incor-
porate a number of video display features into one
board. Care should be taken when programming the AGA to
avoid video memory conflict or show up in the wrong
display mode. Damage to monitor may result due to wrong
programming parameters. We recommend the user to read
through this chapter before attempting to program the
Advanced Graphics Adapter.

6.1 Video Memory Organisation

The Advanced Graphics Adapter has 64K bytes of video
memory. The video memory is organized into two banks
with 32K bytes in each bank. The physical address of
the video memory will depend on the user-selected
display mode.

**Advanced Graphics Adapter Configured in the
Color/Graphics Mode or Emulation Mode.**

There are 16K bytes of video memory available for the
alphanumeric mode and the graphics mode. There are four
submodes of operation.

40 X 25 Alphanumeric mode

In this submode, each page or display screen uses 1K
(40 X 25) bytes of character and 1K bytes of attributs.
That means there are 8 pages available. Their addresses
are:

              Page 0:   b8000 - b87ff
              Page 1:   b8800 - b8fff
              Page 2:   b9000 - b97ff
              Page 3:   b9800 - b9fff
              Page 4:   ba000 - ba7ff
              Page 5:   ba800 - bafff
              Page 6:   bb000 - bb7ff
              Page 7:   bb800 - bbfff

80 X 25 Alphanumeric Mode

There are four pages of display data in this submode. Their addresses are:

```
Page 0:  b8000 - b8fff
Page 1:  b9000 - b9fff
Page 2:  ba000 - bafff
Page 3:  bb000 - bbfff
```

Medium Resolution Color/Graphics Mode (320 X 200)

In this submode, a page requires 16K bytes of memory. Therefore, only 1 page is available. It's address is:

```
b8000 - bbfff
```

The graphics storage is organized in 2 banks of 8K bytes, using the following format:

```
b8000    ┌─────────────────────┐
         │  Even scans lines    │
         │   0,2,4,...,198      │
b9f3f    │                      │
         ├─────────────────────┤
ba000    │  not used            │
         ├─────────────────────┤
         │  Odd scans lines     │
         │   1,3,5,...,199      │
bbf3f    │                      │
         ├─────────────────────┤
         │  not used            │
bbfff    └─────────────────────┘
```

High Resolution Black and White Graphics Mode (640 X 200)

In this submode, the memory organization is the same as the medium resolution Color/Graphics mode.

Plantronics Graphics Mode

There are two submodes: 320 X 200 16 colors and 640 X 200 4 colors. Each submode requires 32K bytes of memory at b8000 - bffff. To generate the extra colors, the video memory is split up into two memory planes with 16K bytes each. (Refer to section 6.2 for detailed video data format.) Plane 0 is located at b8000 - bbfff. Plane 1 resides at bc000 - bffff or it can be mapped to reside at b8000 - bbfff by setting bit 6 of register 3dd to 1.

Their memory organization is as follows:

```
            Plane 0                      Plane 1
b8000  ┌──────────────────┐   bc000  ┌──────────────────┐
       │ Even scans lines │          │ Even scans lines │
       │ 0,2,4,...,198    │          │ 0,2,4,...,198    │
b9f3f  ├──────────────────┤   bdf3f  ├──────────────────┤
       │     not used     │          │     not used     │
ba000  ├──────────────────┤   be000  ├──────────────────┤
       │ Odd  scans lines │          │ Odd scans lines  │
       │ 1,3,5,...,199    │          │ 1,3,5,...,199    │
bbf3f  ├──────────────────┤   bff3f  ├──────────────────┤
       │     not used     │          │     not used     │
bbfff  └──────────────────┘   bffff  └──────────────────┘
```

640 X 200 16 Colors Mode

In this mode, the video data format is the same as the 320 X 200 16 colors which requires 2 memory planes (refer to Section 6.2 for detailed video data format). Each video plane requires 32K bytes of memory with the following memory organization.

```
              Plane 0                      Plane 1

b0000  ┌─────────────────────┐  b8000  ┌─────────────────────┐
       │ 1st scans lines     │         │ 1st scans lines     │
       │ 0,4,8,12,...,196    │         │ 0,4,8,12,...,196    │
b1fff  ├─────────────────────┤  b9fff  ├─────────────────────┤
       │ 2nd scans lines     │         │ 2nd scans lines     │
       │ 1,5,9,13,...,197    │         │ 1,5,9,13,...,197    │
b3fff  ├─────────────────────┤  bbfff  ├─────────────────────┤
       │ 3rd scans lines     │         │ 3rd scans lines     │
       │ 2,6,10,14,..,198    │         │ 2,6,10,14,..,198    │
b5fff  ├─────────────────────┤  bdfff  ├─────────────────────┤
       │ 4th scans lines     │         │ 4th scans lines     │
       │ 3,7,11,15,..,199    │         │ 3,7,11,15,..,199    │
b7fff  └─────────────────────┘  bffff  └─────────────────────┘
```

Since this mode uses up to 64K bytes of memory, please make sure the Advanced Graphics Adapter is the ONLY video adapter in your system before using this mode to avoid video memory conflict.

132 X 25 Color Text Mode

One page of text is provided in this mode. It's address is:

                    b8000 - b9fff

Advanced Graphics Adapter Configured in Monochrome Graphics Mode

IBM Monochrome Mode

The Advanced Graphics Adapter allows 4 pages of text. Their addresses are :

        Page 0: b0000 - b0fff
        Page 1: b1000 - b1fff
        Page 2: b2000 - b2fff
        Page 3: b3000 - b3fff

Hercules Graphics Mode

In this mode, two pages are provided with 32K bytes each. Their addresses are:

        Page 0:   b0000 - b7fff
        Page 1:   b8000 - bffff

Since Page 1 uses the memory address which is normally reserved for the Color/Graphics adapter, when the user wants to access this page, please make sure you have:

    1) no other video adapter in the system, OR

    2) a second Advanced Graphics Adapter which is set
        to Color/Graphics mode or emulation mode, OR

    3) other video adapter which can co-exist with the
        Hercules graphics mode.

The byte which contains the pixel location at co-ordinates (x,y) is offset into the page memory by:

        (2000 * (y MOD 4)) + (5A * INTEGER (y MOD 4))
        + (INTEGER (x/8))

The bit position where the pixel information is stored in that particular byte is:

        7 - (x MOD 8)

        where x is between 0 and 719
              y is between 0 and 347

132 X 25 Monochrome Text

One page of text is provided in this mode. It's address is:
        b0000 - b1fff

132 X 44 Monochrome Text

One page of text is provided in this mode. It's address is:

> b0000 - b3fff

6.2 Video Data Format

In this selection, only the video data format for the Plantronics graphics mode, and the 640 X 200 16 colors mode are discussed.

320 X 200 16 Colors

In this mode, 2 bits from each plane are combined to form a pixel with 16 color combinations.

	b7	b6	b5	b4	b3	b2	b1	b0
Plane 0	c1	c0	c1	c0	c1	c0	c1	c0
Plane 1	c3	c2	c3	c2	c3	c2	c3	c2
	1st pel		2nd pel		3rd pel		4th pel	

c2	c1	c0	c3	Color
I	R	G	B	
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	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	white (high intensity)

640 X 200   4 Colors

In this mode, 1 bit from each plane is combined to form a pixel with 4 color combinations.

	b7	b6	b5	b4	b3	b2	b1	b0
Plane 0	c0	c0	c0	c0	c0	c0	c0	c0
Plane 1	c1	c1	c1	c1	c1	c1	c1	c1
	1st pel	2nd pel	3rd pel	4th pel	5th pel	6th pel	7th pel	8th pel

640 X 200   16 Colors

The video data format in this mode is the same as the 320 X 200   16 colors mode.

6.3 Mode Select Registers

I/O registers for:

PC 10/20 monochrome adapter mode
Hercules graphics mode
Monochrome 132-column text mode
Emulation mode

The following lists the I/O registers used in these modes:

3b0 - 3b1: synonym for 3b4 - 3b5

3b2 - 3b3: synonym for 3b4 - 3b5

3b4: 6845 CRT controller register address port

3b5: 6845 CRT controller register data port

3b8: (write only)
    bit 0: unused
    bit 1: 0 = text mode (default)
           1 = Hercules graphics mode
    bit 2: unused
    bit 3: 0 = disable video
           1 = enable video
    bit 4: unused

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```
     bit 5: 0 = disable blink
            1 = enable blink
     bit 6: unused
     bit 7: 0 = Graphics page 0 displayed
            1 = Graphics page 1 displayed

3ba: Status register (read only)
     bit 0: horizontal sync
     bit 1: unused
     bit 2: unused
     bit 3: video signal
     bit 4: unused
     bit 5: unused
     bit 6: unused
     bit 7: vertical sync

3ba: Mode select register (write only)
     bit 0: reserved
     bit 1: unused
     bit 2: unused
     bit 3: 132-column text for monochrome
     bit 4: 132-column text for color
            (bit 0 of 3d8 must be 1)
     bit 5: set emulation mode in lieu of
            DIP-Switch
     bit 6: set mono mode in lieu of DIP-Switch
     bit 7: set color mode in lieu of DIP-Switch

3bf: (write only)
     bit 0: 0 = disable setting of monochrome
                graphics mode (3b8 bit 1)
            1 = enable setting of monochrome
                graphics mode (3b8 bit 1)
     bit 1: 0 = disable setting of monochrome
                graphics page bit (3b8 bit 7)
            1 = enable setting of monochrome
                graphics page bit (3b8 bit 7)
     bit 2-7: unused
```

I/O registers for:

IBM Color/Graphics adapter
Plantronics Color/Graphics adapter
Color 132-column text mode
Emulation mode
Light pen

The following lists the I/O registers used in these
modes:

    3d0 - 3d1: synonym for 3d4 - 3d5
    3d2 - 3d3: synonym for 3d4 - 3d5
    3d4: 6845 CRT controller register address port
    3d5: 6845 CRT controller register data port

    3d8: (write only)
        bit 0: 0 = 40 X 25 text
               1 = 80 X 25 text
        bit 1: 0 = text mode
               1 = graphics mode
        bit 2: 0 = color mode
               1 = b/w mode
        bit 3: 0 = disable video
               1 = enable video
        bit 4: 0 = non-640 X 200 b/w mode
               1 = 640 X 200 b/w mode
        bit 5: 0 = keep background intensity
                   attribute bit
               1 = change background intensity
                   attribute bit to blink bit
        bit 6-7: unused

    3d9: (write only)
        bit 0:- selects blue border color in 40 X 25,
                80 X 25 text, 320 X 200 16 colors
                or 640 X 200 16 colors mode;
              - selects blue as background color in
                320 X 200 4 colors or 640 X 200
                4 colors mode
              - selects blue as foreground color in
                640 X 200 black and white mode

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bit 1:- selects green border color in 40 X 25,
        80 X 25 text, 320 X 200 16 colors
        or 640 X 200 16 colors mode;
      - selects green as background color in
        320 X 200 4 colors or 640 X 200
        4 colors mode
      - selects green as foreground color in
        640 X 200 black and white mode

bit 2:- selects red border color in 40 X 25,
        80 X 25 text, 320 X 200 16 colors
        or 640 X 200 16 colors mode;
      - selects red as background color in
        320 X 200 4 colors or 640 X 200
        4 colors mode
      - selects red as foreground color in
        640 X 200 black and white mode

bit 3:- selects intensified border color in
        40 X 25, 80 X 25 text, 320 X 200 16
        colors or 640 X 200 16 colors mode;
      - selects   intensified as   background
        color in 320 X 200 4 colors or
        640 X 200 4 colors mode
      - selects intensified as foreground
        color in 640 X 200 black and white
        mode

bit 4:- selects intensified set of foreground
        colors in 320 X 200 4 colors or
        640 X 200 4 colors mode

bit 5:- selects active color set in 320 X 200
        4 colors or 640 X 200 4 colors mode

bit 6 - 7: unused

3da: Status register (read only)
    bit 0: display enable
    bit 1: light pen trigger set
    bit 2: light pen switch made
    bit 3: vertical sync
    bit 4 - 7: unused

3db: clear light pen strobe (write only)

3dc: set light pen strobe (write only)

3dd: (write only)
    bit 0 - 3: unused
    bit 4: 0 = non-320 X 200 16 colors
          1 = 320 X 200 16 colors
    bit 5: 0 = non-640 X 200 4 colors
          1 = 640 X 200 4 colors
    bit 6: 0 = Plane 0: b8000 - bbfff
              Plane 1: bc000 - bffff
          1 = Plane 0: bc000 - bffff
              Plane 1: b8000 - bbfff
    bit 7: 0 = non-640 X 200 16 colors
          1 = 640 X 200 16 colors

3df: (write only)
    bit 0: reserved
    bit 1, 2: unused
    bit 3: 132-column text for monochrome
    bit 4: 132-column text for color
        (bit 0 of 3d8 must be 1)
    bit 5: set emulation mode in lieu of DIP-
        Switch
    bit 6: set monochrome mode in lieu of DIP-
        Switch
    bit 7: set color mode in lieu of DIP-Switch

6.4 Programming the 6845

The values that must be programmed into the 6845 CRT-controller registers to control the different modes of operation supported by the Advanced Graphics Adapter are outlined in the following table:

40 X 25 Color Text Mode

    38,28,2d,0a,1f,06,19,1c,02,07,06,07,00,00

80 X 25 Color Text Mode

    71,50,5a,0a,1f,06,19,1c,02,07,06,07,00,00

320 X 200   4 Colors and 640 X 200 B/W Mode

    38,28,2d,0a,7f,06,64,70,02,01,06,07,00,00

320 X 200   16 Colors and 640 X 200   4 Colors

    38,28,2d,0a,7f,06,64,70,02,01,06,07,00,00

640 X 200   16 Colors (Color Mode)

    70,50,58,0a,40,06,32,38,02,03,06,07,00,00

640 X 200   16 Colors (Emulation Mode)

    61,50,52,08,32,06,32,32,02,07,06,07,00,00

80 X 25 Monochrome Text Mode

    61,50,52,0f,19,06,19,19,02,0d,0b,0c,00,00

Hercules Graphics Mode

    36,2d,2f,07,5b,00,57,53,02,03,00,00,00,00

132 X 25 Color Text Mode

    b5,84,97,0a,1f,06,19,1c,02,07,06,07,00,00

132 X 25 Monochrome Text Mode

    9a,84,8a,0f,19,06,19,19,02,0d,06,07,00,00

132 X 44 Monochrome Text Mode

    9a,84,8a,0f,2d,02,2c,2c,02,07,06,07,00,00

Advanced Graphics Adapter

Video controller - 6845 CRT controller chip

Alphanumeric modes:

Screen size - 40 X 25 characters
            - 80 X 25 characters
            - 132 X 25 characters
            - 132 X 44 characters

Attributes - 16 colors, normal, reverse video,
             blinking, highlighting, underline

Graphics modes:

320 X 200 pixels - 4 colors   (IBM compatible)
640 X 200 pixels - B/W   (IBM compatible)
320 X 200 pixels - 16 colors   (Plantronics comp.)
640 X 200 pixels - 4 colors   (Plantronics comp.)
720 X 348 pixels - Mono. Graphics   (Hercules comp.)
640 X 200 pixels - 16 colors   (AGA Graphics)

Video Display Buffer:

    - 64K bytes of video memory
    - b0000 to b3fff for all monochrome text modes
    - b8000 to bffff for all color or Emulation modes
    - b0000 to bffff for monochrome graphics mode
      or 640 X 200 16 color mode

Fast Flicker free scrolling

Sync Signals - separate horizontal and vertical sync in
               TTL levels
             - horizontal - 15.75 kHz for RGB monitor
                          - 18.432 kHz for TTL mono-
                            chrome monitor
             - vertical   - 60 Hz for RGB monitor
                          - 50 Hz for TTL monochrome
                            monitor

Connectors:

```
Direct Drive      - 9-pin D shell (Female) PC standard
Composite video - AGA Composite Interface Connector or
                  2-pin BERG
RF Modulator      - 4-pin BERG
Light Pen         - 6-pin BERG
```

Connector Specifications:

Video Connector

DB9 Female Connector

Color/Graphic Modes		Monochrome/Emulation Modes	
Pin No.	Signal	Pin No.	Signal
1	GND	1	GND
2	GND	2	GND
3	RED	3	not used
4	GREEN	4	not used
5	BLUE	5	not used
6	INTENSITY	6	INTENSITY
7	COMP. VIDEO*	7	VIDEO
8	H SYNC	8	H SYNC
9	V SYNC	9	V SYNC

*) Composite Video can be disabled to allow for connection to an IBM Enhanced Color Monitor.

Light Pen Connector

Pin No.	Signal
1	- Light Pen Input
2	- (key) not used
3	- Light Pen Switch
4	- GND
5	- + 5 Volts
6	- + 12 Volts

Due to high persistence of monochrome display, light
pen will not work on programs running on PC 10/20
compatible monochrome monitor.

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RF Modulator Interface

       Pin No.   Signal

        1   - + 12 Volts
        2   - (key) not used
        3   - Composite Video Output
                          (NTSC)
        4   - GND

Troubleshooting

If you have any problems with any of the functions of
your Advanced Graphics Adapter, please review the
following:

Installation Related Problems

- you have installed the AGA properly with correct
  switch settings (see Section 2.1, Diagram 2).

- you have set the switches on your computer according
  to the switch settings of your Advanced Graphics
  Adapter (i. e. if your AGA switches are set for
  Color/Graphics mode, your computer's switches are
  also set for color). For the AGA in Color/Graphics or
  Emulation Modes, use the color setting. For the AGA
  in Monochrome Graphics Mode, use mono setting. Refer
  to section 2.1 for details.

- you are using the correct monitor for the display
  mode you are using, i. e. color monitor with
  Color/Graphics mode, monochrome monitor with Mono-
  chrome Graphics or Emulation modes.

- you have allowed your computer 15 seconds or so to
  boot-up.

- all data and power cables are properly connected.

- the card is fully seated in its socket.

- the video display's intensity and contrast controls
  are both turned up far enough to produce an image.

- the video display's vertical and horizontal hold
  controls are properly adjusted. With some types of
  monochrome monitors, it is sometimes required to
  adjust the H-HOLD or V-HOLD of the monitor when the
  display mode is changed.

- with some types monochrome monitors you may have to turn your monitor off and then on again after you switch modes.

- make sure the correct driver is installed on your application software. Use the color driver when you use the Advanced Graphics Adapter in Color/Graphics or Emulation modes and Monochrome or Hercules driver when the AGA is set up in the Monochrome Graphics Mode. Also remember to run either VSET MG1, or MG2 before running monochrome graphics software under the Monochrome Graphics Mode (see Section 3).

If none of the above solve your problem then seek assistance from the dealer who sold you your computer or Advanced Graphics Adapter.

Diagnostics

The Advanced Graphics Adapter diagnostics program contains a video test.

Use the diagnostics program when:

1) You want to verify the operation of the card.

2) The card gives a display but does not work properly. For example - does not display graphics, has missing characters or has no color.

The diagnostic program is completely menu-driven and is started by typing:

A>AGATEST (return)