CHROMAtrs USER'S MANUAL

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First Edition

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CHAPTER 1
GENERAL INFORMATION

1.1 INTRODUCTION

This manual is used to set up the CHROMAtrs on the users '80' type computer, check that everything is working correctly, and provide the programmer with the information needed to utilize the graphics capabilities of the CHROMAtrs through basic or machine language.

1.2 FEATURES

The CHROMAtrs comes with the following standard features:

* Full color graphics with 15 colors simultaneously available.
* 256 x 192 dot resolution.
* 16K of on board dynamic ram.
* Composite video output.
* Allows 3-D simulations through thirty-five prioritized display planes.
* Compatible with the RADIO SHACK TRS-80 models I and III, and other '80' type computers without modifications to computer.
* ATARI controller interface allows use of all currently available controllers.
* 6 bit D/A for sound output.

1.3 SPECIFICATIONS

INTERFACE	TRS-80 (1) MODEL I AND III THROUGH EXPANSION I/O BUS
VIDEO OUTPUT	NTSC COMPOSITE VIDEO .2V TO 4V PEAK TO PEAK 75 OHMS OUTPUT IMPEDANCE
AUDIO OUTPUT	50 - 10,000 HZ 5 V PEAK TO PEAK (MAX) 4.7K OUTPUT IMPEDANCE
POWER SUPPLY	12 VAC 50/60 HZ @ 650 ma SUPPLIED BY 120 VAC 50/60 HZ WALL OUTLET ADAPTER
PHYSICAL CHARACTERISTICS	7 INCHES (18 cm) WIDE 7 INCHES (18 cm) LONG 3.5 INCHES (9.0 cm) HIGH

1.4 EQUIPMENT SUPPLIED

The CHROMAtrs comes prebuilt with the following items:

* CHROMAtrs built, fully tested and in cabinet.
* 120 VAC 50/60 HZ to 12 VAC 50/60 HZ wall outlet adaptor.
* CHROMAtrs user's manual.
* Cassette tape with graphics routines and sample game.

1.5 GENERAL DESCRIPTION

The CHROMAtrs is a sophisticated color video graphics peripheral device that brings high resolution video graphics to the TRS-80. Having a 256 X 192 individually controllable dot graphics display with up to 15 colors simultaneously, the CHROMAtrs can draw pictures for the TRS-80 with more resolution and vividness than ever before. In addition, it has an audio output and will interface to all present ATARI controllers for expanded input capability.

CHAPTER 2
INSTALLATION INSTRUCTIONS AND CHECKOUT

2.1 INTRODUCTION

This chapter provides the instructions to interface the CHROMAtrs to the TRS-80 and various different types of color displays. It also includes a checkout procedure to test the CHROMAtrs after it is first set up .

2.2 UNPACKING INSTRUCTIONS

*** NOTE ***

IF THE SHIPPING CARTON IS DAMAGED UPON RECEIPT, REQUEST THE CARRIER'S AGENT BE PRESENT DURING UNPACKING AND INSPECTION OF THE EQUIPMENT.

Unpack all of the equipment from the shipping carton. Refering to the packing list in the carton, and verify that all of the items are present. Save all of the packing materials for storage or reshipping the equipment.

2.3 INSPECTION

Everything should be carefully inspected for any damage that may have occurred during shipping. Should anything be found damaged, report it to the carrier before he leaves.

2.4 INSTALLATION

After unpacking and inspecting the CHROMAtrs, read paragraphs 2.4 through 2.4.5 carefully. The CHROMAtrs outputs a composite video signal which may be used in one of several ways:

* Connected directly to a high quality color monitor for best possible picture.
* Install the SOUTH SHORE COMPUTER CONCEPTS,Inc. modulator unit to connect directly to your color TV.
* Connected thru the camera input of your VCR.
* Connected to a color TV by an external video modulator.

Decide which way you want to use the video output, then follow the directions to connect to your display.

2.4.1 COLOR MONITOR INSTALLATION

Connect the two phono-plugs as shown in fig 1. Be sure that you don't switch the two cables. This will work for most any NTSC color composite video monitor (example: NEC model JC-1201M(A)) and provides the best results in clarity and color.

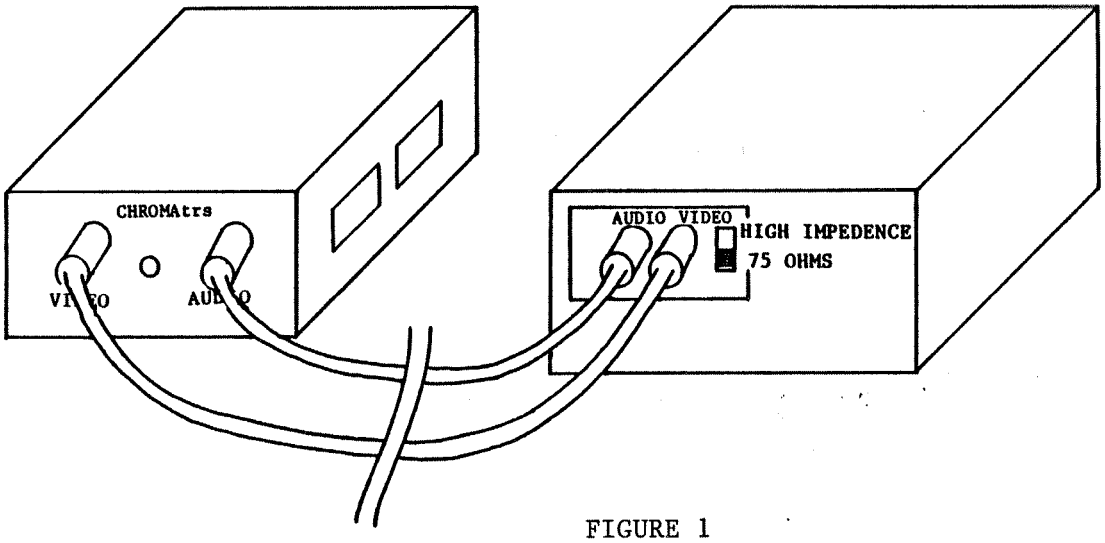


FIGURE 1
COLOR MONITER HOOK-UP

2.4.2 INTERNAL MODULATOR INSTALLATION

The SOUTH SHORE COMPUTER CONCEPTS, Inc. audio/video modulator module may be easily installed by carefully removing the six self-tapping machine screws from the bottom of the case. Slide the top half of the cabinet off to expose the printed circuit board (note: The warranty is NOT voided unless you attempt to modify or remove the board) .

Take the modulator module and position it over the board. The four aluminum standoffs on the CHROMAtrs board should line up with the four mounting holes on the module. The connector pins should line up with each other, as in fig 2. Carefully push the module down onto the standoffs and connector pins watching that they line up properly. Check that the pins are connected, then screw the four acorn nuts onto the bolts that are going through the modulator board. Do not tighten these too hard, overtightening may damage the board.

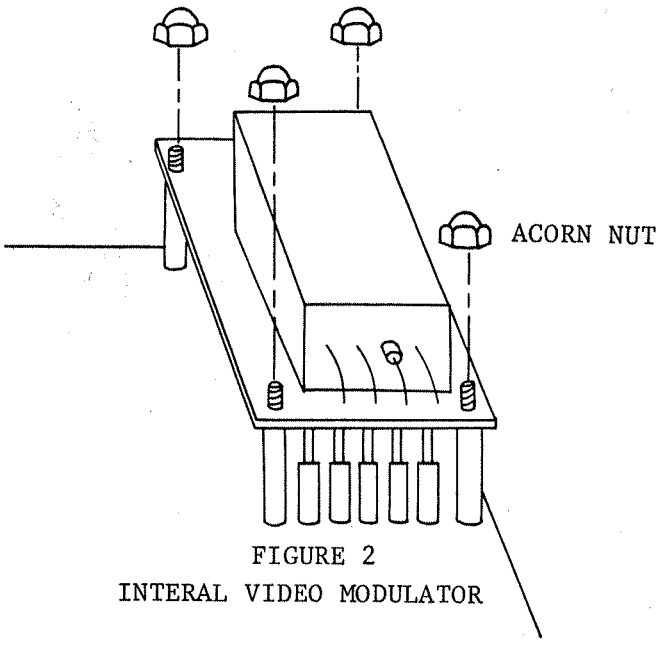


FIGURE 2
INTERAL VIDEO MODULATOR

Slide the top cover of the cabinet back the way it came off and replace the six self tapping screws, making certain that the holes line up and the rubber feet are on the corners of the cabinet.

Refering to fig 3, connect one of the phono-plug cables through the hole in the side of the CHROMAtrs cabinet into the socket on the modulator module. Run this cable to behind your TV set and plug it into the switch box provided on the side marked 'CHROMAtrs'. Next connect your TV antena cable to the side marked 'ANTENNA', and the cable from the switch box to the back of the TV set.

The modulator unit comes jumpered to transmit on channel 3. To use channel 4 instead, cut the wire jumper next to the metal modulator case with a pair of small wire cutters (this jumper is about 1/2 inch long and lies flat on the circuit board). Be CERTAIN that the two pieces of wire left after cutting don't touch anything else on the board before powering the CHROMAtrs.

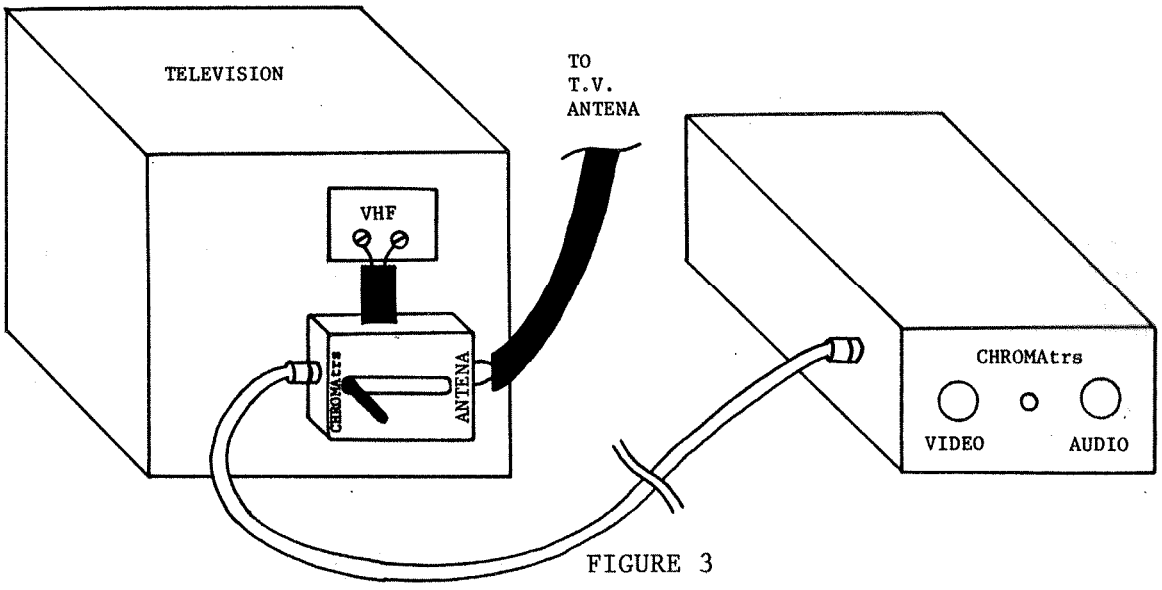


FIGURE 3

CONNECTION TO TELEVISION

2.4.3 VCR INSTALATION

The CROMAtrs may be connected to a standard color television by connecting it through the camera input of many different types of home VCR systems. Refering to fig 4, connect one cable from the video output of the CHROMAtrs to the camera input of your VCR. Next, connect another cable from the audio output of the CHROMAtrs to the microphone input of your VCR. To view the picture on your TV, turn the power switch of your VCR on, the CAMERA/TUNER switch to the CAMERA position, and the VCR/TV switch to VCR. The CHROMAtrs will then be able to display it's picture on your TV without affecting the normal functions of your VCR and TV when the CHROMAtrs is not being used.

2.4.4 USE OF EXTERNAL MODULATOR

The CHROMAtrs may be used with many types of external video modulators by connecting it with shielded cables. In some cases power line noise will interfere with the video signal if the lines are too long, or if

the modulator is not well shielded from your computer or CHROMAtrs.

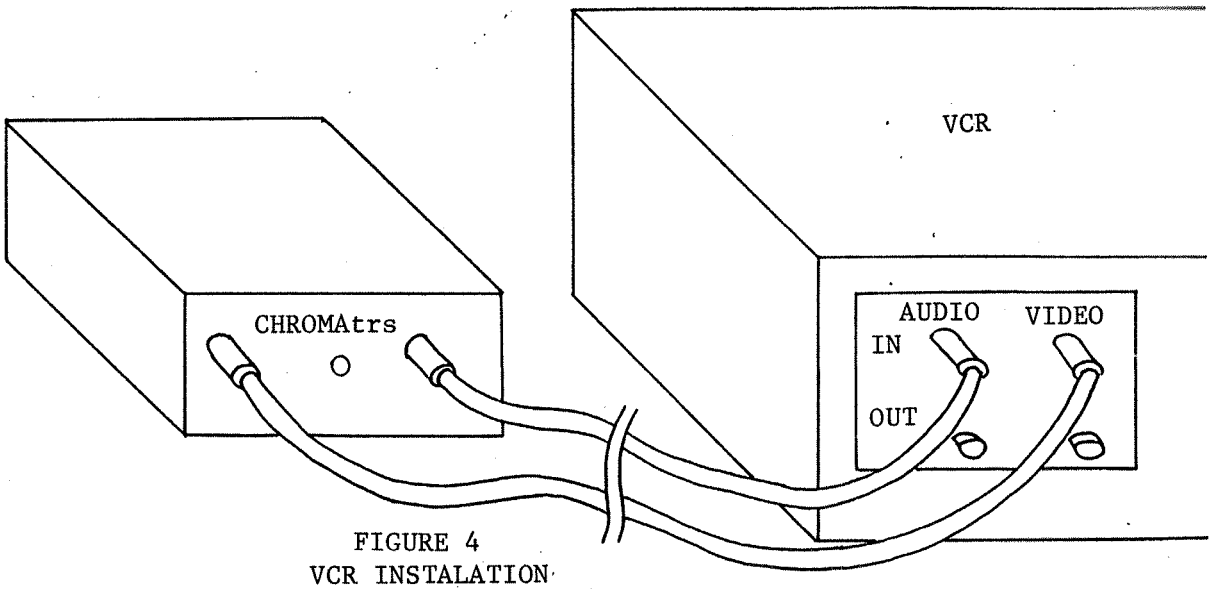


FIGURE 4
VCR INSTALATION

2.4.5 POWER AND COMPUTER CONNECTION

Power is supplied to your CHROMAtrs by a 12 VOLT 1 AMP AC wall mounted power adaptor that is supplied with the prebuilt model. Plug the mini phono plug of the AC wall adaptor into the power jack in the back of your CHROMAtrs. Don't plug the wall adaptor itself into a live wall socket until your computer is connected. If you are using the CHROMAtrs kit, you will need to supply your own 12 VOLT 1 AMP AC transformer.

To connect a TRS-80 model I, you will need a ribbon cable with a 40 pin edge card connector on each end (available from SOUTH SHORE COMPUTER CONCEPTS Inc.). For the TRS-80 model III, you will need a ribbon cable with a 50 pin edge card connector on each end (also available from SOUTH SHORE COMPUTER CONCEPTS Inc.). Refering to fig 5, plug the edge card connector into the side of the CHROMAtrs through the appropriate slot, with the ribbon cable flowing downward from the connector. Then connect the other end of the ribbon cable to your computers I/O expansion bus as shown in fig 6 & 7 . On a Model 1, the ribbon cable should flow downward from the 40 pin expansion slot on the left side of the expansion interface. On a Model 3, the ribbon cable should flow towards the front of the computer and bend left so that the CHROMAtrs will stand at the rear left of the computer with it's video connectors facing foward.

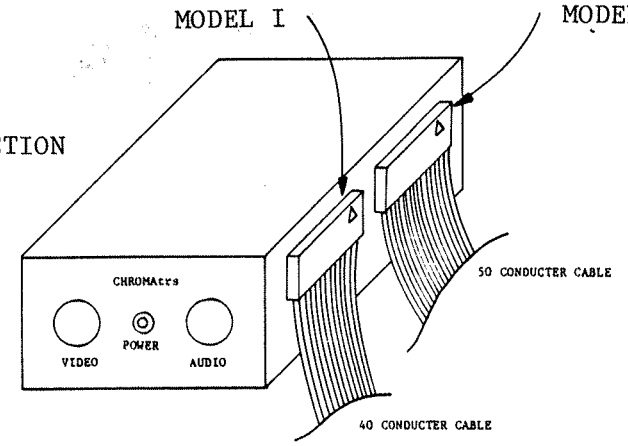


FIGURE 5
CHROMAtrs CABLE CONNECTION

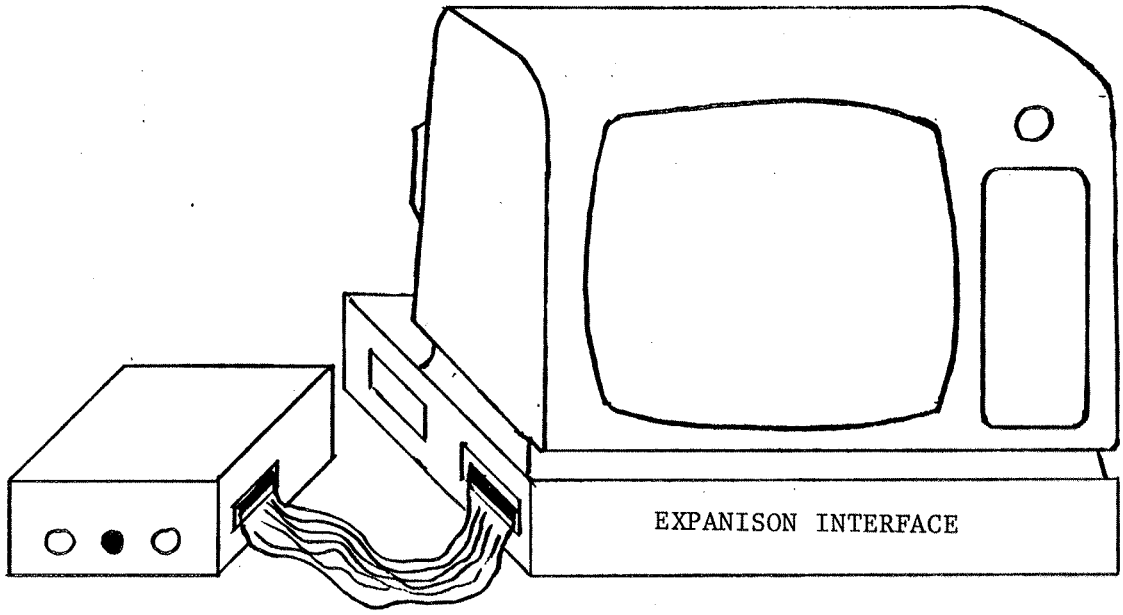


FIGURE 6
MODEL I CABLE CONNECTION

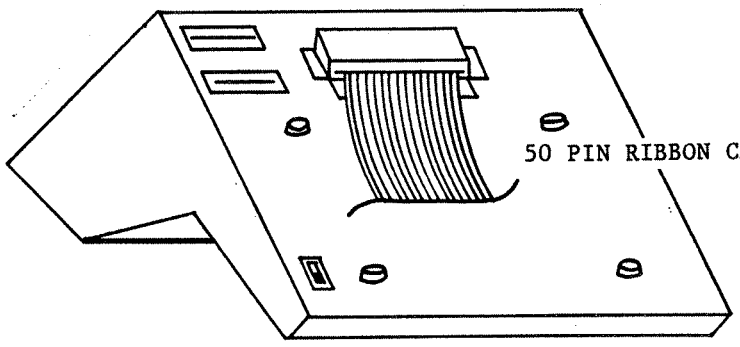
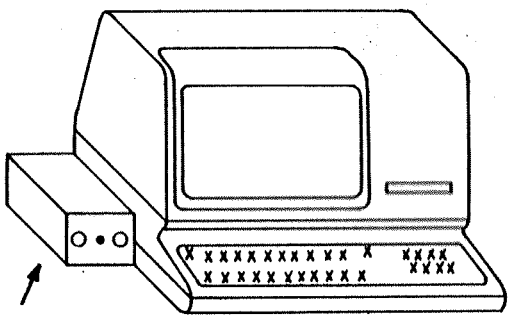


FIGURE 7
MODEL III CABLE CONNECTION



2.5 CHECKOUT

After connecting your CHROMAtrs to your color display, you may check that it is functioning correctly with a program that is supplied. This software is supplied on cassette tape so that it may be loaded into any TRS-80 Model I or Model III microcomputer.

To load these routines, you must first enter Basic in the usual manner for whichever computer/operating system combination you own. Specify a memory size of 45056. From basic, the CHROMAtrs drivers may be loaded via the SYSTEM command. The following is the suggested sequence, (CR) indicates that you type a carriage return:

```
READY
  System (CR)

* Driver (CR)

* / (CR)

* (BREAK)
READY
```

The CHROMAtrs drivers are now loaded. When "/" was typed, your television screen should display the CHROMAtrs logo. If it does not, make certain that the CHROMAtrs is installed correctly and that power is applied. If not, refer to the TROUBLE SHOOTING chapter, then repeat the above procedure.

At this point you may now enter the supplied LUNAR LANDER game. This is done by typing the following:

```
LOAD"LUNAR"
RUN
```

At this point a picture of a lunar landscape will appear and after a few moments a landing pad, and then a landing craft will appear. The game is played using either the arrow keys of your computers keyboard, or with ATARI joystick controllers plugged into the back of your CHROMAtrs.

As this game is written in BASIC, it can be used as a reference for writing your own programs after reading chapter 3.

CHAPTER 3
PROGRAMING INFORMATION

3.1 INTRODUCTION

This chapter is used to write application programs in basic or assembly language. It also supplies information on using the high resolution graphics routines supplied on cassette.

3.2 GENERAL DESCRIPTION

In graphics mode II, (the mode used by all included software), the display consists of 34 display planes that may be thought of as 33 transparencies placed over a fixed backdrop color. Refer to fig 8 for an example.

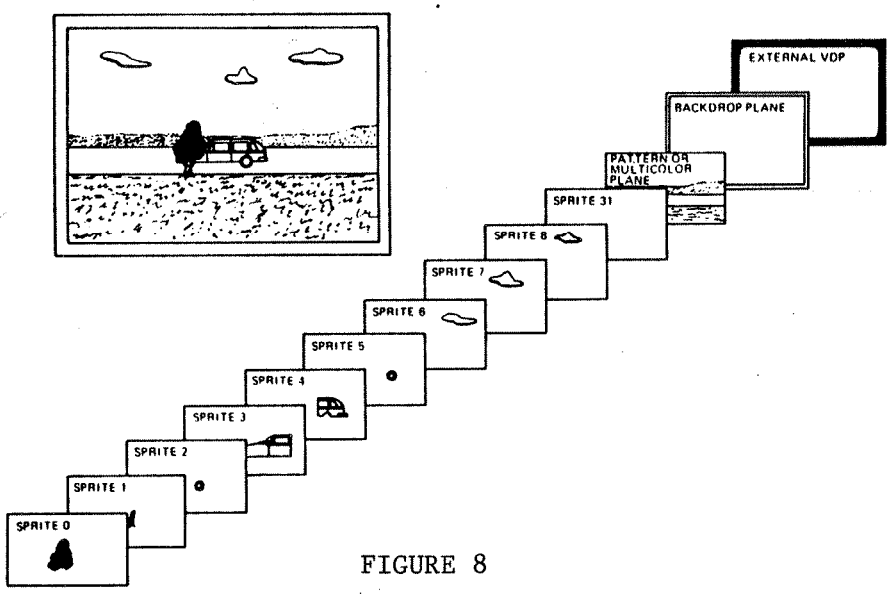


FIGURE 8

The pattern plane consists of 256 X 192 pixels which may be switched on or off individually under user program control. The color of the pixels can be any one of fifteen colors, also under user control, but is limited in that groups of 8 horizontal pixels (a sliver) can only have two colors, a foreground color and a background color. The foreground is used for pixels that are set (on), and background is used for pixels that are reset (off).

The color of the border (the backdrop) may be any one of fifteen colors, and will be visable in the display area only where the sixteenth possible color (transparent) is chosen for a pixel.

There are also 32 display planes known as sprites which are user definable 16 X 16 pixel characters that may be placed anywhere on the display area, without changing the pixels of the main display area. This allows for simple animation by merely redefining the positions of the sprites without having to redraw the character. The sprites are one of the most powerful feature of this video processor as it allows you to

control graphics characters without having to draw, erase, and redraw individual pixels, just specify it's position, and the video processor will display it in it's proper location. Also, since they are on different levels, 3-D simulations are possible as the upper most sprites will partially or fully block lower sprites that are in overlapping locations.

3.3 LOADING DRIVER ROUTINES

Your CHROMAtrs comes supplied with a series of software routines to allow you to draw pictures, input from the controllers, and make various sounds. This software is supplied on cassette tape so that it may be loaded into any TRS-80 Model I or Model III microcomputer.

To load these routines, you must first enter Basic in the usual manner for whichever computer/operating system combination you own. Specify a memory size of 45056. From basic, the CHROMAtrs drivers may be loaded via the SYSTEM command. The following is the suggested sequence, (CR) indicates that you type a carriage return:

```
READY
  System (CR)
                  ****************************************
* Driver (CR)      * To transfer driver program to disk,    *
                  * load the cassette as shown, then use   *
* / (CR)          * your operating systems "DUMP" command. *
                  * Start address is B000, end address is  *
* (BREAK)         * BFFF, and the transfer address is B000.*
READY             ****************************************
```

The CHROMAtrs drivers are now loaded. When "/" was typed, your television screen should display the CHROMAtrs logo. If it does not, make certain that the CHROMAtrs is installed correctly and that power is applied. If not, correct the problem and repeat the above procedure.

During the next several sections, a brief description of each of the CHROMAtrs driver functions is described. Reference will be made to "Call Address", and "Parameter Address", to inform you of how to use the routine.

To set up a call address in Basic you should see your TRS-80's Level 2 users manual. All Call and Parameter Addresses are given in hexadecimal for uniformity.

Parameter addresses are simply memory locations into which you must poke the information which the driver routine will use for data. Driver routines also may return data to the basic program by leaving it at a parameter address where the basic program may read it using the peek function.

3.4 INITIALIZATION

The CHROMAtrs software is automatically initialized when the driver software is activated. If for some reason you need to reinitialize the CHROMAtrs, Call address B006 (no parameters). This initializes the video

controller into Graphics Mode 2, the highest possible resolution ,and is used by all other driver routines.

To clear the screen use call address B009. Parameter address B037 must be set to the backdrop (border) color, and B036 must be poked with the Foreground/Backround color BEFORE calling the clear screen routine. The color is determined from the color table at the end of this section. To set the desired color combination, multiply the foreground color by 16 and add the backround color. For example, to create a Cyan backround with a Red forground you first lookup Cyan in the color table (it's a 7). Then lookup Red (it's a 6). The statement in basic to setup this parameter would be:

```
POKE &HB036,6*16+7
```

This formula applies to ALL functions which require a forground or backround color to be used.

COLOR	VALUE
transparent	0
black	1
medium green	2
light green	3
dark blue	4
light blue	5
dark red	6
cyan	7
medium red	8
light red	9
dark yellow	10
light yellow	11
dark green	12
magenta	13
gray	14
white	15

3.5 DOT ROUTINES

The key to creating pictures on your CHROMAtrs is placing different color dots on the screen. Like the TRS-80, your CHROMAtrs has commands to SET, RESET, and TEST different points on the screen.

To SET a point use call address B00C. Poke the color (address B036) in the same manner as used in the clear screen routine. Poke the X (horizontal) coordinate into address B038, and poke the Y (vertical) coordinate into address B039. Note that X must not exceed 255, and Y must not exceed 191. If the X,Y values exceed these maximums, you may be very disappointed with the results. If you do not specify a color, whatever color was used last will be used again.

RESET works in the same manner as Set, and is used to turn off a point on the screen. The call address is B00F. There is no need to specify a color. The X and Y coordinates are specified in the same manner as the Set command.

The TEST command is used to determine whether a point is on or off. The call address of TEST is B012. Poke the X,Y coordinates in the same

manner as in SET and RESET. If the point specified is set, a zero will be returned at address B06D, if the point is not set, a non-zero number will appear at address B06D.

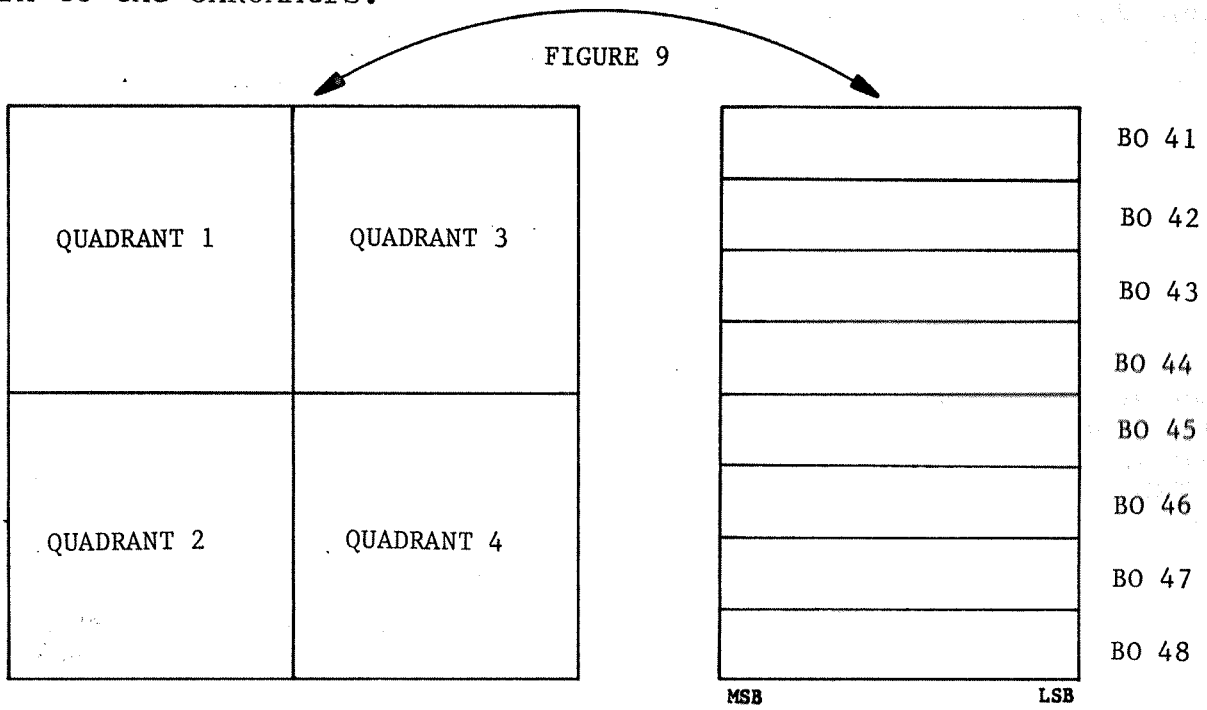
3.6 SPRITE ROUTINES

A SPRITE is the key to creating animations and games. There are 32 sprites available for your use with the CHROMAtrs. Each is defined as a 16 X 16 square of pixels. Sprites may be moved around the screen as whole objects, thus making fast, smooth motions not available with other graphics controllers. There are four routines available for using the sprites, these will allow you to define and move sprites around on the screen. For more advanced sprite applications, some knowledge of assembly language, and the TMS-9918A users manual are required.

Each sprite has two table references, one defining the sprite's pattern, and one defining it's color and position on the screen.

The first table defines all of the available patterns that may be used for sprites. It consists of 64 groups of 32 byte definitions, which are bit mapped representations of the character. To define one of the 64 pattern slots available, you need to poke the 32 bytes which make up the pattern into the computers memory starting at address B041 (see fig 9 for details). Next, poke the sprite pattern number multiplied by 4 (take my word for it!!) into address B061. Finally call address B015 to define the pattern to the CHROMAtrs.

FIGURE 9



There are a total of 32 sprites available. Each one may be defined as any one of the 64 sprite patterns that were previously defined (see above paragraph). To place a sprite onto the video screen you must first point the sprite at the appropriate pattern, then point it at a position on the screen. To point at the pattern use call address B018 after poking the desired pattern number into address B062 and the desired sprite number at address B061, and the desired color at address B040. This will define any one of the 32 sprites as being the selected pattern and color.

To move the sprite to an X,Y coordinate simply poke the X coordinate into address B063 and the Y coordinate into address B064, and the sprite number into address B061, then call address B01B. The X,Y coordinate supplied for the sprite always refers to the upper left point on the sprite pattern block (not necessarily the corner of the figure itself).

The bounds for the X,Y coordinates of a sprite are the same as for a point (255,191) with one exception; If the Y coordinate is equal to 208 then that sprite, and all sprites with numbers larger than that sprite will not be displayed. Note also that only 4 sprites can be displayed on one horizontal line at one time. If more than 4 exist on a line all sprite numbers greater than the fourth will not be displayed!

One other routine is supplied for the sprites which simply clears all the patterns to zeros. There are no parameters to pass, only call address B01E.

3.7 LINE DRAW ROUTINES

A line draw routine speeds the creation of shapes when operating in Basic. To draw a line poke the starting and ending coordinates into memory and call address B021. The addresses for the starting X and Y are B03A and B03C, the addresses for the ending X and Y are B03E and B03F.

A routine for filling in simple areas is also provided (only in versions 2.0 and above available 12/82). To use it poke a central point within the area to be filled into addresses B038 and B039, poke the color into B036, and call address B024.

3.8 CHARACTER ROUTINES

Two routines are provided to allow you to place alphanumeric information onto the color screen created by the CHROMAtrs.

First is the STRING print routine. To place a string of characters from Basic to the screen you must poke the low order byte of the 16 bit address of the string into address B067, and the high order byte into address B068. Then poke the length of the string into address B069. The address and length of a string are provided by Basic's VARPTR funtion (see TRS-80 level 2 users manual). Then poke the X,Y screen coordinate of the upper left corner of the first character to appear in address B038 and B039. Lastly poke the color for the letters into address B036 and call address B027. When the string has finished printing, the X,Y coordinates for the next character are already in position, so that the next string printed will be immediately following the first.

Another routine, call address B02A, is provided for game scoring and other similar functions. This routine simply needs an integer number poked into address B065, color poked into address B036 and the number will be printed at the current X,Y coordinate (specified by poking to B038 and B039).

3.9 OTHER CHROMAtrs ROUTINES

Your CHROMAtrs has the ability to make music and other sounds. The provided driver routine allows you to produce tones of varying frequency, duration and amplitude. To output a tone poke the frequency (0-255) into address B06A, amplitude (loudness from 0-32) into address B06B, and duration (0-255, equal to the number of cycles to play) into address B06C. Then call address B02D to play the tone.

To read an ATARI joystick poke the stick number (0-1) into address B06D and call B033. The value returned may be peeked at address B06D. If no joystick is attached, the arrow keys and spacebar on the TRS-80's keyboard are scanned instead. The values returned from this routine are the same for both the keyboard and the joystick so games may be written so that the same program is universal.

To read an ATARI paddle controller, poke the paddle number (0-3) into address B06D and call address B030. The number returned in address B06D (0-255) is the position of the paddle.

CHAPTER 4
TECHNICAL INFORMATION

4.1 INTRODUCTION

This chapter is used by the advanced programmer. The technical information needed to control the CHROMAtrs directly without the use of the included routines is given. It provides the port mapping and bit definitions required.

4.2 GENERAL DESCRIPTION

The CHROMAtrs uses the powerful TEXAS INSTRUMENTS TMS 9918A video display processor to generate full color graphics in a number of available modes and options. The following programs and information work in the highest resolution mode available, and are meant as general purpose aids in program development. For a more detailed description on using all of the options available, a suggested book for further information is the TEXAS INSTRUMENTS "TMS 9918A VIDEO DISPLAY PROCESSOR" manual which describes the video generator fully. This is obtainable from SOUTH SHORE COMPUTER CONCEPTS,Inc by filling out the order form included with any purchase of CHROMAtrs related products.

The rest of the support hardware consists of 6 main functional blocks (see fig 10):

* Port selection and EXTIO logic
* Audio port and 6 bit D/A
* Left joystick interface
* Right joystick interface
* Paddle interface
* Triple voltage sequenced power supply

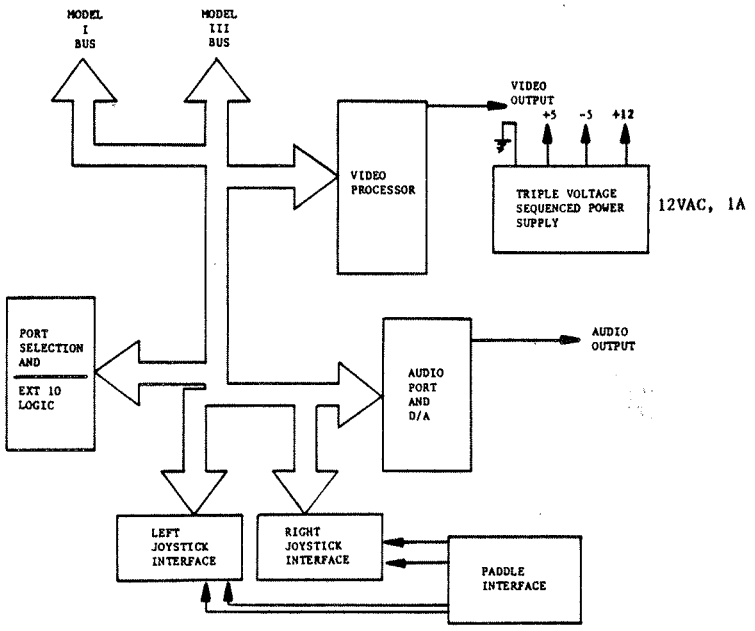


FIGURE 10
SYSTEM BLOCK DIAGRAM

These blocks will be described further in the following sections. The power supply is not further described since it would have little meaning for the programmer. During the following descriptions, you may want to refer to the schematic in section 5.10 for exact functionality.

4.3 PORT SELECTION AND EXTIO LOGIC

This block controls the selection of the various ports in the CHROMAtrs. Normally they are as follows:

PORT NUM.	READ	WRITE
78H	TMS 9918A VRAM read	TMS 9918A VRAM write
79H	TMS 9918A STATUS	TMS 9918A REG/ADDR
7A-7BH	NOT DEFINED	NOT DEFINED
7C-7DH	LEFT JOYSTICK	NOT DEFINED
7E-7FH	RIGHT JOYSTICK	D/A and TIMER START

NOTE: Do not use undefined addreses as they are for future enhancements.

If a different addressing is desired, jumpers may be installed to change the base address. This is necessary if more then one CHROMAtrs is being used on one computer. The jumpers are marked 3,4,5,6 refering to the address lines they effect. Without a jumper (the normal configuration), the logic will wait for a logic one on that address line, with a jumper it waits for a logic zero. The following table may be used to set for other base addresses:

A3	A4	A5	A6	BASE ADDRESS
JUMPER	JUMPER	JUMPER	JUMPER	00H
-	JUMPER	JUMPER	JUMPER	08H
JUMPER	-	JUMPER	JUMPER	10H
-	-	JUMPER	JUMPER	18H
JUMPER	JUMPER	-	JUMPER	20H
-	JUMPER	-	JUMPER	28H
JUMPER	-	-	JUMPER	30H
-	-	-	JUMPER	38H
JUMPER	JUMPER	JUMPER	-	40H
-	JUMPER	JUMPER	-	48H
JUMPER	-	JUMPER	-	50H
-	-	JUMPER	-	58H
JUMPER	JUMPER	-	-	60H
-	JUMPER	-	-	68H
JUMPER	-	-	-	70H
-	-	-	-	78H

This functional block also switches the port bus buffer direction during a read to be compatible with the model III. Being an open collector driver, it will not interfere with any other peripherals also on the same external bus.

4.4 LEFT JOYSTICK INTERFACE

This block contains the necessary hardware to interface the joystick controller. It is also read to determine the paddle position if in use.

This port is read only and will return a byte which is decoded as follows:

BIT	MEANING
D0	1=normal 0=left
D1	1=normal 0=right
D2	1=normal 0=top
D3	1=normal 0=bottom
D4	1=normal 0=fire
D5	0 for all REV C boards
D6	Paddle A test
D7	Paddle B test

Bit D5 may be used to determine the current board revision to allow for future enhancements. For revisions D-K, it will be tied to D/A convertor port bits D0-7 respectivly.

4.5 RIGHT JOYSTICK INTERFACE

This block is the same as the left joystick interface except that bit D5 is the TMS-9918A IRQ request pin, and can be used to test the IRQ flag without resetting it. The IRQ line goes low at the end of every frame, and doesn't go high until the status port of the TMS-9918A is read. The bits are defined as follows:

BIT	MEANING
D0	1=normal 0=left
D1	1=normal 0=right
D2	1=normal 0=top
D3	1=normal 0=bottom
D4	1=normal 0=fire
D5	1=normal 0=IRQ
D6	Paddle C test
D7	Paddle D test

4.6 AUDIO PORT AND D/A

The audio port (7EH) is an eight bit write only port. The lower six bits (D0-5) are used by the D/A convertor to generate an analog voltage on the audio output. The voltage output is approximately equal to:

$$V = 5 - X * 0.161$$

where X is the decimal value of the lower six bits. Since the D/A convertor output buffer is capacitively coupled, the actual voltage at the phono jack output is time dependent.

The upper most bit (D7) is used to reset and trigger the oneshots used to determine the resistance of the paddle controllers. When it is at logic one, the one shots are reset (this takes about 4mS). At a logic zero, the oneshots are started.

4.7 PADDLE INTERFACE

The paddle interface consists of four oneshots that are triggered by D7

of the D/A port as described above. After the oneshots are triggered (D7 reset), bits D6&7 of the joystick controller ports will go low. The time that they stay low is determined by the resistance (thus position) of the paddle controllers. To determine the positions of the paddle controlers, clear the oneshots by setting D7 high for 4mS, trigger the oneshots by setting D7 low, then measure the time it take for bit D6 or 7 of the joystick port to go from low to high. Typically this takes from 1 to 30 mS over the full range.

CHAPTER 5
CHROMAtrs KIT ASSEMBLY

5.1 INTRODUCTION

This chapter is the assmebly instructions for the CHROMAtrs kit. If you bought the kit version, read this chapter completly BEFORE you begin construction. Note that SOUTH SHORE COMPUTER CONCEPTS,INC is not responsible for components that are damaged due to poor workmanship or being exposed to conditions beyond their rated limits, and will not replace for free any components that SHOUTH SHORE COMPUTER CONCEPTS, Inc considers damaged by improper use or handling by the customer. This kit is not for beginners, and should be built only by someone who has built computer product related boards before.

5.2 RESISTORS

( ) Check the parts you received against the parts list at the end of this chapter to make certain that you have all the components you need to assemble your CHROMAtrs.

( ) Insert and solder ten 20K 1/4W resistors (red, black, orange, gold) in locations R1,2,22,23,31,33,35,37,39,41.

( ) Insert and solder nineteen 4.7K 1/4W resistors (yellow, violet, red, gold) in locations R3-18,20,24,25.

( ) Insert and solder one 2K 1/4W resistor (red, black, red, gold) in locations R19,.

( ) Insert and solder one 1K 1/4W resistor (brown, black, red, gold) in location R21.

( ) Insert and solder four 1M 1/4W resistors (brown, black, green, gold) in locations R26-29.

( ) Insert and solder six 10K 1/4W resistors (brown, black, orange, gold) in locations R30,32,34,36,38,40.

( ) Insert and solder one 150 Ohm 1/4W resistor (brown, green, brown, gold) in location R42.

( ) Insert and solder one 470 Ohm 1/4W resistor (yellow, violet, brown, gold) in location R43. Don't use the larger 1/2w resistor here, use the small 1/4W.

( ) Insert and solder one 75 Ohm 1/4W resistor (violet, green, black, gold) in location R44.

( ) Insert and solder one 470 Ohm 1/2W resistor (yellow, violet, brown, gold) in location R45.

( ) Insert and solder two 100 ohm 1/4W resistors (brown, black, brown, gold) in location R48,52.

( ) Insert and solder one 10 Ohm 2W resistor in location R49.

( ) Insert and solder 2 5k trimmer resistors in locations R50,51.

( ) At this point, double check that the correct resistors are in the correct locations. Go over the list one at a time checking that the colored bands match those specified in the above list

5.3 DISCRETE SEMICONDUCTORS

( ) Insert and solder five 1N914 diodes in locations marked CR1-4,7,. Be certain that the cathode (the side with the black band) is the correct direction.

( ) Insert and solder one LED in location CR5. be certain that the cathode (the side with the shorter lead and notch) is in the hole marked negative (-).

( ) Insert and solder three 1N4002 diodes in locations marked CR6,9,11. Be certain that the cathode (the side with the silver band) is the correct direction.

( ) Insert and solder one 1N751 diode in locations marked CR8. Be certain that the cathode (the end with the black band) is the correct direction.

( ) Insert and solder two 2N2222 transistors in locations marked Q1,2. Be certain that the flat part of the case faces the correct direction.

( ) At this point, go back and double check that all of the discrete semiconductors are in the correct positions, and facing the correct direction.

5.4 CAPACITORS

( ) Insert and solder eleven 0.01 uf ceramic capacitors in locations C1-8,14,15,21.

( ) Insert and solder seventeen 0.1 uf ceramic capacitors in locations C9,13,20,22,24-31,33,34,37,38,42.

( ) Insert and solder four 0.047 uf mylar capacitors in locations C16-19.

( ) Insert and solder two 10 uf 16 VDC electrolytic capacitors in locations C23,36.

( ) Insert and solder one 100 uf 16 VDC electrolytic capacitor in location C32.

( ) Insert and solder one 100 uf 25 VDC electrolytic capacitor in location C35.

( ) Insert and solder one 470 uf 25 VDC electrolytic capacitor in location C39. (NOTE: C39 and C40 have three holes on the board in order to accomidate either axial or radial parts. For axial parts use the two

holes farthest from each other. For radial parts use the two holes nearest to the edge of the P.C. board.)

( ) Insert and solder two 2200 uf 25 VDC electrolytic capacitor in location C40,41.

5.5 REGULATOR COMPONENTS

( ) Insert the two black heat sinks by lining up their tabs with the mounting holes on the board and pressing them into the board until they are fully seated.

( ) Insert and solder the regulator LM-340-12 (may be marked 7812) into the area marked U20. Then bolt the regulator to the heat sink with a 4-40 1/4 bolt and nut.

( ) Insert and solder the regulator LM-340-5 (may be marked 7805) into the area marked U11. Then bolt the regulator to the heat sink with a 4-40 1/4 bolt and nut.

( ) Insert and solder one power jack connector in location J3. Bend the solder tabs as shown in fig 11 and be certain to solder a small wire from the third tab to the pad directly below it.

( ) At this point go over all the work you have done until now to check for any possible mistakes you may have made. The next step is to power the board and check the regulator circuit. Any errors detected now will save you work later.

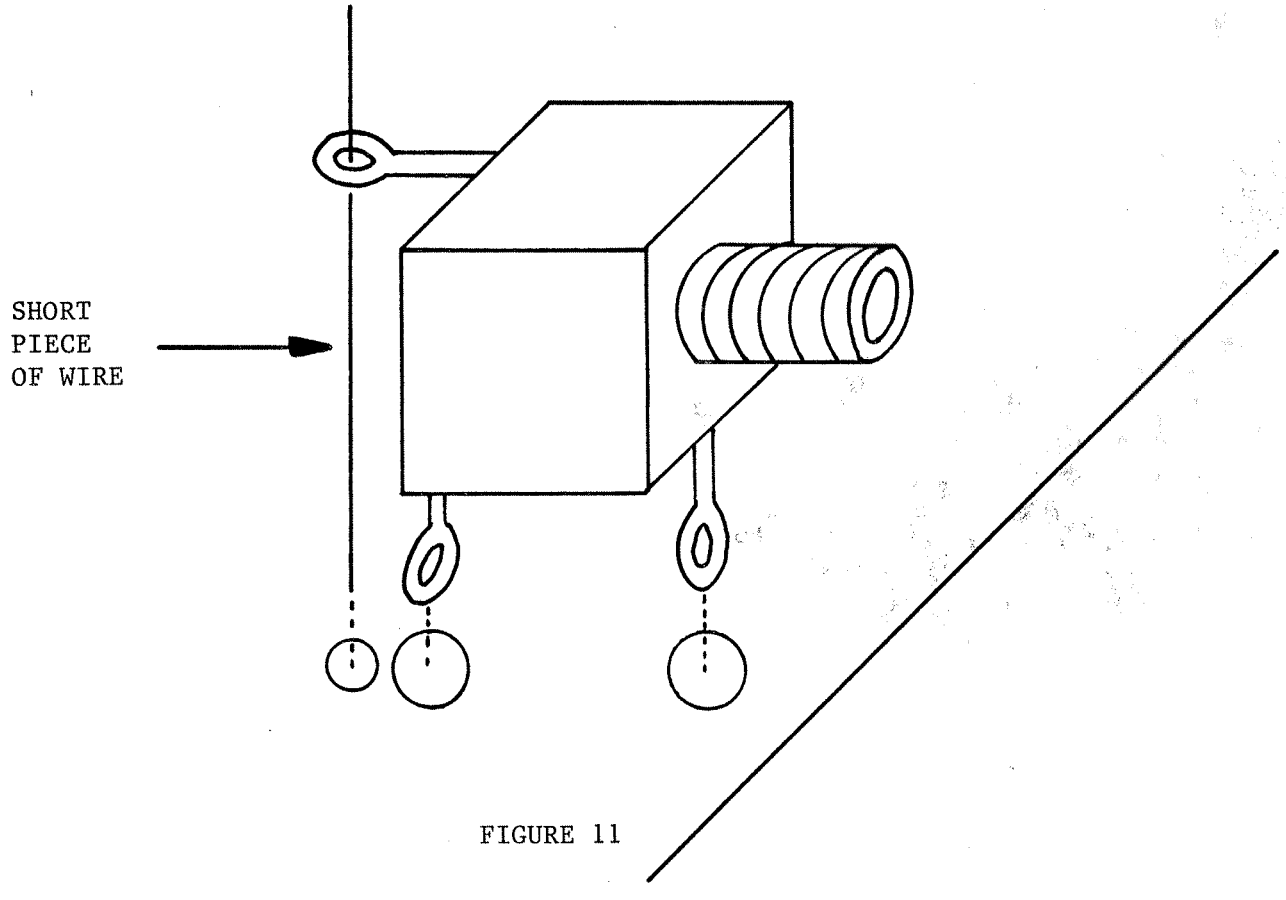


FIGURE 11

5.6 POWER SUPPLY CHECKOUT

To test the CHROMAtrs out at this point, you will need an accurate volt meter and a 12 Volt AC 1 Amp power transformer (example: RADIO SHACK No. 273-1505). This step may be skipped, but if the power supply were to malfunction, it could damage the delicate dynamic ram chips. Any components damaged due to a defective power supply are NOT guarranteed, and SOUTH SHORE COMPUTER CONCEPTS, Inc will not replace them for free.

( ) Connect your 12 VAC power to the power connector on the board. DO NOT APPLY POWER YET !!

( ) Connect the positive lead of your volt meter to the negative side of C40 (ground), and the negative side of your voltmeter to the cathode of CR8 (-5vdc). Set the scale to read 5 vdc.

( ) Apply power momentarily. If -5 VDC is not present, do not continue appling power!! Doing so WILL result in burnt out components. Go over all your work and find the fault.

( ) Remove power. Connect the negative lead of your meter to the negative side of C40, and the positive lead to the input of U11 (pin 1)(12 VDC). Set the scale to read 15 VDC.

( ) Connect power again. If 12 VDC is present, then move the positive lead of your meter to the output of U11 (pin 3) and check that 5 VDC is present. If either supply is not functioning, check the TROUBLE SHOOTING chapter before going any further.

( ) Remove power and continue with assembly.

5.7 INTEGRATED CIRCUITS

Before inserting any integrated circuits, momentarily short out filter capacitors C39, C40 and C41 with a jumper wire to ensure that power is no longer applied to the circuit.

Some of the integrated circuits used in the CHROMAtrs are MOS and do require at least some special care during assembly.

1- Use only a three wire soldering iron that is properly grounded.

2- Never insert the IC's into nonconductive foam.

3- Never leave IC's lying around on your work bench.

4- Always ground yourself before touching a MOS chip.

5- Work away from carpets and aviod wearing wool or other clothing prone to static build up.

( ) Start the assembly by soldering the eight 16-pin sockets for the video memory into the areas marked U-11 thru U-18. Make certain that the pin one mark faces the correct direction.

( ) Solder the 40-pin IC socket into the area marked U-19. Make certain that the pin one mark faces the correct direction.

( ) Insert and solder the two SN74LS244 integrated circuits into the areas marked U-1 and U-2. Make certain that the pin one mark faces the correct direction.

( ) Insert and solder the SN74LS273 I.C. into the area marked U-3. Make certain that the pin one mark faces the correct direction.

( ) Insert and solder the SN74LS138 I.C. into the area marked U-4. Make certain that the pin one notch faces the correct direction.

( ) Insert and solder the SN74LS85 I.C. into the area marked U-5. Make certain that the pin one notch faces the correct direction.

( ) Insert and solder the two MC14069UB I.C.'s into the area marked U6 and U7. Make certain that the pin one notch faces the correct direction.

( ) Insert and solder the DM7438N into the area marked U-8. Make certain that the pin one notch faces the correct direction.

( ) Insert and solder the SN74LS02N into the area marked U-9. Make certain that the pin one notch faces the correct direction.

( ) Insert and solder the SN74S04N into the area marked U-22. Make certain that the pin one notch faces the correct direction.

( ) At this point, double check your work, paying close attention to the direction of the chips and the part numbers.

( ) Now re-test the power supply as above in section 5.6

5.8 MISCELLANEOUS PARTS

( ) Insert and solder one 10.738635 MHZ crystal in location Y1.

( ) Insert and solder two right angle phono-jacks in the areas marked J1,2.

( ) Carefully slip the two DE-9P joystick connectors onto the edge of the board in the areas marked LEFT and RIGHT. Make certain that the side with five pins faces up, the side with four pins faces down, and that the pins line up properly. Press it on until the plastic part rests firmly against the edge of the board, then solder it in place.

( ) Insert and solder five MOLEX connector pins in the holes by capacitor C40 marked G,V,+12,A. Make certain that these pins are soldered in straight or the modulator won't fit correctly.

( ) Assemble the four standoffs as shown in fig 12.

( ) Insert the eight 4116 ram chips in IC sockets U12-19. Make certain that they are facing the correct direction. Be careful not to bend or break any of the leads.

( ) Insert the TMS 9918A in IC socket U10. Make certain that it is facing the correct direction. Be careful not to bend or break any of the leads.

( ) Double check all of your work one last time

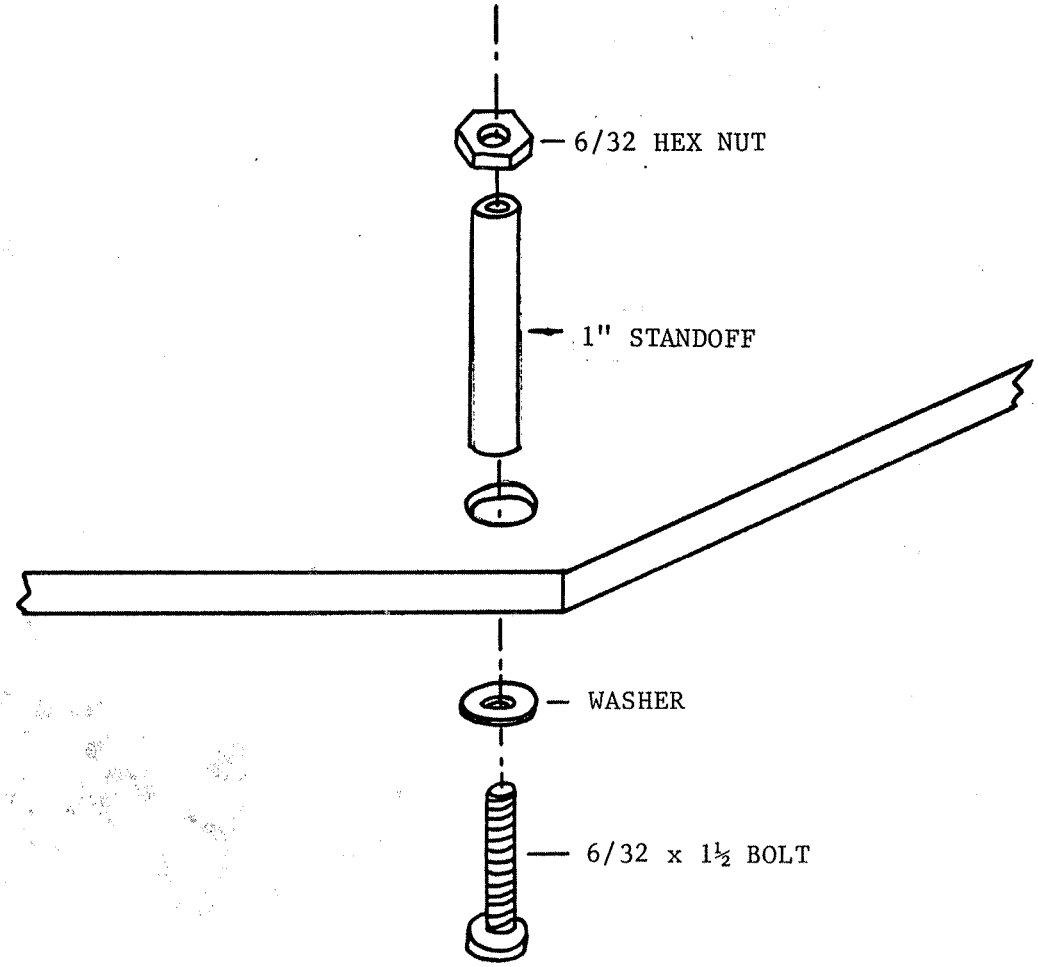


FIGURE 12
STANDOFF ASSEMBLY

5.9 FINAL CHECKUOT

( ) After you are certain that all of your work is correct, connect the CHROMAtrs to your TRS-80 as directed in chapter 2.

( ) Plug your CHROMAtrs into a convient wall outlet. The red pilot light should glow. CAUTION: Several of the components in the power supply get quite hot. This is normal, however you should exersize care not to burn your fingers.

( ) Load the driver software as described in chapter 2, a full color copywrite message should be displayed. If it is not refer to the TROUBLE SHOOTING chapter for a possible remidy.

5.10 PARTS LIST.

DESIGNATION	DESCRIPTION	QTY
C1-8,14,15,21	.01 uF CERAMIC CAP	11
C9,13,20,22, 24-31,33,34, 37,38,42	.1 uF CERAMIC CAP	16
C16-19	.047uF MYLAR CAP	4
C32	100 uF 16V CAP	1
C35	100 uF 25V CAP	1
C39	470 uF 25V CAP	1
C40,41	2200 uF 25 V CAP	2
CR1-4,7	1N914 DIODE	5
CR5	LIGHT EMITTING DIODE	1
CR6,9,10,11	1N4002 DIODE	4
CR8	1N751A ZENER DIODE	2
J1,2	PHONO JACK	2
J3	3.5 mm POWER JACK	1
Q1,Q2	2N2222 TRANSISTOR	2
R1,2,22,23,31,33 35,37,39,41	20K 1/4 W RESISTOR	10
R3-18,20,24,25	4.7K 1/4 W	19
R19,48	2K 1/4 W	2
R21	1K 1/4 W	1
R26-29	1M 1/4 W	4
R42	150 OHM 1/4 W	1
R43	470 OHM 1/4 W	1
R44	75 OHM 1/4 W	1
R45	470 OHM 1/2 W	1
R48,52	100 OHM 1/4 W	1
R49	10 OHM 5 W	1
R50,51	5K TRIMER POT.	2
U1,2	74LS244	2
U3	74LS273	1
U4	74LS138	1
U5	74LS85	1
U6,7	MC14069	2
U8	7438	1
U9	74LS02	1
U10	TMS 9918A	1
U11	LM340T5 (LM7805)	1
U12-19	4116B-15 OR MM5290N-2	8
U20	LM340T12 (LM7812)	1
Y1	10.738635 MHZ CRYSTAL	1

MISCELANIOUS COMPONENTS

ITEM	QTY
DE-9P JOYSTICK CONNECTOR PLUGS	2
MOLEX TYPE CONNECTOR PINS	5
HEAT SINKS, BLACK ANODIZED ALUMINUM	2
6-32 1 1/2 INCH BOLTS (LARGE ONES)	4
4-40 1/4 INCH BOLTS (SMALL ONES)	2
6-32 NUTS	4
4-40 NUTS	2
6-32 WASHERS	4
4-40 WASHERS	2
6-32 1 INCH ALUMINUM SPACERS	4

CHAPTER 6
TROUBLE-SHOOTING

Although your CHROMAtrs kit has been throughly engineered to assure that it will work the first time, it is possible that some minor trouble could be encountered. This table deals with various possible problems which you may encounter, and lists some possible cures.

If your CHROMAtrs (kit or prebuilt) does not work, please consult this table BEFORE calling South Shore Computer Concepts, this will assure you of the quickest possible service.

SYMPTOM:	CAUSE:	CURE:
No power at all	Bad transformer	Replace
No positive voltage (negitive ok)	U20,CR9,CR11 C40,C41 reversed	Replace Repair
+12 volts too high	U20	Replace
+5 volts too high	U11	Replace
No +5 volts	U11 C23 reversed	Replace Repair
-5 volts too high	CR8	Replace
No -5 volts	CR8 C36,C39,CR7 reversed	Replace Repair
No color in picture	Y1	Replace Fine tune T.V.
Picture fuzzy or distorted		
	Interference.	Move T.V. or TRS-80 to minimize. Fine tune T.V.
	Wrong impedence monitor	
	Bad transistor Q2	Replace
Can't read joystick	U1,U2	Replace
Can't read paddle (joystick ok)	Controller not plugged in U3,U6,CR1-CR4	Replace
No audio output	U3,Q1	Replace

In addition to the above, check all of your soldered connections. If the connection is rough looking, reheat it. Make certain that there are no shorts on the back or front of the board.

Check the polarity of ALL capacitors and diodes, it is very easy to insert them backwards. Also check that the transistors and IC's are inserted in the correct direction.

When ALL ELSE fails, call us at South Shore Computer Concepts, and ask for tecnical assistance. We will be happy to help you out.

CONCLUSION

We hope that this manual was of some help in getting your CHROMAtrs running and programmed. Although an effort was made to ensure accuracy and completeness of this manual, errors probably exist. Any corrections or sugestions regarding this manual or the CHROMAtrs itself would be greatly appreciate, and will receive our prompt attention.

For those of you who are wondering what to do with your CHROMAtrs now that you have had a chance to use it a little, we are forming a program exchange to buy and sell the best application programs we find. We will sell programs that we write ourselves and those written by other CHROMAtrs users on a royalties basis. For those of you who are interested in receiving more information about this, please fill out the postpaid registration card included with your CHROMAtrs and send it to us. We will put your name on our mailing list for subsequent mailings of our software exchange catalog.