Genoa Spectrum™ Graphics Card

USER'S MANUAL

G Genoa
SYSTEMS CORPORATION

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PREFACE

This manual contains detailed instructions for installing, operating and programming the GENOA SPECTRUM Graphics Card for the IBM and its compatible PCs.

The manual is divided into two parts: The first part is a user's guide of operation written for all users, and the second part is a technical reference written for those who need to know the technical aspects of the SPECTRUM Card.

To use the SPECTRUM Card, a user needs to read only the first part of the manual. It is IMPORTANT that a user read the first part of the manual before installing the SPECTRUM Card.

We have made every effort to document all necessary information which will allow users to install and operate the SPECTRUM Card without special training.

All product information provided in this manual is based on the latest information available at the time of printing. We have carefully reviewed the accuracy of product information. However, GENOA SYSTEMS CORPORATION cannot be held responsible for any inadvertent omissions or errors that may appear in this document.

GENOA's products are warranted against defects in material and workmanship. The warranty period for the hardware supplied by GENOA SYSTEMS CORPORATION is one year including parts and labor. For additional information on warranty, refer to the APPENDIX.

CAUTION:

> **BE SURE THAT YOU READ SECTION 3 OF THIS MANUAL BEFORE YOU USE THE SPECTRUM CARD. BECAUSE OF THE DESIGN OF THE MONITOR, YOUR MONITOR MAY BE DAMAGED IF YOU DO NOT FOLLOW THE INSTALLATION PROCEDURES.**

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PART I

GUIDE TO OPERATION

1.0   GENERAL DESCRIPTION

1.1   FEATURES

The SPECTRUM Graphics Card from GENOA SYSTEMS combines the functions of the IBM Monochrome Adapter, IBM color Graphics Adapter, Hercules Graphics Adapter and Plantronics Colorplus Adapter, into a single card. In addition, it offers 132 column text in both monochrome and color modes and allows users to run IBM color or Plantronics Colorplus programs on IBM or equivalent monochrome or color monitors.

The features of the SPECTRUM Card are:

* IBM Monochrome text: 80 COL x 25 LINE text using 9 x 14 character box.

* Hercules compatible monochrome graphics: 720 x 348 high resolution graphics on the monochrome monitor.

* Monochrome 132 column text: either 132 COL x 44 LINE or 132 COL x 25 LINE text.

* IBM color text: either 80 COL x 25 LINE or 40 COL x 25 LINE color text.

* IBM Color graphics: either 320 x 200 resolution graphics in 4 colors or 640 x 200 resolution graphics in 2 colors.

* Color 132 column text: 132 COL x 25 LINE color text.

* Plantronics compatible enhanced color graphics: either
    320 x 200 resolution graphics in 16 colors or
    640 x 200 resolution graphics in 4 colors.

* Color Emulation on monochrome monitor: displaying IBM Color text, IBM Color graphics, Plantronics enhanced color graphics colors in terms of shades on the monochrome monitor.

1.2 COMPUTER AND MONITOR COMPATIBILITY

The following is a list of computers and monitors that we have tested satisfactorily with the SPECTRUM Card as of the time of printing.

COMPUTERS:
- 1) IBM PC, XT, AT
- 2) Columbia PC
- 3) Tava PC
- 4) Tandy 1200PC

MONITORS:
- 1) IBM Monochrome Monitor
- 2) Princeton Graphics Systems MAX-12 Monochrome Monitor
- 3) IBM Color Monitor
- 4) Princeton Graphics Systems HX-12 Color Monitor
- 5) Taxan 420 and 425 Color Monitors
- 6) Quimax PX-IV Color Monitor: It is an excellent monitor especially for color 132 column mode.

Following monitors have been observed to have one problems or another with the SPECTRUM Card. These problems may be caused by inherent monitor incompatibility to some extent with IBM monitors.

- 1) Amdek 310A Monochrome Monitor: It is required to turn off and on the monitor each time the display mode is changed. It works well in all monochrome modes except when running the color software on the monochrome monitor in the emulation mode; only about 95% of the vertical screen can be seen.

- 2) Quimax DM-14 Monochrome Monitor: It works well in all monochrome modes except when running the color software on the monochrome monitor in the emulation mode; only about 95% of the vertical screen can be seen.

- 3) Taxan 121 Monochrome Monitor: It is sometimes required to adjust the H-HOLD in the back of the monochrome monitor when the display mode is changed.

2.0   PARTS LIST

Following items are contained in your carton:

1. One SPECTRUM Card.
2. One card guide.
3. A SPECTRUM user's manual.
4. A SPECTRUM utility diskette.

3.0   INSTALLATION

Follow these procedures to install your SPECTRUM Card:

1) Turn off your computer and unplug its power cord.

2) Take off the system unit top cover by removing the mounting screws from the back of the system unit. (Refer to Figure 3.1)

3) Remove the cover by sliding it toward you until it stops, and then tilt it up as shown in Figure 3.2.

4) Refer to Appendix A.1 for IBM system board switch settings and SPECTRUM Card jumper settings. Set the switches and jumpers accordingly and keep a note of the default use of the SPECTRUM Card. You will need this information later in step 10.

5) Install lightpen, according to the manufacturer's instructions, if any. For lightpen connector location, see Figure 3.3.

    DUE TO HIGH PERSISTENCE OF MONOCHROME DISPLAY, LIGHTPEN WILL NOT WORK ON PROGRAMS RUNNING ON MONOCHROME MONITOR.

6) Locate an unused expansion board slot in your system unit and remove the screw and the cover as shown in Figure 3.4.

7) Insert the supplied card guide into the front of the system unit, using the holes corresponding to the expansion slot chosen for the SPECTRUM Card. Refer to Figure 3.5

8) Install the SPECTRUM Card in the selected system expansion slot along the card guide.

9) Replace the system unit cover and fasten the screws.

10) Connect your monochrome monitor cable to the SPECTRUM Card video connector if the SPECTRUM is installed as either the "only video card" or the "monochrome adapter". Otherwise, connect your color monitor cable to the SPECTRUM Card video connector. See Fig. 3.3 for the video connector location.

11) Connect your printer cable (if any) to the SPECTRUM Card printer connector. See Fig. 3.3 for the printer connector location.

12) Plug your PC power cord into the wall outlet and turn on your computer.

13) Now you are ready to use your SPECTRUM Card.

14) After getting your computer running, you should make a copy of the utility diskette shipped with the SPECTRUM Card and keep it on hand for normal use. Save your original SPECTRUM diskette for future use.

Mounting Screws
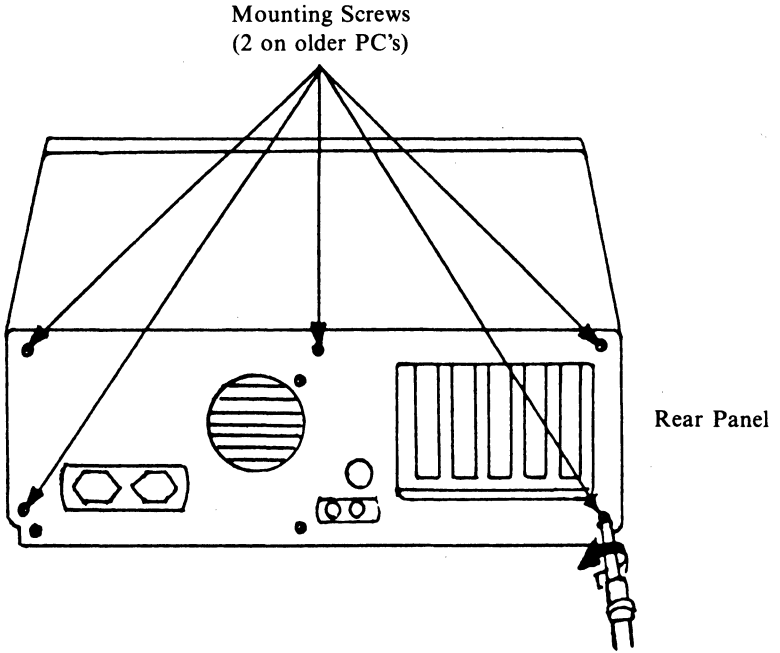(2 on older PC's)

Rear Panel

Figure 3.1 Remove Rear-panel Mounting Screws
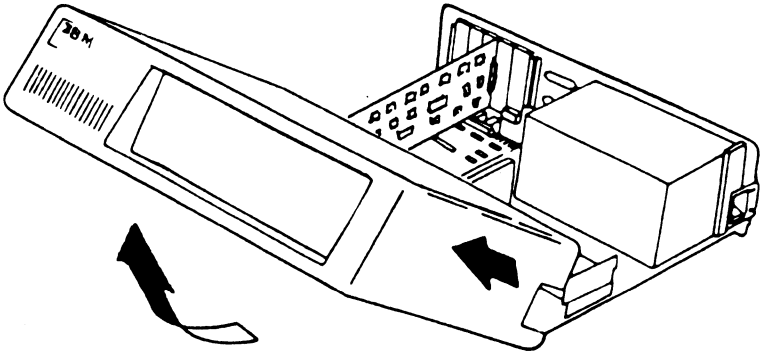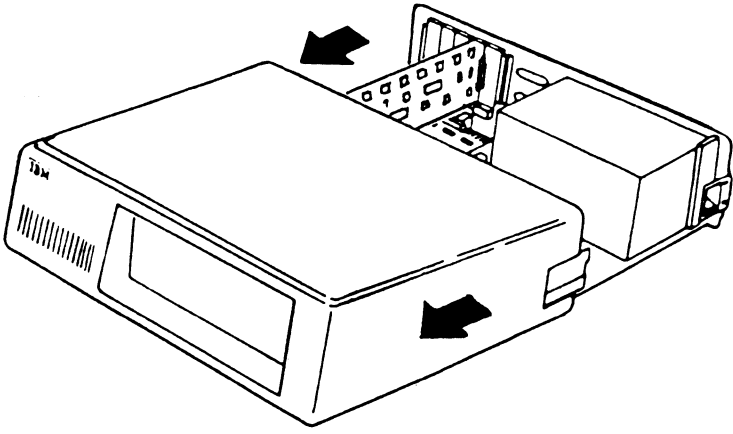
Figure 3.2 Removing IBM PC Top Cover

Jumper

Pin

JP2

Light Pen Connector

JP4

J3   1

Video Connector

Printer Connector

JP3

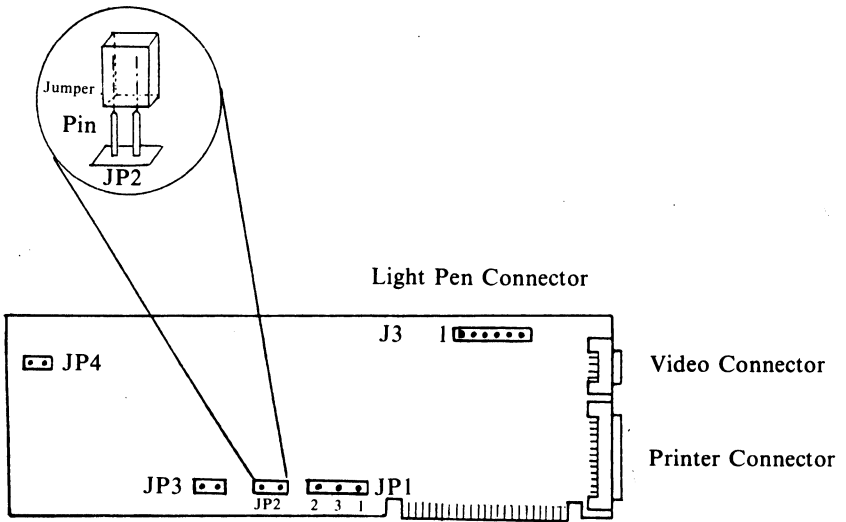JP2   2 3 1   JP1

Figure 3.3 Spectrum Board Jumpers and Connectors
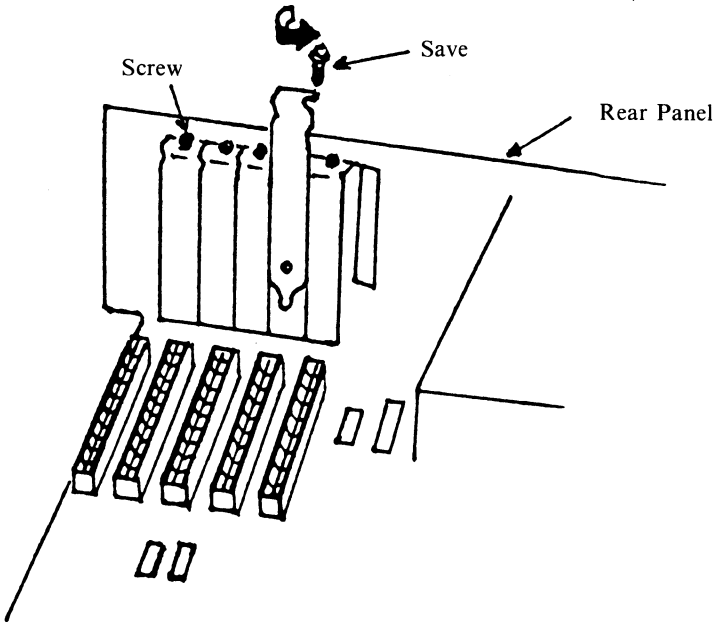
Figure 3.4 Preparing an Expansion Slot
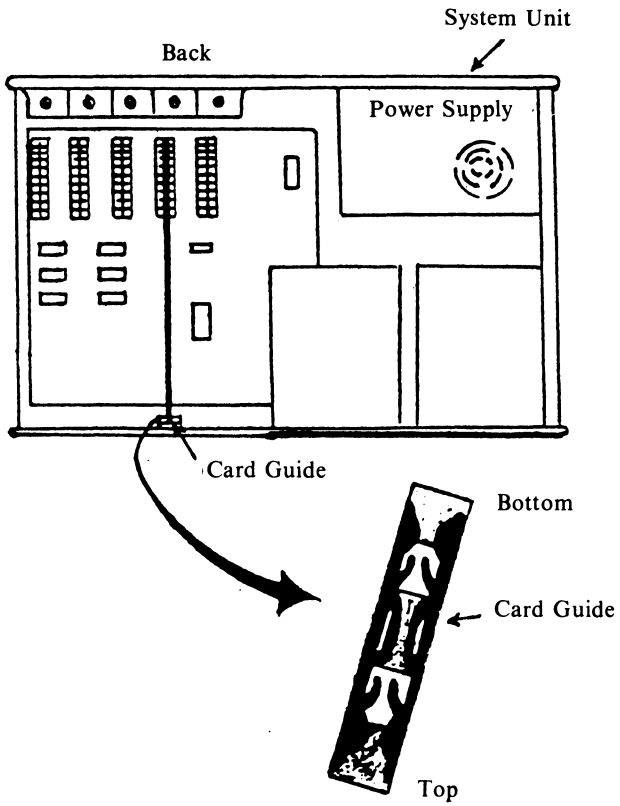
Figure 3.5 Installing a Card Guide and the Spectrum Board

4.0   USING THE SPECTRUM CARD IN VARIOUS MODES

After you complete the installation procedures of the SPECTRUM Card, you should be able to run those programs described under the DEFAULT CAPABILITY of your configuration in Appendix A.1 without and help from the utility diskette.

The utility diskette is needed only if you want to run programs which do not conform to the DEFAULT CAPABILITY described under your configuration.

If your SPECTRUM Card is installed as a color graphics adapter because you have only a color monitor (such as CONFIGURATION C or D in Appendix A.1), then you are only allowed to switch among the color modes.

If your SPECTRUM Card is installed as either a color graphics or monochrome adapter because you have both monochrome and color monitors and another adapter (such as CONFIGURATION E, F or G in Appendix A.1), you may still use the utility program to switch between the two monitors. However, some of the enhanced modes may not work on your other adapter. This is due to the limitation of the adapter.

If your SPECTRUM Card is installed as the only video card in your system and you have only a monochrome monitor (such as CONFIGURATION A or B in Appendix A.1), you can use this utility program to switch among the monochrome modes and the emulation modes.

If your SPECTRUM Card is installed as the only video card in your system and you have both monochrome and color monitors, (such as CONFIGURATION H or I in Appendix A.1), you can use the utility program to switch among the monochrome, the emulation and the color modes.

On the utility diskette there are two programs called 'SM' and 'SM2'. Use the SM program when you have the SPECTRUM Card as the only video board in your PC. If you have installed two display adapters in your PC, you should use the SM2 program. By using this program, a user can switch from one mode of display to another without opening the PC.

MAKE SURE THAT YOU READ THE FILE"READ.ME" ON THE UTILITY DISKETTE BEFORE YOU USE THE "SETMODE" PROGRAM. The "Read.me" file contains instructions about adjusting your monochrome or color monitor for 132 column application as well as which program (SM or SM2) you should use.

When you switch from monochrome monitor to color monitor or vice versa, the SM program will remind you to check if you have the correct monitor connected to the SPECTRUM Card.   IT IS IMPORTANT THAT YOU FOLLOW THE DIRECTIONS CAREFULLY.

The SM program is a menu driven program. Enerything you need to know about using the program is shown on the menu. All you need to do is to type:

```
SM   CR (carriage return or enter key)
```

after the system prompt, A ⟩ .

Notice that typing 'SM' or 'sm' invokes the same program.

After typing SM, a menu is displayed on the monitor as the one in Fig. 4.1. Now make a selection by entering a number (1 - 11) for the mode desired. If everything is alright, this is all you need to do and the program will return you to the familiar DOS prompt, A ⟩ . Now you are all set for running programs in the selected mode. If there are any problems or additional information is needed, the program will inform you and lead you from there.

After you are familiar with the utility program, you may want to skip the menu. This can be done by typing:

```
SM   keyword   CR (carriage return or enter key)
```

after the system prompt, A ⟩ . You can find the keyword of your choice from Fig. 4.1 or from the menu (shown in reversed video).

```
╔══════════════════════════════════════════════════════╗
║         GENOA SPECTRUM MODE SELECT MENU                ║
╠══════════════════════════════════════════════════════╣
║                                              KEYWD     ║
║    1. Monochrome      Text          80 x 25      MT    ║
║    2. Monochrome      Graphics      HALF         MGH   ║
║    3. Monochrome      Graphics      FULL         MGF   ║
║    4. Monochrome      Text          132 x 44     M44   ║
║    5. Monochrome      Text          132 x 25     M25   ║
║    6. Emulation       Text          80 x 25      E80   ║
║    7. Emulation       Text          80 x 25      E40   ║
║    8. Color           Text          80 x 25      C80   ║
║    9. Color           Text          40 x 25      C40   ║
║   10. Color           Text          132 x 25     C132  ║
║   11. Exit to DOS                                      ║
╠══════════════════════════════════════════════════════╣
║                                                        ║
║  Select A Number (1 - 11) -〉                          ║
╚══════════════════════════════════════════════════════╝
```

Figure 4.1 Genoa Spectrum Mode Select Menu

The modes appearing on the selection menu are:

1. Monochrome Text 80 x 25 ---
   This is the only mode for IBM monochrome adapter. It also corresponds to HGC DIAG for Hercules graphics mode.

2. Monochrome Graphics HALF Mode ---
   This corresponds to HGC HALF for Hercules graphics mode.

3. Monochrome Graphics FULL Mode ---
   This corresponds to HGC FULL for Hercules graphics mode. When using LOTUS 123 with the Hercules driver, it is required that this mode be set before 123 is started.

4. Monochrome Text 132 x 44 ---
   This gives you 132 columns by 44 lines on your monochrome monitor. However, if you are planning to run the program in this mode you have to make sure that your program itself supports the mode.

5. Monochrome Text 132 x 25 ---
   This gives you 132 columns by 25 lines on your monochrome monitor. However, if you are planning to run the program in this mode you have to make sure that your program itself supports the mode.

6. Emulation Text 80 x 25 ---
   This mode allows you to run IBM color text 80 x 25 program on the monochrome monitor.

7. Emulation Text 40 x 25 ---
   This mode allows you to run IBM color text 40 x 25 program on the monochrome monitor.

8. Color Text 80 x 25 ---
   This corresponds to the IBM Color Graphics Adapter 80 x 25 text mode.

9. Color Text 40 x 25 ---
   This corresponds to the IBM Color Graphics Adapter 40 x 25 text mode.

10. Color Text 132 x 25 ---
    This gives you 132 columns by 25 lines on your color monitor. Again, if you are planning to run application program in this mode the application program has to support the mode.

11. EXIT to DOS ---
    Return to DOS from the menu.

You will notice that none of the color graphics modes are included in the menu. This is because those modes are normally set by the application programs.

EXAMPLE:

Suppose that you are in Emulation Text 40 x 25 right now and you would like to switch to Monochrome Text 80 x 25 mode (maybe for better text quality). What would you do?

There are two ways you can do this:

One way is to use the menu:

1. Insert the copy of SPECTRUM utility diskette in the floppy drive.

2. After DOS prompts, A ⟩ , type:

   SM   CR(carriage return or enter key)

3. After the menu is displayed, type:

   1   CR

Another way is to bypass the menu (if you already know the keyword):

1. Insert the copy of SPECTRUM utility diskette in the floppy drive.

2. After DOS prompt, A ⟩ , type:

   SM   MT   CR

5.0   NOTES FOR SOME APPLICATION SOFTWARE

5.1   WORDSTAR IN 132 COLUMN MODE

If you would like to run the WORDSTAR wordprocessing program in a 132 column mode, you need to modify the WS.COM file on your WORDSTAR diskette. Follow these simple steps:

* Load WS.COM using the DEBUG program
  (Refer to your DOS manual for loading files
  under DEBUG program.)

* Type E cs:248, hit CR key

* Type 2B, hit CR key

* Type E cs:249, hit CR key

* Type 84, hit CR key

* Type w, hit CR key

5.2   INSTALLING LOTUS 123 FOR MONOCHROME GRAPHICS MODE

If you would like to run the Lotus 123 program to draw pie charts, bar charts etc. on the monochrome monitor in Hercules Graphics mode, here is what you should do:

1. Make sure that you have LOTUS 123 version 1.0a.

2. Install the Hercules driver from your 123 Utility Diskette as follows:

   * Make sure that you are in DOS with the system prompt.

   * Insert your 123 Utility Diskette from LOTUS in your A drive, referred to here as the source drive.

   * Switch from the DOS to the source drive where the 123 Utility Diskette is. For instance, if you are using drive C now, after seeing the DOS system promt C ⟩ , type:

     A: CR

     from your keyboard to get the DOS system prompt A ⟩ .

   * Type:

     HERCULES x:

     where x is the target drive that the driver is going to be copied to from the 123 Utility Diskette.

   * Follow the instructions of the install program from Lotus 123 now.

   * After finishing the installation, run the setmode program and select Monochrome Graphics FULL Mode.

   * After finishing the setmode program, you are all set to run the 123 program.

5.3   SPECTRUM FOR LOTUS SYMPHONY

Because the SPECTRUM Card is compatible with the Hercules Graphics Board and Plantronics Colorplus Board, you can install SPECTRUM as either Hercules or Plantronics.

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5.4.   SPECTRUM FOR SUPERCALC 3

It is recommended that you either install the Hercules driver for SuperCalc 3 or use the Emulation mode if you are using the monochrome monitor. This will give you a better business graphics capability.

If you install the IBM driver for SuperCalc 3, you must select the monochrome text mode using the SPECTRUM utility program before running SuperCalc 3.

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PART II

TECHNICAL REFERENCE FOR ADVANCED USERS

6.0   PROGRAMMING INFORMATION

6.1   MODES OF OPERATION

The SPECTRUM Card can operate in various modes which combine the functions of the IBM Monochrome Display Adapter, the IBM Color Graphics Adapter, Hercules Graphics Adapter and Plantronics Colorplus Adapter. These modes are described as follows:

```
IBM Monochrome Adapter Mode (80 x 25)
```

The SPECTRUM Card emulates the IBM Monochrome Display Adapter. It produces 25 lines of 80 characters on the IBM Monochrome Monitor.

```
IBM Color Graphics Adapter Mode
```

The SPECTRUM Card emulates the IBM Color Graphics Adapter. It can be connected directly to an RGB monitor. There are total of 7 sub-modes:

1. 40 x 25 alpha black/white mode:
   Displays 25 lines of 40 characters each.

2. 40 x 25 alpha color mode:
   Displays 25 lines of 40 characters each.

3. 80 x 25 alpha black/white mode:
   Displays 25 lines of 80 characters each.

4. 80 x 25 alpha color mode:
   Displays 25 lines of 80 characters each.

5. Low resolution graphic mode:
   Displays 100 rows of 160 pels ("Picture Elements") each.

6. Standard medium resolution graphic mode:
   Displays 200 rows of 320 pels each with maximum of 4 colors.

7. Standard high resolution graphic mode:
   Displays 200 rows of 640 pels each with maximum of 2 colors.

```
Monochrome Graphics Mode (Hercules Graphics Adapter compatible)
```

The SPECTRUM Card functions as the Hercules Monochrome Graphics Adapter. It produces 348 rows of 720 pels each on an IBM Monochrome Monitor.

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Enhanced Color Graphics Mode (Plantronics compatible)

The SPECTRUM Card emulates the Plantronics Colorplus Adapter. It provides two enhanced submodes in addition to the seven submodes of the IBM Color Graphics Adapter. These two enhanced modes are:

1. Enhanced median resolution graphics mode:
   Displays 200 rows of 320 pels each with a maximum of 16 colors.

2. Enchanced high resolution graphics mode:
   Displays 200 rows of 640 pels each with a maximum of 4 colors.

Emulation mode

When the SPECTRUM Card is displaying IBM Color Graphics or Enhanced Color Graphics on a monochrome monitor, it is in the Emulation mode.

For the user of the SPECTRUM Card, Emulation mode is the same as IBM Color Graphics or Enhanced Color Graphics mode as long as the switches and jumpers are correctly set during the installation. Simply run the software as if it was going to be displayed on a color monitor.

Monochrome 132 Column Text Mode

In this mode, the SPECTRUM Card allows you to display 132 column text on the IBM or an equivalent monochrome monitor. This mode is useful for applications where seeing more than 80 columns on the screen is important. It is also useful for seeing exactly what's to be printed on a 132-column line printer.

Color 132 Column Text Mode

In this mode, the SPECTRUM Card allows you to display 132 column text on the IBM or an equivalent color monitor. This mode is useful for applications where seeing more than 80 columns on the screen is important. It is also useful for seeing exactly what's to be printed on a 132-column line printer.

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6.2 PROGRAMMING SEQUENCE

Follow the general programming sequence listed below to program the SPECTRUM Card.

- Program CRT control port with video disabled.
- Program Configuration port.
- Program the 6845 CRT controller.
- Program Color select port if needed.
- Program video memory.
- Program CRT control port with video enabled.

For the Enchanced Color Graphics Modes, follow this programming sequence.

- Program CRT control port with video disabled.
- Program the 6845 CRT controller.
- Program Extended control port 3DD with standard video memory plane selected.
- Program the standard plane of video memory.
- Program Extended control port 3DD with extended video memory plane selected.
- Program CRT control port with video enabled.

6.3 MODE CONTROLS

```
Mode Control for
        IBM MONOCHROME ADAPTER MODE
        MONOCHROME GRAPHICS (HERCULES) MODE
        MONOCHROME 132 COLUMN TEXT MODE
```

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

* 3B0-3B1: synonym for 3B4-3B5

* 3B2-3B3: synonym for 3B4-3B5

* 3B4: 6845 register address port
      refer to "6845 Programming"

* 3B5: 6845 register data port
      refer to "6845 Programming"

* 3B6-3B7: unused

* 3B8: CRT control port (write only)

                bit 0: 1= IBM Monochrome Adapter mode
                       x= for other modes
                bit 1: 0= text mode for Monochrome Graphics
                          (power on default)
                       1= graphics mode for Monochrome
                          Graphics (MUST Reprogram 6845 each
                          time this bit is changed.)
                       x= for 132 column modes
                bit 2: not used
                bit 3: 0= video disable
                       1= video enable
                bit 4: not used
                bit 5: 0= disable blink
                       1= enable blink
                bit 6: not used
                bit 7: 0= page 0 for Monochrome Graphics
                          mode (Power on default. Display
                          region is B0000-B7FFF.)
                       1= page 1 for Monochrome Graphics
                          mode. (Display region is B8000-
                          BFFFF.)
                       x= for other modes.

* 3B9: unused

* 3BA: CRT status port (read only)

      bit 0: 0= non-horizontal sync
             1= horizontal sync
      bit 1: not used
      bit 2: not used
      bit 3: 0= black / white video inactive
             1= black / white video active
      bit 4: not used
      bit 5: not used
      bit 6: not used
      bit 7: 0= vertical sync
             1= non-vertical sync

* 3BB: unused

* 3BC: Printer data port (read or write)

* 3BD: Printer status port (read only)

      bit 0: not used
      bit 1: not used
      bit 2: not used
      bit 3: 0= printer error
             1= printer is normal
      bit 4: 0= printer not attentive
             1= printer is listening
      bit 5: 0= normal operation
             1= out of paper
      bit 6: 0= accepting data
             1= ready for more data
      bit 7: 0= printer is busy
             1= normal operation

* 3BE: Printer control port (read or write)

      bit 0: 0= strobe the printer to accept data at
             the data latch
             1= release the strobe (default)
      bit 1: 0= auto line feed
             1= remote line feed (default)
      bit 2: 0= initialize the printer(default)
             1= release printer from normal operation
      bit 3: 0= de-select the printer
             1= select the printer (default)
      bit 4: 0= mask off IRQ7 (default)
             1= enable IRQ7
      bit 5 - bit 7: not used

* 3BF: Configuration port (write only)

bit 0: 0= disable setting of monochrome
         graphics mode bit (Port 3B8 bit 1)
         Power on default is '0'.
      1= enable setting of monochrome
         graphics mode bit (Port 3B8 bit 1)
bit 1: 0= disable setting of monochrome
         graphics page bit (Port 3B8 bit 7)
         Power on default is '0'. The available
         display memory is B0000-B7FFF
         when this bit is '0'.
      1= enable setting of monochrome graphics
         page bit (Port 3B8 bit 7). The
         available memory is B0000-BFFFF when
         this bit is '1'.

> CAUTION: You can set this bit when the SPECTRUM
> Card is the only display adapter in the system.

bit 2: not used
bit 3: 0= non 132 column modes. Power on default.
      1= 132 column modes.
bit 4 - bit 5: not used
bit 6: 0= disable software switch for monochrome mode.
      1= software switch in lieu of hardware jumper
         to force the SPECTRUM Card into color
         modes. The software switch works only with
         jumper JP1 off.

> CAUTION: You can set this bit only if you are sure that
> the SPECTRUM Card is connected to a monochrome
> monitor.

bit 7: 0= disable software switch for color mode.
      1= software switch in lieu of hardware jumper
         to force the SPECTRUM Card into color
         modes. The software switch works only with
         jumper JP1 off.

> CAUTION: You can set this bit only if you are sure that
> the SPECTRUM Card is connected to a color monitor.
> Emulation modes will not work with this bit set.

```
▄█████████████████████████████████████████████████████████████████████████▄
█ Mode Control for                                                          █
█         IBM COLOR GRAPHICS ADAPTER MODE                                   █
█         ENHANCED COLOR GRAPHICS MODE                                      █
█         EMULATION MODE                                                    █
█         COLOR 132 COLUMN TEXT MODE                                        █
▀█████████████████████████████████████████████████████████████████████████▀
```

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

* 3D0-3D1: synonym for 3D4-3D5

* 3D2-3D3: synonym for 3D4-3D5

* 3D4: 6845 register address port
      refer to "6845 Programming"

* 3D5: 6845 register data port
      refer to "6845 Programming"

* 3D6-3D7: unused

* 3D8: CRT control port (write only)

        bit 0: 0= 40 x 25 alphanumeric mode
               1= 80 x 25 alphanumeric mode
        bit 1: 0= alpha modes selected
               1= graphics modes selected
        bit 2: 0= color modes selected
               1= black / white modes selected
        bit 3: 0= disable video signal
               1= enable video signal
        bit 4: 0= non 640 x 200 high resolution mode
               1= 640 x 200 high resolution mode
        bit 5: 0= keep background intensity
                  attribute bit
               1= change background intensity
                  attribute bit to a blink bit
        bit 6 - bit 7: not used

* 3D9: Color select register (write only)

bit 0: selects blue border color in 40 x 25, 80 x 25
alpha modes or enhanced medium resolution
mode;
selects blue as background color in standard
medium resolution graphics mode or enhanced
high resolution graphics mode;
selects blue as foreground color in standard high
resolution graphics mode;

bit 1: selects green border color in 40 x 25, 80 x 25
alpha modes or enhanced medium resolution mode;
selects green as background color in standard
medium resolution graphics mode or enhanced
high resolution graphics mode;
selects green as foreground color in standard
high resolution graphics mode;

bit 2: selects red border color in 40 x 25, 80 x 25
alpha modes or enhanced medium resolution
mode;
selects red as background color in standard
medium resolution graphics mode or enhanced
high resolution graphics mode;
selects red as foreground color in standard
high resolution graphics mode;

bit 3: selects intensified border color in 40 x 25, 80 x 25
alpha modes or enhanced medium resolution
mode;
selects intensified background color in standard
medium resolution graphics mode or enhanced
high resolution graphics mode;
selects intensified foreground color in standard
high resolution graphics mode;

bit 4: selects intensified set of foreground colors in
standard medium resolution graphics mode or
enhanced high resolution graphics mode;

bit 5: selects active color set in standard medium
resolution graphics or enhanced high
resolution graphics mode;

bit 6: not used

bit 7: not used

* 3DA: CRT status port (read only)

  bit 0: display enable

  bit 1: light pen trigger set

  bit 2: light pen switch made

  bit 3: vertical sync

  bit 4 - bit 7: not used

* 3DB: clear light pen strobe (write only)

* 3DC: set light pen strobe (write only)

* 3DD: Extended control port
  (write only, CLEARED IN ALPHA MODES)

  bit 0-3: not used

  bit 4: 0= non-enhanced medium resolution mode
         (power on default)
      1= enhanced medium resolution mode

  bit 5: 0= non-enhanced high resolution mode
         (power on default)
      1= enhanced high resolution mode

  bit 6: 0= select standard memory plane
         for CPU or CRT output.
      1= select extended memory plane
         for CPU or CRT output.

  bit 7: always set '0'

* 3DF: Configuration port (write only)

   bit 0 - 2: not used.

   bit 3: 0= non 132 column modes. Power on default.
           1= 132 column modes;

   bit 4 - 5: not used.

   bit 6: 0= disable software switch for monochrome
             mode.
           1= software switch in lieu of hardware jumper
             to force the SPECTRUM Card into the
             monochrome mode. The software switch
             works only with the jumper JP1 off.

```
CAUTION: You can set this bit only if you are
sure that the SPECTRUM Card is connected
to a monochrome monitor.
```

   bit 7: 0= disable software switch
           1= software switch in lieu of hardware jumper
             forcing SPECTRUM Card into color modes.
             The software switch works only if jumper
             JP1 off.

```
CAUTION: You can set this bit only if you can
be sure the SPECTRUM Card is connected to a
color monitor. Emulation modes will not work
with is bit set.
```

6.4   VIDEO CONTROLLER (6845) PROGRAMMING

The 6845 is an integrated video controller used on the SPECTRUM Card t
control the width and height of the screen. There are 17 registers in the 6845 which a₁
programmed via output ports 3B4/3B5 or 3D4/3D5. To program the 6845, port 3E
or 3D4 is written with the register number (between 0 and 16) and then port 3B5 ₍
3D5 is written with desired value.

Register number	Descriptions
0	Total characters per row including sync minus 1.
1	Number of visible characters per row.
2	Position of the first character of the horizontal sync minus 1.
3	Number of characters during horizontal sync per row minus 1.
4	Total number of rows per screen including sync minus 1.
5	Total number of scan lines (row fractions) in addition to total number of rows per screen.
6	Number of visible rows per screen.
7	Position of the first row of vertical sync minus 1.
8	Interlace mode, always output 2.
9	Number of scan lines per row minus 1.
10	First scan line occupied by the cursor.
11	Last scan line occupied by the cursor.
12	Offset of the display in the video memory (high byte).
13	Offset of the display in the video memory (low byte).
14	Offset of the cursor position in the video memory (high byte).
15	Offset of the cursor position in the video memory (low byte).
16	Offset into the video memory when light pen is triggered (high byte).
17	Offset into the video memory when light pen is triggered (low byte).

The typical value to be programmed for each of the modes of the SPECTRUM Card are listed below in register sequence and are listed in HEXIDECIMAL notation. To program 6845 with different values, please consult with the 6845 specification:

IBM Monochrome Adapter Mode:

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

IBM Color Graphics Mode, Enhanced Color Graphics Mode, Emulation Mode:

* 40x25 Modes
38,28,2d,0a,1f,06,19,1c,02,07,06,07,00,00,00,00,00

* 80x25 Modes:
71,50,5a,0a,1f,06,19,1c,02,07,06,07,00,00,00,00,00

* All other Color Graphics Modes:
38,28,2d,0a,7f,06,64,70,02,01,06,07,00,00,00,00,00

Monochrome Graphics Mode:

35,2d,2e,07,5b,02,57,57,02,03,00,00,00,00,00,00,00

6.5   VIDEO MEMORY ORGANIZATIONS AND DATA FORMAT

The SPECTRUM Card has 64k bytes of video memory. Generally, memory locations B0000-B7FFF are reserved for monochrome applications and locations B8000-BFFFF are reserved for color applications. This section describes the available memory, the memory organization and video data format under each mode:

```
▐IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII▐
IBM MONOCHROME ADAPTER MODE
▐IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII▐
```

On the IBM Monochrome Adapter, the available video memory address is B0000-B0FFF. However, the memory address for the SPECTRUM Card is B0000-B3FFF. This is four times more video memory than the IBM Monochrome Adapter.

A page in this mode is defined as 2k (= 80x25) bytes of data and 2k bytes or attributes. For the attribute format, please refer to the IBM Technical Manual.

In order to view different pages, a user can program the start address registers of 6845 as recommended below (in Hex values):

Page 0 (B0000-B0FFF):	R12=0
	R13=0
Page 1 (B1000-B1FFF):	R12=8
	R13=0
Page 2 (B2000-B2FFF):	R12=10
	R13=0
Page 3 (B3000-B3FFF):	R12=18
	R13=0

132 COLUMNS X 25 ROWS MONOCHROME TEXT MODE

The memory address for this mode is B0000-B3FFF. A page in this mode is defined as 4k (=132x25) bytes of data and 4k bytes of attributes. For the attribute format, please refer to the IBM Technical Manual.

In order to view different pages, a user can program the start address registers of 6845 as recommanded below (in Hex values):

Page 0 (B0000-B1FFF):	R12=0
	R13=0
Page 1 (B2000-B3FFF):	R12=10
	R13=0

132 COLUMNS X 44 ROWS TEXT MODE

The memory address for this mode is B0000-B3FFF. A page in this mode is defined as 8k (=132x25) bytes of data and 8k bytes of attributes. Therefore, there is only one page available in this mode of operation. For the attribute format, please refer to the IBM Technical Manual.

132 COLUMNS 25 ROWS COLOR TEXT MODE

The memory address for this mode is B8000-BBFFF. A page in this mode is difined as 4k (=132x25) bytes of data and 4k bytes of attributes. For the attribute format, please refer to the IBM Technical Manual.

In order to view different pages, a user can program the start address registers of 6845 as recommended below (in Hex values):

Page 0 (B0000-B1FFF):	R12=0
	R13=0
Page 1 (B2000-B3FFF):	R12=10
	R13=0

IBM COLOR GRAPHICS ADAPTER MODE

1. 80x25 alpha submode:

Basically, this mode is the same as the Monochrome Adapter mode except for a few thing.

   a. The video memory address is B8000-BBFFF.

   b. Page 0 range is B8000-B8FFF.
   Page 1 range is B9000-B9FFF.
   Page 2 range is BA000-BAFFF.
   Page 3 range is BB000-BBFFF.

   c. Attribute formats are different. Please refer to the IBM Technical Reference Manual.

2. 40x25 alpha submode:

This submode is similar to 80x25 alpha submode except for the following:

   a. A page is defined as 1k (=40x25) bytes of data and 1k bytes of attributes.

   b. Page 0: B8000-B87FF 6845 Start address reg. R12=0, R13=0
   Page 1: B8800-B8FFF   R12=4, R13=0
   Page 2: B9000-B97FF   R12=8, R13=0
   Page 3: B9800-B9FFF   R12=c, R13=0
   Page 4: BA000-BA7FF   R12=10, R13=0
   Page 5: BA800-BAFFF   R12=14, R13=0
   Page 6: BB000-BB7FF   R12=18, R13=0
   Page 7: BB800-BBFFF   R12=1c, R13=0

3. Standard medium resolution graphics submode:

A page in this submode is defined as 16k bytes. The video memory address B8000-BBFFF is the same as IBM Color Graphics Adapter.

For the video data format, refer to the IBM Technical Reference manual.

4. Standard high resolution graphics submode:

A page in this submode is defined as 16k bytes. The video memory address B8000-BBFFF is the same as the IBM Color Graphics Adapter.

For the video data format, refer to the IBM Technical Reference manual.

MONOCHROME GRAPHICS MODE

Since the resolution in this mode is 720x348, a page is 32k (720x348/8) bytes. There can be two pages of display buffer depending on the user's configuration.

If the user has only the SPECTRUM Card in the system, the second page can be accessed at location B8000-BFFFF. To access the second page, make sure that you have output port 3BF with 3.

In order to display the second page, bit 7 of the Mode Control Port (Port 3B8) has to be set. A user can therefore program page 1 while page 0 is displayed and vice versa.

The offset into the page of the byte containing dot (x,y) in each page is (in Hex value):

$$[\,2000\,*\,(y\ MOD\ 4)\,]\ +\ [\,5A\,*\,INTEGER\ (y\ MOD\ 4)\,]\ +$$
$$[\,INTEGER\ (x\,/\,8)\,]$$

The bit in the byte that stores the dot is bit position

$$7 - (x\ MOD\ 8)$$

where x is between 0 and 719

where y is between 0 and 347

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ENHANCED COLOR GRAPHICS MODE

By setting bit 4 or bit 5 of Port 3DD, the SPECTRUM Card will be in the enhanced color graphics mode   (Refer to section 6.3 for details.)

Under this mode, a second video memory plane (plane 1) is added to the standard video memory plane (plane 0) to provide extra colors. Plane 0 provides all the video memory for the standard IBM color graphics modes and resides at B8000-BBFFF. Plane 1 can be accessed in two ways:

1. Set bit 6 or Port 3DD and then write the same location of the memory as if in the standard mode (i.e. make believe that the memory is still residing at B8000-BBFFF). This method is consistent with the Plantronics Colorplus board.

or

2. Treat the second memory plane as if it is residing from BC000 and up to BFFFF. This method has an advantage of faster screen update.

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1. Enhanced Medium Resolution Graphics (320x200x4):

In this mode, the adjacent pairs of bits at identical addresses in the two video memory planes are combined to form a 4-level pel.

The MEMORY format is:

	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
PLANE 0	C1	C0	C1	C0	C1	C0	C1	C0
PLANE 1	C3	C2	C3	C2	C3	C2	C3	C2
	1st display pel		2nd display pel		3rd display pel		4th display pel	

The BIT format is:

C0 : GREEN
C1 : RED
C2 : INTENSITY
C3 : BLUE

2. Enhanced High Resolution Graphics (640x200x2):

One bit from each video memory plane is combined to form a 2-level pel.

The MEMORY format is:

	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
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

The BIT format is (same as Standard Medium Resolution):

bit5 of Port 3D9	C0	C1	Color
0	0	0	Background color
0	0	1	Green
0	1	0	Red
0	1	1	Brown
1	0	0	Background color
1	0	1	Cyan
1	1	0	Magenta
1	1	1	White

7.0   SPECIFICATIONS

Bus: IBM PC, XT, AT standard 62-pi. bus

Bus Loading: One TTL Load

Power Consumption: +5.0 Volt @1.8 Amp.

Inputs: 6-pin Berg strip for lightpen connection

Outputs: 9-pin connector for monitor connection
25-pin connector for printer connection

Memory Address: B0000-B7FFF for all Monochrome text modes
B8000-BFFFF for all Color or Emulation modes
B0000-BFFFF for Monochrome Graphics mode

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APPENDIX

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A.1   JUMPER AND SWITCH SETTINGS

Three jumpers are located on the SPECTRUM Card to be used to accommodate various monitor and printer configurations. Their uses are as follows:

Jumper 1 (JP1): Monitor Type Selection Jumper

> This jumper is used to select a monochrome or a color monitor that is to be connected to the SPECTRUM Card. As long as the SPECTRUM Card is the only video display board in your system and you have a monochrome monitor, this jumper should be removed. If you have a two-monitor cofiguration or if you have only a color monitor, then you should install the jumper as described in Sec. A.1.1.

Jumper 2 (JP2): Printer Enable / Disable Jumper

> This jumper is used to enable or disable the printer connection on the SPECTRUM Card.

Jumper 3 (JP3): Monitor Brand Selection Jumper

> This jumper is used to select the type of color monitor you have.

These three jumpers are preset in the factory to the 'OFF' position; that is, these jumpers are installed only on one of the pins with the other end of the jumper hanging loose. You may use the same technique to save your jumper on the card for later use.

Jumper 4 (JP4): Scrolling Option Jumper

> This jumper can be removed to eliminate the annoying screen blanking during scrolling experienced with the IBM Color Graphics Adapter.

This jumper is preset in the factory to the 'ON' position.

See the next section for instructions on installing these jumpers to suit your particular configuration. Location of the jumpers are shown in figure A.1.

In addition to setting the jumpers on the SPECTRUM Card, the system board switches must be set properly before powering up your system. Locate the switch on your IBM PC system board labeled SW1 which is shown in Figure A.2.
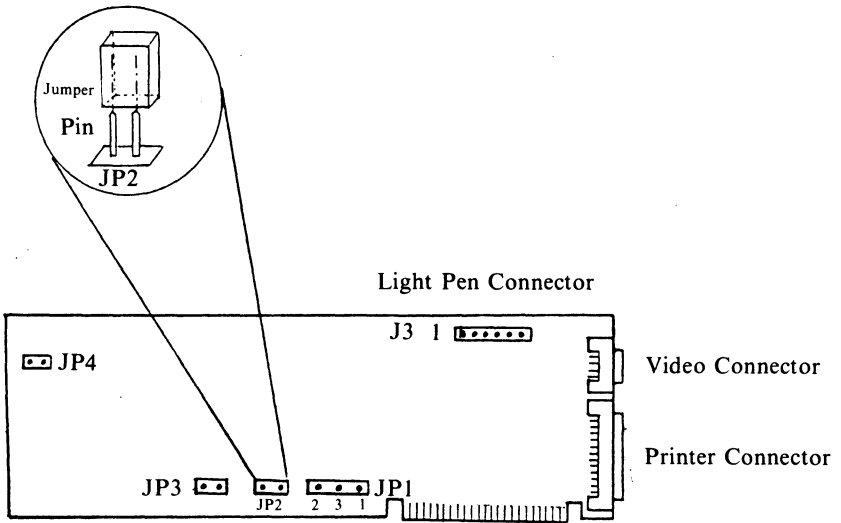
Light Pen Connector

Jumper

Pin

JP2

JP4

J3 1

Video Connector

Printer Connector

JP3   JP2   JP1
        2 3 1

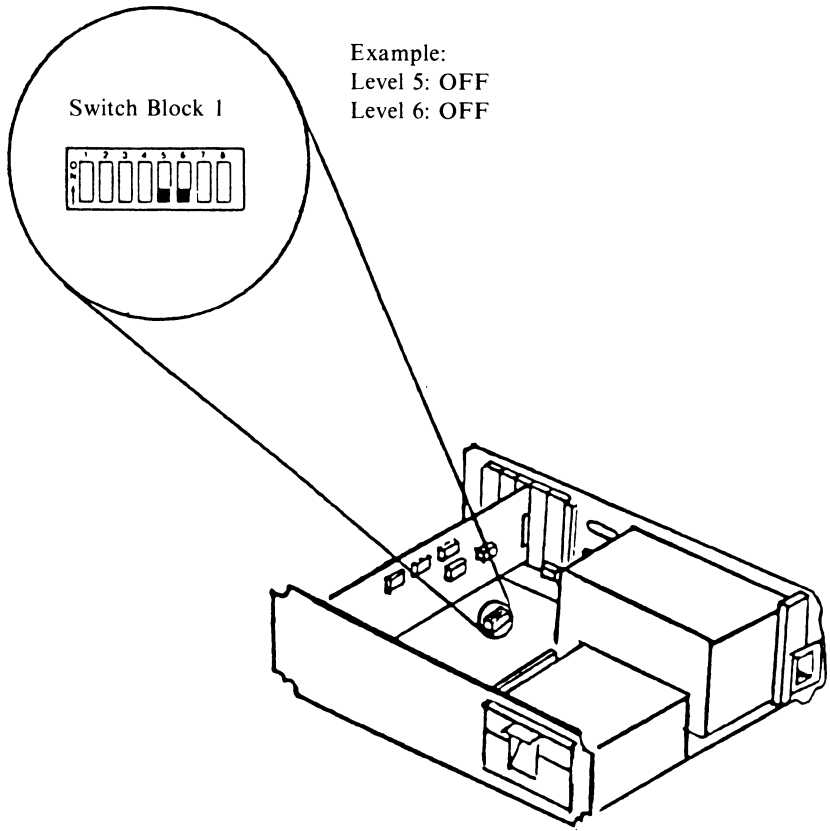Figure A.1 Spectrum Board Jumpers and Connectors

Figure A.2 IBM System Switch

A.1.1. MONITOR AND DISPLAY ADAPTER CONFIGURATIONS

An attempt is made here to list some conceivable configurations in which the SPECTRUM Card may be used. Find the one that matches your existing configuration in this section and follow the procedures accordingly. If you cannot locate your configuration, contact your dealer or Genoa Systems Corporation.

CONFIGURATION A through I below list possible hardware you may already have in your computer. After you locate your configuration, follow the steps in the "ACTION" part. Once you finish your installation, the SPECTRUM Card is capable of running some programs without the aid of the SPECTRUM utility program. These capabilities are described in the "DEFAULT CAPABILITY" part. Keep a note of whether your SPECTRUM Card is installed as "The Monochrome Adapter", "The Color Graphics Adapter" or "The Only Video Card". This information can be found in the "Install SPECTRUM as:" part.

CAUTION: ALWAYS save the jumpers you remove. You may want to use them later.

```
CONFIGURATION A:
You have:
    * IBM OR EQUIVALENT MONOCHROME MONITOR
    * IBM MONOCHROME ADAPTER

Install SPECTRUM as:
    * The Only Video Card
```

ACTION:
* Remove IBM Monochrome Adapter
* Set SW1 on IBM system board:

                        Lever 5 to ON
                        Lever 6 to OFF

* Remove the jumper from JP1.
* Check Sec. A.1.2 for the printer configuration and set JP2 accordingly.

DEFAULT CAPABILITY:
* SPECTRUM allows execution of all programs written for IBM Color Graphics Adapter and Plantronics Color-Plus Adapter in shades on a monochrome monitor.

```
CONFIGURATION B:
You have:
    * IBM OR EQUIVALENT MONOCHROME MONITOR
    * HERCULES GRAPHICS ADAPTER

Install SPECTRUM as:
    * The Only Video Card
```

ACTION:
- Remove Hercules Graphices Adapter
- Set SW1 on IBM system board:

                              Lever 5 to ON
                              Lever 6 to OFF

- Remove the jumper from JP1.
- Check Sec. A.1.2 for the printer configuration and set JP2 accordingly.

DEFAULT CAPABILITY:
- SPECTRUM allows execution of all programs written for IBM Color Graphics Adapter and Plantronics Color-Plus Adapter in shades on a monochrome monitor.

To run some programs written for the Hercules Graphics Adapter, you have to use the utility program in Section 4 to preset to Hercules mode. For some newer programs, you can just install the driver without presetting to the Hercules mode.

CONFIGURATION C:
You have:
   * IBM OR EQUIVALENT COLOR MONITOR
   * IBM OR EQUIVALENT COLOR GRAPHICS ADAPTER

Install SPECTRUM as:
   * The Color Graphics Adapter

ACTION:
   * Remove IBM Color Graphics Adapter
   * Set SW1 on IBM system board:

                    Lever 5 to ON
                    Lever 6 to OFF

   * Put the jumper on pin 3 and pin 2 of JP1.
   * Remove jumper from JP3
   * Check Sec. A.1.2 for the printer configuration and set JP2 accordingly.

DEFAULT CAPABILITY:
   * SPECTRUM allows execution of all programs written for IBM Color
   Graphics Adapter and Plantronics Color-Plus Adapter in colors on a
   color monitor.

```
CONFIGURATION D:
You have:
    * PRINCETON GRAPHICS HX-12 COLOR MONITOR
    * IBM OR EQUIVALENT COLOR GRAPHICS ADAPTER

Install SPECTRUM as:
    * The Color Graphics Adapter
```

ACTION:
        * Remove The Color Graphics Adapter
        * Set SW1 on IBM system board:

                            Lever 5 to ON
                            Lever 6 to OFF

        * Put the jumper on JP1 pin 3 and pin 2.
        * Put the jumper on the two pins of JP3
        * Check Sec. A.1.2 for the printer configuration and set JP2 accordingly.

DEFAULT CAPABILITY:
        * SPECTRUM allows execution of all programs written for IBM Color
          Graphics Adapter and Plantronics Color-Plus Adapter in colors on a
          color monitor.

```
CONFIGURATION E:
You have:
    * IBM OR EQUIVALENT MONOCHROME MONITOR
    * IBM OR EQUIVALENT COLOR MONITOR
    * IBM MONOCHROME ADAPTER

Install SPECTRUM as:
    * The Color Graphics Adapter
```

ACTION:
    * Set SW1 on IBM system board:

                                    Lever 5 to OFF

                                    Lever 6 to OFF
    * Put the jumper on JP1 pin 2 and pin 3.
    * Remove the jumper from JP3.
    * Check Sec. A.1.2 for the printer configuration and set JP2 accordingly.

DEFAULT CAPABILITY:
    * SPECTRUM allows execution of all programs written for IBM Color
      Graphics Adapter and Plantronics Color-Plus Adapter in colors on a
      color monitor.

NOTE:
    In this two-monitor configuration, IBM has chosen to have the system
    powered up on the monochrome monitor with only a blinking cursor on
    the color monitor. Simply run your program as usual.

```
CONFIGURATION F:
You have:
    * IBM OR EQUIVALENT MONOCHROME MONITOR
    * PRINCETON GRAPHICS HX-12 MONITOR
    * IBM MONOCHROME ADAPTER

Install SPECTRUM as:
    * The Color Graphics Adapter
```

ACTION:
* Set SW1 on IBM system board:
    Lever 5 to OFF
    Lever 6 to OFF
* Put the jumper on JP1 pin 3 and pin 2.
* Put the jumper on the two pins of JP3.
* Check Sec. A.1.2 for the printer configuration and set JP2 accordingly.

DEFAULT CAPABILITY:
* SPECTRUM allows execution of all programs written for IBM Color Graphics Adapter and Plantronics Color-Plus Adapter in colors on a color monitor.

NOTE:
In this two-monitor configuration, IBM has chosen to have the system powered up on the monochrome monitor with only a blinking cursor on the color monitor. Simply run your program as usual.

```
CONFIGURATION G:
You have:
    * IBM OR EQUIVALENT MONOCHROME MONITOR
    * IBM OR EQUIVALENT COLOR MONITOR
    * IBM OR EQUIVALENT COLOR GRAPHICS ADAPTER

Install SPECTRUM as:
    * The Monochrome Adapter
```

ACTION:
    * Set SW1 on IBM system board:
                                    Lever 5 to OFF
                                    Lever 6 to OFF
    * Put the jumper on JP1 pin 3 and pin 1.
    * Remove the jumper from JP3.
    * Check Sec. A.1.2 for the printer configuration and set JP2 accordingly.

DEFAULT CAPABILITY:
    * SPECTRUM allows execution of all programs written for IBM
    Monochrome Display Adapter on a monochrome monitor.

NOTE:
    Certain graphics programs, such as Lotus 1-2-3, written for Hercules
    Graphics Adapter cannot run under this configuration due to extra video
    memory needed. This is compatible with the Hercules Graphics Adapter.
    You have to remove the Color Graphics Adapter and configure the
    SPECTRUM Card as Configuration H or I if you want to run all the
    programs written for the Monochrome Graphics mode (except those
    programs which only requires 32KB of memory).

```
CONFIGURATION H:
You have:
   * IBM OR EQUIVALENT MONOCHROME MONITOR
   * IBM OR EQUIVALENT COLOR MONITOR

Install SPECTRUM as:
   * The Only Video Card
```

ACTION:
   * Set SW1 on IBM system board:

                                   Lever 5 to ON
                                   Lever 6 to OFF
   * Remove the jumper from JP1.
   * Remove the jumper from JP3.
   * Check Sec. A.1.2 for the printer configuration and set JP2 accordingly.

NOTE:

You must always power up your system with a monochrome monitor and use the utility program to switch to various modes. If you need to power up from your color monitor, put the jumper on pin 2 and pin 3 of JP1. Refer to Section 4 for details of using the utility program.

DEFAULT CAPABILITY:
   * SPECTRUM allows execution of all programs written for IBM Color Graphics Adapter and Plantronics Color-Plus Adapter in shades on a monochrome monitor.

```
CONFIGURATION I:
You have:
    * IBM OR EQUIVALENT MONOCHROME MONITOR
    * PRINCETON GRAPHICS HX-12 COLOR MONITOR

Install SPECTRUM as:
    * The Only Video Card
```

ACTION:
> * Set SW1 on IBM system board:
>
> > Lever 5 to ON
> >
> > Lever 6 to OFF
>
> * Remove the jumper from JP1.
> * Put the jumper on JP3 pin 1 and pin 2.
> * Check Sec. A.1.2 for the printer configuration and set JP2 accordingly.

NOTE:
> You must always power up your system with a monochrome monitor and use the utility program to switch to various modes. If you need to power up from your color monitor, put the jumper on pin 2 and pin 3 of JP1. Refer to Section 4 for details of using the utility program.

DEFAULT CAPABILITY:
> * SPECTRUM allows execution of all programs written for IBM Color Graphics Adapter and Plantronics Color-Plus Adapter in shades on a monochrome monitor.

A.1.2 PRINTER CONFIGURATION:

If you already have a parallel printer connector from other boards such as the IBM Printer Adapter, third party multifunction boards, or IBM Monochrome Adapter:

> * Put the jumper on two pins of JP2 to disable
>   the printer function of the SPECTRUM Card.

Otherwise, remove the jumper from JP2 to enable the printer function. See Figure A.1 for the location of JP2.

A.2   PRODUCT WARRANTY

The GENOA SYSTEMS CORPORATION (hereafter refer to as GENOA) warrants this GENOA SPECTRUM Card to be in good working order for a period of one year from the date of purchase from GENOA or a dealer. Should this Product fail to be in good working order at any time during this one-year warranty period, GENOA will at its option, repair or replace this Product without charge. Repairs, parts and replacement Products will be furnished on an exchange basis and will be either reconditioned or new. All replaced parts and products become property of GENOA. This limited warranty does not include service to repair damage to the Product resulting from accident, disaster, misuse, abuse, modification or service to the Product unauthorized by GENOA.

The warranty terms are as follows:

This Product shipped by GENOA will be subject to inspection and test by Purchaser, and in case any part is defective in material or workmanship, Purchaser shall have the right to reject the Product within thirty (30) days of shipment. The Product rejected by Purchaser will have a failure report and purchase receipt attached and shall be forwarded to GENOA, in the original packaging, freight prepaid. GENOA will not accept freight COD for the Product returned.

After this Product is accepted for thirty (30) days from date of shipment, GENOA shall provide parts and labor warranty only, provided that the warranty period has not elapsed.

If this Product fails during the warranty period, Purchaser shall notify GENOA and request return authorization. The defective Product should then be returned in the original packaging (or equivalent) with a failure report and purchase receipt attached, to GENOA, freight prepaid. GENOA will not accept freight COD for the Product returned. If the Product is not returned with the original packaging (or equivalent) and hence damaged during shipping, the warranty will be voided.

ALL EXPRESS AND IMPLIED WARRANTIES FOR THIS PRODUCT INCLUDING THE WARRANTIES OF MERCHATABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED IN DURATION TO A PERIOD OF ONE YEAR FROM THE DATE OF PURCHASE, AND NO WARRANTIES, WHETHER EXPRESS OR IMPLIED WILL APPLY AFTER THIS PERIOD. SOME STATE DO NOT ALLOW LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS, SO THE ABOVE LIMITATIONS MAY NOT APPLY TO YOU.

IF THIS PRODUCT IS NOT IN GOOD WORKING ORDER AS WARRANTED ABOVE, YOUR SOLE REMEDY SHALL BE REPAIR OR REPLACEMENT AS PROVIDED ABOVE. IN NO EVENT WILL GENOA BE LIABLE TO YOU FOR ANY DAMAGES, INCLUDING ANY LOST PROFITS, LOST SAVINGS OR OTHER INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OF OR INABILITY OT USE SUCH PRODUCT, EVEN IF GENOA OR A DEALER HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES, OR FOR ANY CLAIM BY ANY OTHER PARTY.

SOME STATE DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES FOR CONSUMER PRODUCTS, SO THE ABOVE LIMITATIONS OR EXCLUSIONS MAY NOT APPLY TO YOU.

THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY HAVE OTHER RIGHTS WHICH MAY VARY FROM STATE TO STATE.

A.3   SERVICE WARRANTY

Any out-of-warranty repairs are warranted against defects in materials and workmanship for a period of thirty (30) days from date of service.