RGB INTERFACE MANUAL

FOR THE APPLE //c COMPUTER

Video-7 Incorporated

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FCC ID: D2A62LRGB-//c

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Certified to comply with Class B limits, Part 15 of FCC Rules. See Instructions if interference to radio reception is suspected.

Radio and Television Interference

The equipment described in this manual generates radio-frequency energy. If it is not installed properly it may cause interference with radio and television reception. The RGB or NTSC monitor you purchase must comply with the limits for Class B computing devices in accordance with the specifications in Subpart J, Part 15, of FCC rules. These rules are designed to provide reasonable protection against such interference in a residential installation.
The cable connection between the computer and the monitor must be a shielded cable with the shield properly grounded. You can determine if your equipment is the cause of interference by turning it off. If the interference stops, it was probably caused by the computer or the monitor. To correct the problem try:

1. Turning the TV or radio antenna until the interference stops.

2. Moving the computer to one side or the other of the TV or radio.

3. Moving the computer farther away from the TV or radio.

4. Plugging the computer into an outlet that is on a different circuit breaker or fuse than the TV or radio.

5. Installing a rooftop antenna connected to your TV and radio with a coaxial cable.

6. Identifying the offending piece of hardware by selectively turning them off one at a time and checking for interference.

If necessary, you should consult your computer dealer for additional suggestions. You may find the booklet "How to Identify and Resolve Radio-TV Interference Problems" prepared by the Federal Communications Commission helpful. The booklet is available from the U.S. Government Printing Office, Washington, D.C. 20402, stock number 004-000-00345-4.

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CHAPTER 1

1.1 Product Features

The RGB Interface faithfully translates the NTSC video of the Apple //c for complete compatibility with RGB monitors. RGB monitors, due to their inherent higher resolution, are able to display 80-column text as well as color graphics. Thus, instead of having two monitors, a monochrome monitor to display 80-column text, and a color monitor to display color graphics, one monitor will perform both functions.
The RGB interface improves the Apple //c's video output by removing the extraneous colors in LORES and MERES and by displaying tinge-free 40 or 80-column text in the bottom four lines of the screen when in mix mode.
The RGB Interface generates a Black and White HIRES, as well as the usual six color HIRES, for use with software that utilizes this mode for bit-mapped text generation. Text in this mode is free from the color tinging problem usually seen in the six color mode.

1.1.1 Video Modes

The RGB interface allows you to select the text default color from a palette of four colors by setting two switches inside the box (see section 1.1.3 of this chapter). Normal text will be displayed in the color you have selected through the switches and inverse text is displayed in black on a white background for extra highlighting. The following video modes are available:

1. 40-column text.
2. 80-column text.
3. 16 color LORES with option of mixing mode 1.
4. 16 color LORES with option of mixing mode 2.
5. 6 color HIRES with option of mixing mode 1.
6. 2 color HIRES with option of mixing mode 1.
7. 6 color HIRES with option of mixing mode 2.
8. 16 color MERES with option of mixing mode 2.
9. 2 color 560X192 (double density) with option of mixing mode 2.
10. 16 color 140X192 (double density) with option of mixing mode 2.
11. Mix Mode allows modes 9 and 10 to be mixed anywhere on the screen.

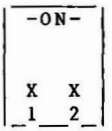
Modes 1 through 8 are supported by the Apple //c monitor ROM. Modes 6, 8, 9, 10 and 11 are supported by the double density drivers supplied in the demonstration diskette.

1.1.2 Software Compatibility

The RGB Interface is 100% compatible with ALL Apple //c software. The total compatibility stems from the fact that the RGB Interface deals only with video output of the Apple //c.

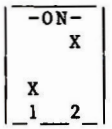
1.1.3 Text Color Switches

The RGB Interface simulates monitors of different color phosphorous. Highlighting of inverse text however, is always done in white to accentuate the highlighted text. If you are accustomed to doing your word processing in either green, blue, amber, or white, you may select that text color by setting the two switches inside the box with a thin screw driver as shown in Figure 1 as follows:

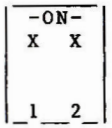


green 40 or 80-column text.

blue 40 or 80-column text.



amber 40 or 80-column text.



white 40 or 80-column text.

Text will now be displayed in the color of your choice. If at a future time you decide to change the text color, be sure to turn the power off to your computer before changing the switch positions.

1.2 Installation

Your RGB Interface kit should include the following items:

1. The RGB interface adapter enclosed in its packaging material.
2. This manual.
3. A demonstration diskette.

If any of the above items are missing, please contact your dealer. To attach the RGB Interface to your Apple //c, carry out steps 1 through 6 listed below.

1. Make sure the power to your Apple //c has been turned off by checking to see that the green light on the top right hand corner of the keyboard is off.
2. Remove the RGB Interface from its package and set the text color switches to your preferred color as shown in Figure 1 and as explained in section 1.1.3.
3. Attach the cable on the RGB interface box to the Apple //c computer, as shown in Figure 2.
4. Attach the cable from the monitor to the connector at the opposite end of the RGB interface box as shown in Figure 3.
5. Secure both cables to their respective connectors using the screws provided as shown in Figure 4.
6. Insert the demonstration diskette in the Apple //c drive and turn the power on to the computer.

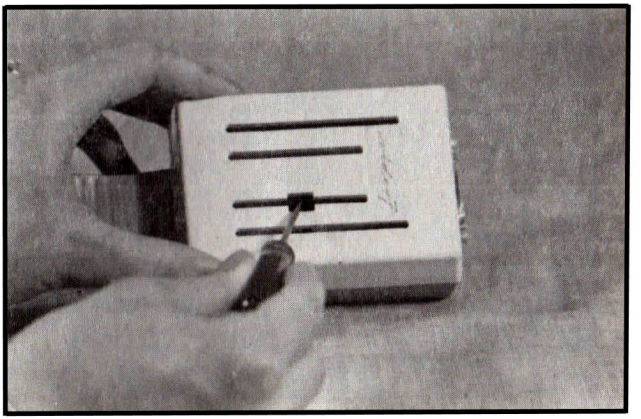


Figure 1. Setting the text color switches using a thin screw driver.

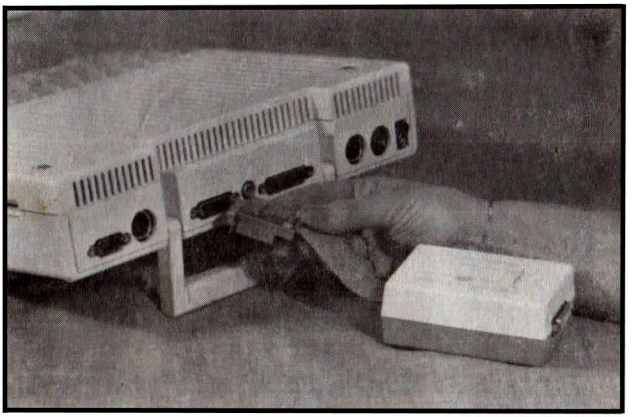


Figure 2. Installation of the RGB Interface to the Apple //c.

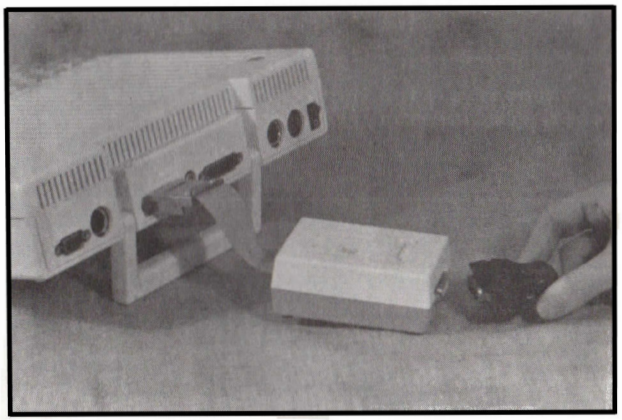


Figure 3. Installation of the cable from the monitor to the RGB Interface box.

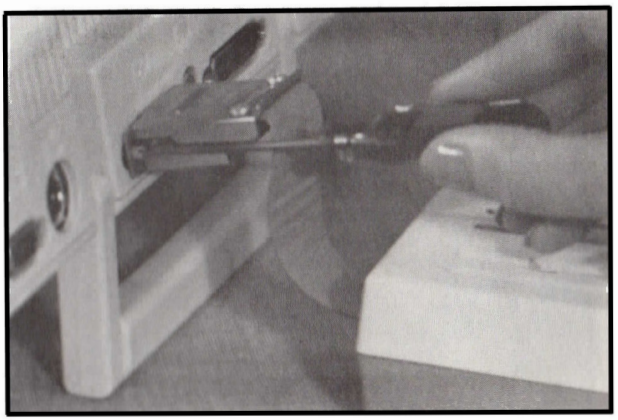


Figure 4. Securing the cables to their respective connectors will ground the cable's shield and reduce TV interference.

CHAPTER 2

2.1 Introduction

This chapter describes the demonstration diskette and its double density software drivers. The double density drivers are a powerfull software tool at your disposal to allow you to manipulate the Apple //c's double density graphics.

2.2 The Demonstration Diskette

Upon booting the demonstration diskette your computer should display the following menu:

1 Business Demo
2 Word Processing
3 Art Show Case
4 Slide Show
5 Video Modes
6 Color Switches
7 Color Mouse Draw
8 Boot B&W HIRES
9 Quit

Run through the demonstration to get fully acquainted with the RGB Interface and its many capabilities.

Option 7 will allow you to make drawings using your Apple //c mouse in the 16 color 140X192 video mode. The software allows you to clear the screen to a specified color, draw lines, rectangles, and color fill portions or the whole screen. You may also save the file to disk and retrieve it at a later time to modify your drawing. To obtain instructions on how to operate this software package move the cursor to the square containing a question mark (?) and press the mouse button.

Option 8 will set the RGB Interface to the Black and White HIRES mode so you may run programs that make use of intensive text in this mode. Since this mode is in black and white the text will be completely legible.

You may also load some of the Applesoft programs found in the diskette and list them on your printer to see how the Applesoft double density drivers were actually used.

2.3 The Applesoft Double Density Drivers

The Applesoft BASIC double density drivers are implemented as a series of ampersand routines. This allows considerable flexibility in the command formats and gives you a very easy-to-use interface through Applesoft. The routines described below are implemented as machine language code segments located in main and auxiliary memory. The commands are activated by BRUN-ing the binary code file from an Applesoft Basic program as follows:

```
PRINT CHR$(4);"BRUN HIRES"
```

The double density drivers may also be activated directly from the keyboard by typing:

```
BRUN HIRES
```

When either of the above commands is executed, the code file is loaded into the system, and the new commands are installed into memory. The first command that must be given is the & GR command in order to initialize the desired video mode.

The double density drivers contained in the demonstration diskette operate under DOS only. ProDOS double density drivers may be purchased for $49.95 from:

Video-7 Incorporated
12340 Saratoga Sunnyvale Rd. Suite 1
Saratoga, California 95070
(408) 725-1433

Send a check with your purchase order and a diskette with manual will be sent to you within six weeks.

2.3.1 & GR X; Where X may range from 0 to 6.

This is the initial entry point for the graphic routines. When this command is executed, the current pen position is moved to location 0,0 (the top left corner of the screen), the pen color is set to white and the background or fill color is set to black.

This command must be followed by a mode specification from the following table:

0	Disconnect Drivers
1	Two color 560X192
2	Sixteen color 140X192
3	Mix Mode
4	Preset graphic mode 5
5	Black and White HIRES
6	MERES

NOTES:
1. If the mode specification is given as zero, i.e., & GR 0, the graphic routines are disconnected and the space allocated to them is returned to the system.

2. To select mode 5, mode 4 MUST first be set followed by mode 5 i.e. execute the following commands: & GR 4 : & GR 5

A positive mode specification causes the RGB interface to display data according to the video mode given in the above table and to load the corresponding driver routine for that video mode. Mode 3 is defaulted with the drivers for mode 1. A negative mode specification will load the driver for that particular video mode without changing the video state of the RGB interface. This is particularly useful when dealing with video mode 3 which allows you to mix, anywhere on the screen, modes 1 and 2. Executing the command & GR 3 causes the RGB interface to display data as in mode 3 and to load the driver for mode 1. Executing the command & GR -2 will activate the mode 2 double density driver but not change the video mode. Any further commands will now be interpreted and transfered to the screen as in mode 2.
To paint portions of the screen in mode 1 you must issue the & GR -1 or & GR 3 command before you perform any further plotting.

2.4 The Graphic Commands

Nine commands that support graphic generation have been created. The commands allow for plotting dots or lines and color filling portions of the screen or the whole screen.

2.4.1 & TEXT

This command switches the display back to the text screen, and also ensures that the DOS print hooks are correctly set. You should always execute this command prior to terminating a program which uses any of the graphic commands.

2.4.2 & COL = X; Where X may be a variable or expression

This command specifies the pen color to be used for drawing, for example:

```
& COL = 2
```

The color number should be in the range 0 to 15, and specifies the following colors:

0	Black	4	Dark Green	8	Brown	12	Green
1	Magenta	5	Grey 1	9	Orange	13	Yellow
2	Dark Blue	6	Medium Blue	10	Grey 2	14	Aquamarine
3	Purple	7	Light Blue	11	Pink	15	White

Any of the above colors may be used with modes 2 and 6. With
`des 1, 3 and 4, which plot in black and white, only codes 0
15 should be used. All modes default to white as the plot

2.4.3 & BCOL = X; Where X may be a variable or an expression

This command specifies the background or fill color. This color is used for the & CLEAR and & VFILL routines, and also as the background color when displaying characters or bit mapped shapes. The command is used as follows:

```
& BCOL = 1
& BCOL = X+1
```

The color specification is the same as for the & COL command. The default color for all modes is black.

2.4.4 & CLEAR

This command clears the whole screen to the color specified by the last & BCOL command (or black if no & BCOL command has been given since the last & GR command). It has the same effect as an & VFILL command which specifies the whole drawing area, except that it is much faster in execution speed. The command has no parameters.

2.4.5 & VFILL (X1,X2,Y1,Y2); Where Xi and Yi may be variables or expressions

This command clears a portion of the screen to the background color as specified in the last & BCOL command (or black if no & BCOL command has been given since the last & GR command). Four parameters are required to specify the screen bounds to be filled, for example:

```
& VFILL (10,30,20,100)
& VFILL (XL,XL+20,YL,YL-12)
```

The first two parameters specify the horizontal pixel coordinates, while the second specify the vertical coordinates. The values in each pair may be specified in any order.

2.4.6 & MOVE (X,Y); Where X and Y may be variables or expressions.

This command moves the current pen position to pixel coordinate (X,Y) without drawing on the screen. The command requires two coordinates, for example:

```
& MOVE (20,50)
```

The first parameter is the new horizontal position in terms of pixels from the left edge of the screen, and the second is the new vertical row location of the pixel counting from the top of the screen.

2.4.7 & DOT

This command places a dot in the foreground color at the current pen position. No parameters are required for this command.

2.4.8 & PLOT (X,Y); Where X and Y may be variables or expressions.

This command draws a line in the foreground color from the current pen position to a new pen position specified as parameters to this statement. The following statements will, for example, draw a brown line across the top of the screen in mode 2:

```
& PRINT CHR$(4);"BRUN HIRES"
& GR 2
& MOVE (0,0)
& COL = 8
& PLOT (139,0)
END
```

2.4.9 & SCRN (X); Where X may be an integer or real variable.

This command returns a value to the variable X representing the color at the current pen position. One parameter is required to accept the returned value, for example:

```
& SCRN (VA)
```

In this case the returned value will be placed in the destination variable VA. The value returned is in the range 0 to 15 and represents a color as specified in the table of section 2.4.2

2.5 The Disk Commands

The Disk Commands allow for storage and retrieval of double density graphics generated using the Applesoft double density drivers.

2.5.1 & SAVE FN$

This command saves the double density graphic area in main and auxiliary memory to a specified disk file, for example:

```
& SAVE "TEST PICTURE"
```

The disk file name may be specified as a literal or in a string variable. Slot, drive and volume parameters may be specified as described in the Apple //c DOS Users Guide. The file will appear to be a binary file in the disk directory, but is not in the standard binary format and can only be loaded using the & LOAD command described in section 2.5.2.

2.5.2 & LOAD FN$

This command loads a file from disk which has been saved using the & SAVE command. A filename must be specified in the same manner as for the & SAVE command, for example:

```
& LOAD "PIE.PIC"
& LOAD "MY GRAPH,S6,D2"
```

2.6 The Graphic Text and Shape Commands

The Applesoft double density drivers contain commands to place text as well as predefined shapes anywhere on the screen.

2.6.1 &GPRNT

This command replaces the standard screen output hooks by a pointer to a routine in the graphics package which replaces text on the graphics screen. The default character font is very similar to that used for standard text output by the Apple //c. After this command has been given, all output via the standard Applesoft PRINT statements will be directed to the graphics screen until a command such as &TPRNT is given which restores the Apple //c's output hooks. The routine disconnects the Disk Operating System while it is active. All characters are printed in a matrix of 7 horizontal and 8 vertical pixels (the same as the standard text screen) and all characters are displayed downwards and to the right of the current pen position. After each character is written, the pen position is moved right seven pixels.

The following command sequence illustrates how characters may be placed on the screen:

```
& GR 2                  Initialize graphics mode 2
& BCOL = 2              Set fill color to dark blue
& CLEAR                 Clear the screen to dark blue
& COL = 13              Set pen color to yellow
& MOVE (30,96)          Move pen to center of screen
& GPRNT                 Redirect output to graphic screen
PRINT "Some text"       Print text on the graphic screen
& TPRNT                 Restore normal print output
```

Unless the command & CPRNT 1 has been executed (see section 2.6.2) all control characters are ignored except for the carriage return (ASCII code 13) and line feed (ASCII code 10) characters.
The line feed characters cause the current pen position to be moved down the screen by 8 pixels, the equivalent of the character row size on the text screen. If the downward movement results in an attempt to move off the bottom of the screen, the pen wraps around to the top to the screen.

The carriage control character moves the pen position horizontally to the left edge of the screen and moves the pen vertically downward as described for the linefeed character. This is the exact equivalent of a carriage return in text mode.

2.6.2 & CPRNT X; Where X may be 0 or 1.

In some circumstances the user may not wish control characters to be ignored, for example, extra graphic characters may be defined in this area. The & CPRNT command controls the control character trap in the graphic print routines, and allows the user to output control characters. The routine requires one parameter, for example:

```
& CPRNT 1
& CPRNT 0
```

If the parameter is zero, control characters will not be printed, and if it has a value of one it will enable control character printing. When the drivers are first activated an implied & CPRNT 0 is executed.
It is the responsibility of the user to ensure that suitable characters are defined in the font that were loaded by the & NCHARS command explained in section 2.6.4 before executing an & CPRNT 1 command. The default font has definitions for all control characters.

2.6.3 & TPRNT

This routine restores the print hook to normal when text is no longer to be sent to the graphics screen. It has no effect if the & GPRNT command is not active. The & TEXT command contains an implicit & TPRNT call.

2.6.4 & NCHARS F$

The & NCHARS and & SCHARS commands are used to change the font used for displaying text on the graphics display. The & NCHAR

command changes to a user defined font, and & SCHARS changes back to the standard font.

The & NCHARS command requires one parameter which specifies the disk file containing the new font. For example:

```
& NCHARS "ROMAN.FONT"
& NCHARS "BYTE.FONT,S6,D2,V12"
& NCHARS F$
```

The system font is automatically loaded when the HIRES is activated as described in section 2.3. Appendix A describes the character cell format that must be used when generating font tables.

2.6.5 & SCHARS

This command changes the font used for displaying text on the graphics screen back to the system standard font.

2.6.6 & DRAW (ba,br,cd,rd,bw,bh); Parameters may be variables or expressions

This procedure draws a predefined shape on the screen. It performs a bit map transfer to the screen of a specified portion of a block of memory. The shape is placed below and to the right of the current pen position, which is not changed by this command. Each bit set to a "one" in the source block is put on the screen using the current pen color and each "zero" bit uses the current fill color. Six parameters are required for this procedure.

Block Address: The first parameter is an address pointer to the first element of the source block in memory.

Bytes per row: The second parameter specifies the number of bytes in each row of the source block.

Column Bit Displacement: The third parameter specifies the number of bits to skip in each source row before beginning the transfer.

Row Displacement: The fourth parameter specifies the number of source rows to skip before beginning the transfer process.

Width of Block: The fifth parameter specifies the bit width of the block portion to be transferred to the screen.

Height of Block: The sixth parameter specifies the total number of rows of the block portion to be transferred to the screen.

For example:

```
& DRAW (768, 3, 0, 0, 24, 8)
```

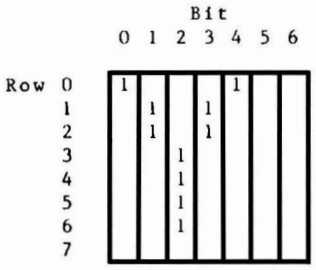
This would specify that the bit array starting at memory locations 768 ($0300 hexadecimal) is to be used as a block source, that each row is 3 bytes long, that drawing should commence at the start of the array and that the area to be drawn is 24 bits wide and 8 rows in height. Appendix B gives a detailed example of a shape block definition.

CHARACTER CELL FORMAT

Each cell is stored as a seven by eight bit array. This cell array is "bit mapped" unto the screen. All bits containing a "one" are plotted as dots with the foreground color and all bits containing a "zero" are plotted in the background color. Each character array is stored as eight bytes, one byte for each row of seven dots. Only the low order seven bits are displayed and the high order bit is ignored.

Within the array, the least significant bit of each byte is the left most dot displayed. The eight bytes (character block) making up one character are stored consecutively, with the top row first. The data bytes must be arranged as successive character blocks, of eight bytes each, corresponding to the ascending order of the 128 ASCII characters. The total font file containing the new character set must, therefore, contain 1024 bytes.

For example the letter "Y" would have to be coded as follows:



Format of a Character Cell
for the letter Y.
Note that all zero bits have been left blank.

APPENDIX B

SHAPE BLOCK GENERATION

The demonstration diskette contains a shape binary file called "plane". This file when BLOADED will reside in memory location starting at address $0300 (decimal 768). You may examine the contents of this shape by performing the following:

```
RUN APLANE      Run Applesoft program to display the plane
PRESS A KEY     Program ends on a key press
LIST            List program when its done.
CALL -151       Get into the Apple //c monitor
300.317         Dump locations 300 through 317 to screen
3D0G            Get back to Applesoft
```

The program listing should be:

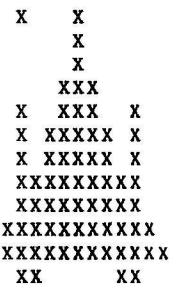
```
10  PRINT CHR$(4);"BRUN HIRES"            Load Drivers
20  PRINT CHR$(4);"BLOAD PLANE,A$300"     Load Shape
30  &GR1                                  560X192 graphics
40  &CLEAR:&MOVE(250,80)                  Clear screen, move pen
50  &DRAW(768,2,0,0,13,12)                Draw shape
60  GET A$                                Wait for key press
70  &TEXT:&GR0                            Disconnect Drivers
80  HOME:END                              Clear screen and end
```

The 300 through 317 core dump should be:

```
300- 22 00 02 00 02 00 07 00
308- 27 20 2F A0 2F A0 3F E0
310- 3F E0 7F F0 FF F8 30 60
```

The shape and shape table were generated as follows:

1. The shape was first defined on paper:



2. The shape was then coded:

Bits

Row		3 2 1 0	3 2 1 0	3 2 1 0	3 2 1 0	Hex.
	0	1	1			22 00
	1		1			02 00
	2		1			02 00
	3		1 1 1			07 00
	4	1	1 1 1	1		27 20
	5	1	1 1 1 1	1 1		2F A0
	6	1	1 1 1 1	1 1		2F A0
	7	1 1	1 1 1 1	1 1 1		3F E0
	8	1 1	1 1 1 1	1 1 1		3F E0
	9	1 1 1	1 1 1 1	1 1 1 1		7F F0
	10	1 1 1 1	1 1 1 1	1 1 1 1	1	FF F8
	11	1 1		1 1		30 60

Note that the locations containing "zeroes" have been left blank. To enter and save the shape table perform the following:

```
CALL -151
300:22 0 2 0 2 0 7 0 27 20 2F A0 2F A0 3F E0 3F E0 7F F0 FF F8
30 60
3D0G
BSAVE PLANE,A$300,L$20
```

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