CGC OPERATORS MANUAL ADDENDUM

Document Number 070263
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CGC SERIES

CHROMATICS, INC.

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REMOVAL AND INSTALLATION
DEPENDENCY CHART

The major assemblies of the CGC-7900 should
be removed in the sequence shown in Fig. 1-1.
The installation of these assemblies is in
the reverse order of the removal. If the
procedure is obvious, it is omitted. The
number after the assembly refers to the
section describing the removal of that
assembly.
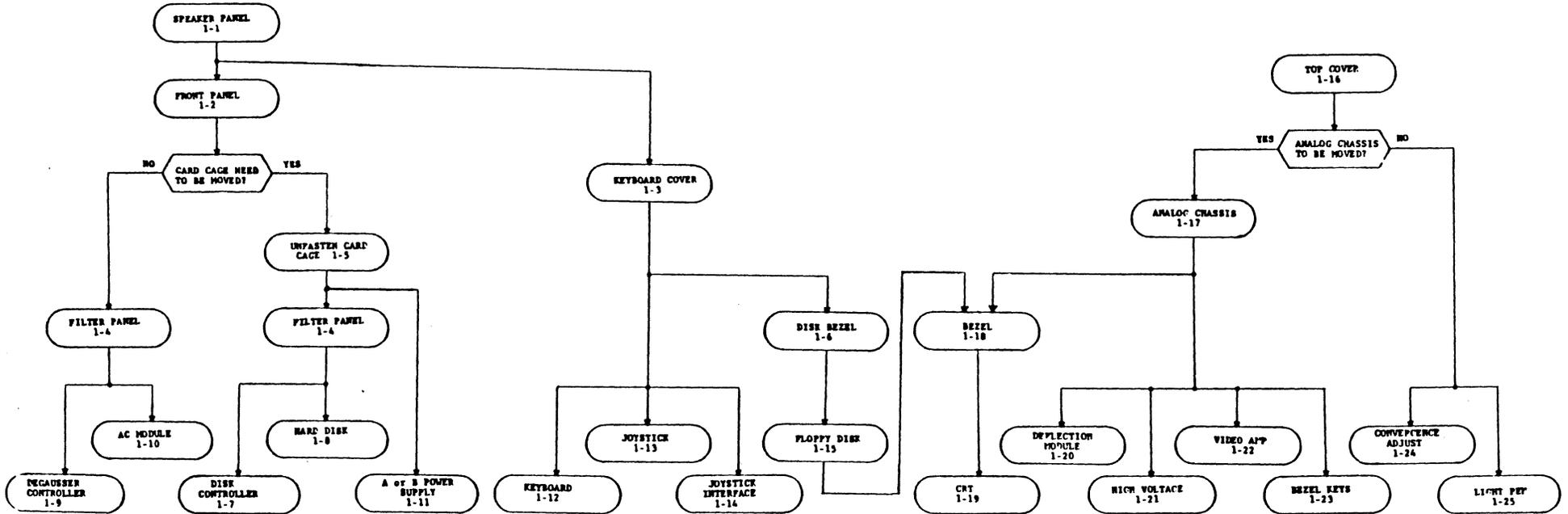
Figure 1-1

1-1   SPEAKER PANEL

1-1.1   Speaker Panel Removal (Fig. 1-2)

  1. Disconnect the speaker cable from the CPU board. Refer to the
      label on the inside of the back panel for CPU board and speaker
      cable location.

  2. Remove the two phillips screws (A) at the top of the speaker panel.

  3. Push the two spring loaded latches (B) toward the center of the
      panel.
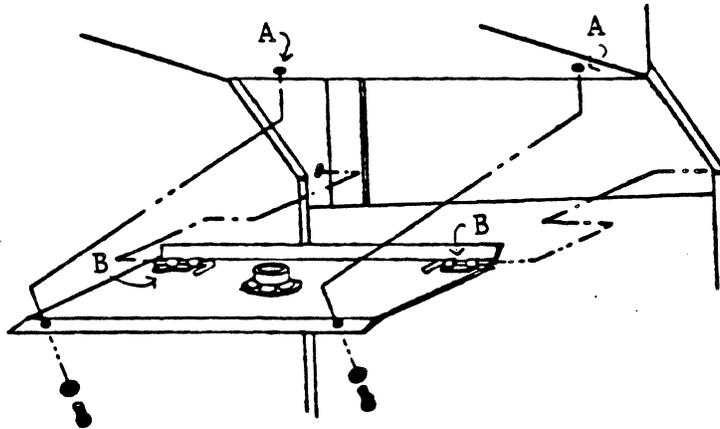
Figure 1-2 Speaker Panel

1-2   FRONT PANEL

1-2.1   Front Panel Removal

  1. Perform section 1-1.

  2. Remove the two phillips screws at the top of the front panel.

  3. Lift the panel straight up until it clears the two retainer pins at
      the bottom.

1-3   KEYBOARD COVER

1-3.1   Keyboard Cover Removal (Fig. 1-3)

  1. Perform section 1-1.

  2. Remove the 4 counter sunk phillips screws from beneath the cover.

  3. Slide the cover straight out.
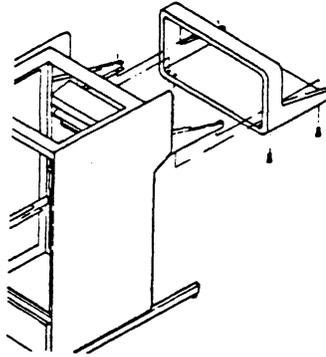
Figure 1-3 Keyboard Cover

1-4   FILTER PANEL

1-4.1   Filter Panel Removal (Fig. 1-4)

1. Remove the AC power cord from the unit.

2. Remove the 4 phillips screws located at each corner of the panel.

3. Remove the panel.
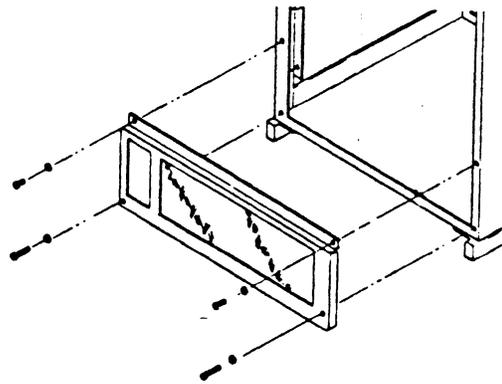
Figure 1-4 Filter Panel

1-5   CARD CAGE

1-5.1   Unfasten Card Cage (Fig. 1-5)

1. Open the back door of the unit to gain access to the digital section.

2. Remove the 4 phillips screws from each of the two retainers that secure the card cage to the unit frame.

3. Gently pull the card cage to the desired distance.
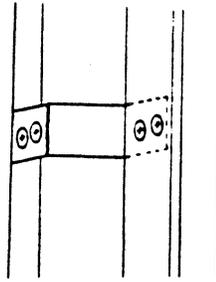
Figure 1-5 Card Cage Retainer

1-6   DISK BEZEL

1-6.1   Disk Bezel Removal (Fig. 1-6)

1. Perform sections 1-1 and 1-3.

    CAUTION: Ensure that the power cord has been removed from the unit
    before proceeding.

2. Remove the phillips screws from either end of the bezel.

3. Gently pull the bezel out so that the connector on the power switch
    can be reached.

4. Disconnect the power switch cable.

5. Remove the bezel.
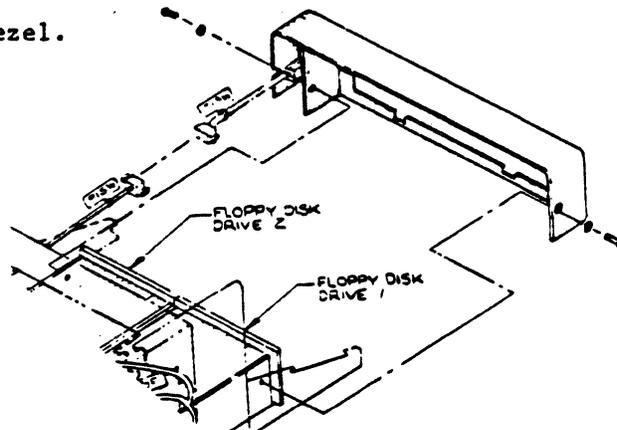
Figure 1-6 Disk Bezel

1-7   DISK CONTROLLER

1-7.1   Disk Controller Removal (when mounted on hard disk [Fig. 1-7])

1. Perform sections 1-1, 1-2, 1-4 and 1-8.

2. Remove the cable from J4 on the disk controller.

3. With a pair of needle nose pliers, compress the locking tabs on the
    4 nylon fasteners (A) and remove them from the disk controller.

4. Remove the remaining phillips screw (B).
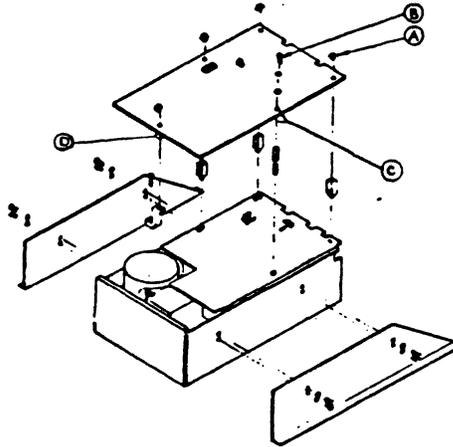
Figure 1-7 Disk Controller with Hard Disk

NOTE: When installing or removing disk controller card, PN 928008, be sure to note proper positioning of insulating washers on top and bottom of PCB at location C. Some early disk controller mounts require an additional insulating washer at location D to prevent the circuitry on the disk controller card from contacting the hard disk frame.

1-7.2 Disk Controller Removal (without hard disk [Fig. 1-8])

1. Perform sections 1-1, 1-2 and 1-4.

2. Disconnect the cable from J1.

3. Remove the 4 phillips screws that hold the controller chassis to the frame of the unit and remove the entire assembly.

4. Remove the 5 phillips screws (A) that fasten the controller to the chassis.
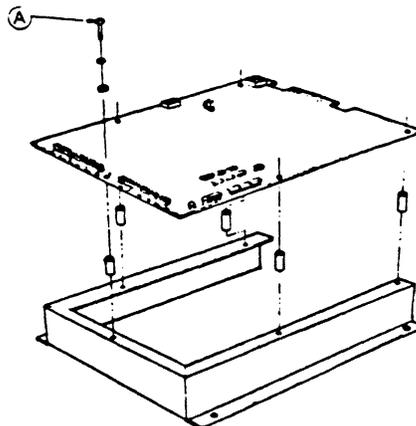
Figure 1-8 Disk Controller without Hard Disk

1-8   HARD DISK

1-8.1 <u>Hard Disk Removal</u> (Fig. 1-7)

CAUTION: DO NOT TILT THE HARD DISK ASSEMBLY. IT MUST REMAIN UPRIGHT!!

1. Perform sections 1-1, 1-2, 1-4 and 1-5.

2. Remove the 2 phillips screws at the back of the hard disk that secure it to the frame.

3. Slide the card cage back slightly and remove the 2 phillips screws from the front of the hard disk that secure it to the frame.

4. Remove the cables from J1, J6, and J9 of the disk controller and from J1, J5, and J4 of the hard disk.

5. Very gently remove the hard disk from the front of the unit.

1-9   DEGAUSSER CONTROLLER

1-9.1 <u>Degausser Controller Removal</u> (Fig. 1-9)

1. Perform sections 1-1, 1-2 and 1-4.

2. Ensure that the power has been disconnected from the unit, i.e., remove AC power cord.

3. Disconnect the AC wires from the terminal block on the AC module and from the connector for the degaussing control (see Figure 1-11).

4. Remove the 4 phillips screws that hold the controller to the frame.

5. Remove the degausser controller.
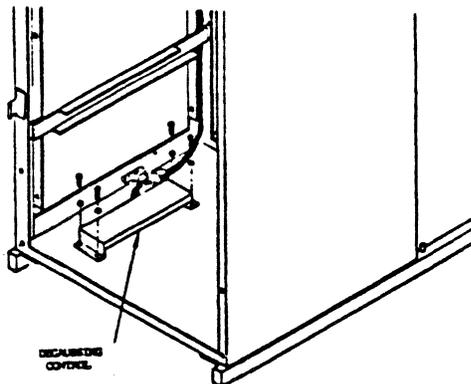
Figure 1-9 Degausser Controller

1-10   AC MODULE

1-10.1 <u>AC Module Removal</u> (Fig. 1-10, 1-11)

1. Perform sections 1-1, 1-2 and 1-4.

2. Remove all labeled wires from terminals 1 through 10 on the AC
    module and connectors J1 and J3 from the 60 cycle sync board (see
    Fig. 1-11).

3. Remove the two phillips screws (A of Fig. 10) from the bottom of
    the module.

4. Tilt the top of the module towards the center of the unit and
    remove the module.
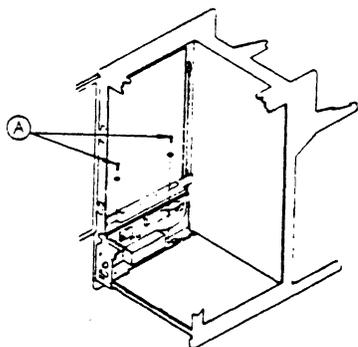
Figure 1-10 AC Module
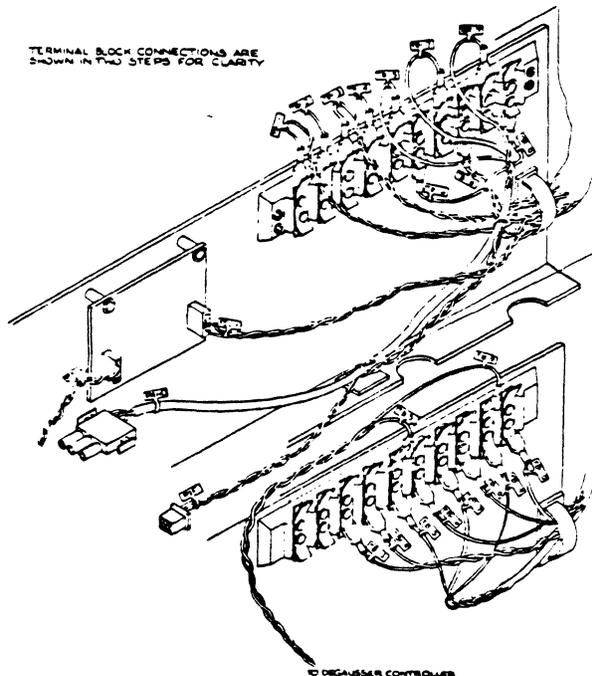
Figure 1-11 AC Module Wiring

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1-11   "A" or "B" POWER SUPPLY

1-11.1 "A" or "B" Power Supply Removal (Fig. 1-12, 1-13)

1. Ensure that the power has been disconnected from the unit.

2. Perform sections 1-1, 1-2 and 1-5.

3. As you are facing the power supplies from the front of the unit, the "A" supply is on the right, and the "B" supply is on the left.

4. Disconnect the 3 plugs (A, B and C of Fig. 1-12) and the terminal strip that is at the top of the power supply.

Mounting screws

Green wire must be down on PS connector
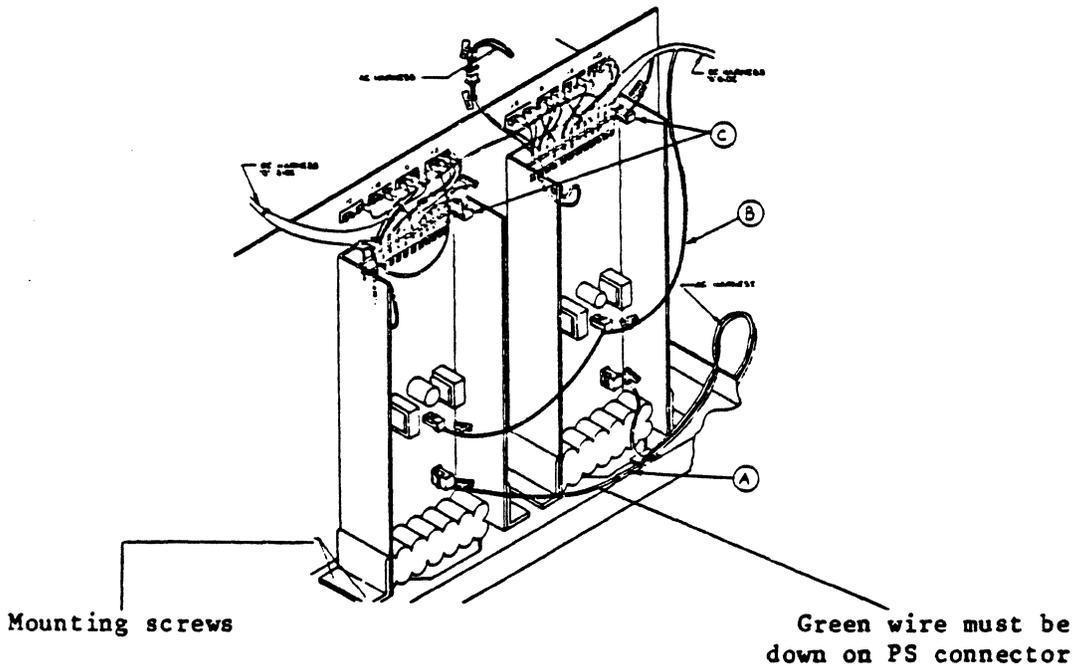
Figure 1-12 Power Supply Connectors

5. At the bottom of the power supply are two brackets that hold it to the card cage frame. Remove the two screws from each bracket (Fig. 1-12).

6. Remove the power supply.
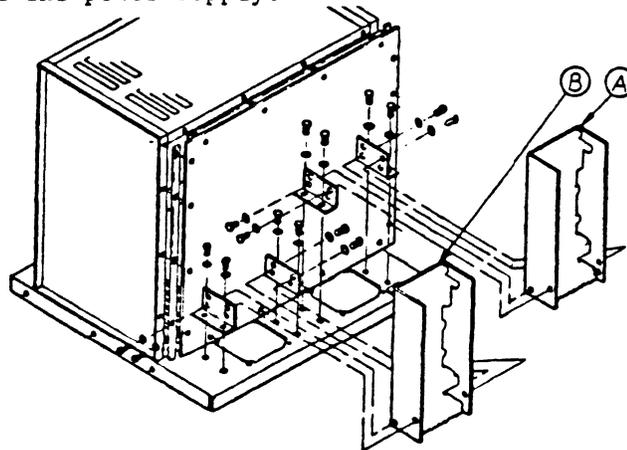
Figure 1-13 Power Supply Mounting

1-12   KEYBOARD

1-12.1 Keyboard Removal (Fig. 1-14)

1. Perform sections 1-1 and 1-3.

2. Underneath the keyboard in each corner is a 1/4" nut with a star washer. Remove the items identified by A in Fig. 1-14.

3. Remove the keyboard cable from the keyboard and the joystick cable from the joystick interface (if it is installed).

4. Remove the keyboard ground wire from terminal #3 of the "A" power supply.

5. Carefully lift the lower edge of the keyboard and then gently slide the keyboard out.
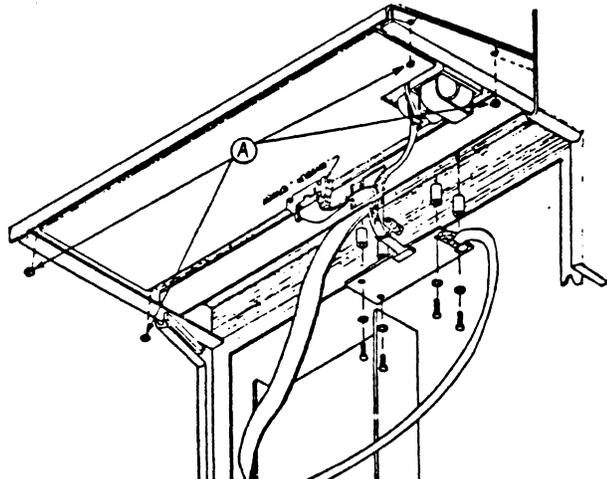
Figure 1-14 Keyboard and Joystick Interface

1-13   JOYSTICK

1-13.1 <u>Joystick Removal</u> (Fig. 1-15)

    1. Perform sections 1-1 and 1-3.

    2. Disconnect the cable from the joystick interface, which is the board located next to the keyboard.

    3. Beneath the keyboard at the joystick are four 1/4" nuts that mount the joystick. Remove these nuts.

    4. Gently remove the joystick from the keyboard.
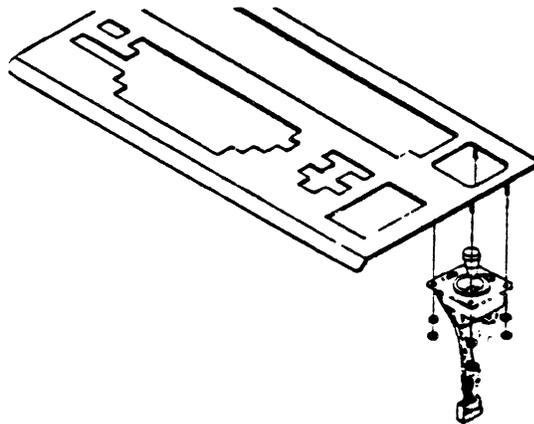
Figure 1-15 Joystick

1-14   JOYSTICK INTERFACE

1-14.1 <u>Joystick Interface Removal</u> (Fig. 1-14)

    1. Perform sections 1-1 and 1-3.

    2. Disconnect both cables from the interface board.

    3. Remove the 4 phillips screws that mount the board to the frame and remove the board.

1-15   FLOPPY DISK DRIVE

1-15.1   Floppy Disk Drive Removal (Fig. 1-16)

    1. Perform sections 1-1, 1-3, 1-6, and 1-12.

    2. Remove the shield from top of floppy drive.

    3. Remove the ribbon cable from the drive and the two power cables.

    4. Remove power supply drain wire from floppy drive chassis.

    5. Each drive has 4 phillip screws that mount it to the frame. These screws are located next to the joystick interface card. Remove the 4 screws.

    6. Carefully remove the drive from the front.

NOTE: To remove drive 1, the 4 screws that mount drive 2 must be removed. This will allow enough play to remove drive 1.
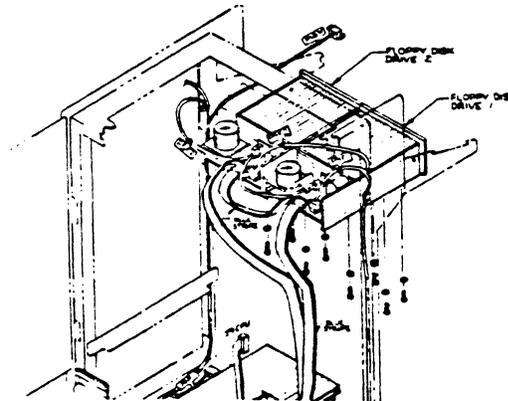
Figure 1-16 Floppy Disk Drive

1-16   TOP COVER

1-16.1   Top Cover Removal (Fig. 1-17)

    1. Remove the two phillips screws from the rear of the top cover. These are located on either side of the heat fins.

    2. Carefully slide the cover back and up until it is clear of the unit.
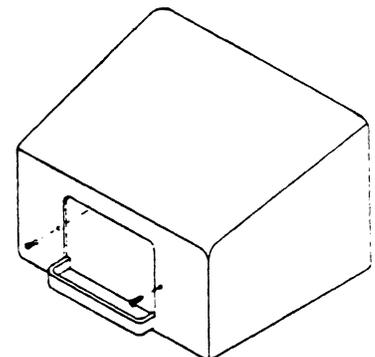
Figure 1-17 Top Cover

1-17   ANALOG CHASSIS

1-17.1 Analog Chassis Troubleshooting Position

1. Perform section 1-16.

2. Fasteners are located at the front corners of the analog chassis. Loosen both fasteners with a straight slot screw driver.

3. Slide chassis back until a second set of fastener receptacles are revealed. Slide chassis forward so that fasteners can be locked in these receptacles.

1-18   BEZEL

1-18.1 Bezel Removal (Fig. 1-18)

1. Perform sections 1-1, 1-3, 1-6 and 1-15.

2. Perform sections 1-16 and 1-17.

3. On the right side of the bezel, remove the convergence adjust board and brightness pot.

4. Disconnect the cables for the degaussing coil and degaussing switch.

5. If the unit has a light pen, remove the two phillips screws from the plate at the back of the light pen housing. Pull the plate and cable back until the connector can be unplugged (see Fig. 1-19).

6. On the CPU card, unplug the ribbon cable for the bezel switches and feed the cable up past the analog chassis.

7. Inside the floppy drive opening are 3 phillips head screws that fasten the bezel to the lower frame. Remove these screws.

8. Remove the 3 countersunk phillips screws from the top of the bezel.

9. Remove the bezel assembly.
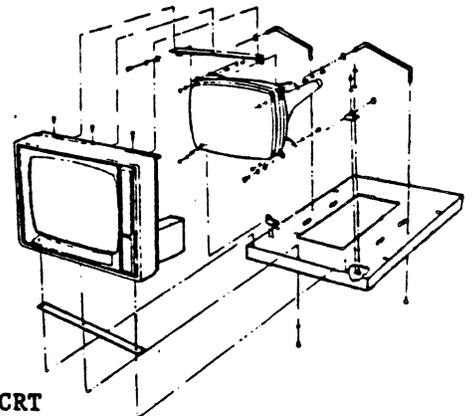
Figure 1-18 Bezel Assembly and CRT

1-19   CRT

1-19.1   <u>CRT Removal</u> (Fig. 1-18)

   1.   Perform sections 1-1, 1-3, 1-6 and 1-15.

   2.   Perform sections 1-16, 1-17 and 1-18.

   3.   Remove the CRT socket, purity rings, convergence coils, and yoke from the neck of the tube.

   4.   Remove the anode cap and the grounding straps.

   5.   Remove the bolts from each corner of the CRT.

   6.   Very carefully remove the CRT.

1-20   DEFLECTION MODULE

1-20.1   <u>Deflection Module Removal</u>

   1.   Perform sections 1-16 and 1-17.

   2.   Disconnect all of the cables from the deflection module.

   3.   Remove the 6 phillips screws from the rear of the heat fins that secure the deflection module heatsink.

   4.   Unsnap the two black latches at the front of the board.

   5.   From the rear of the unit, remove the deflection module out the right side.

1-21   HIGH VOLTAGE MODULE

1-21.1   <u>High Voltage Module Removal</u>

   1.   Perform sections 1-16 and 1-17.

   2.   Disconnect all of the cables from the high voltage board and remove the anode cap and the ground strap from the CRT.

   3.   Remove the two phillips screws from the front bracket and the two phillips screws from the heat fin that secures the high voltage heatsink.

   4.   Remove the high voltage module.

1-22   VIDEO AMPLIFIER

1-22.1 Video Amplifier Removal

    1. Perform sections 1-16 and 1-17.

    2. Disconnect all of the cables from the video amp.

    3. Remove the 4 phillips screws from the back of the heatfins that secure the video amp.

    4. Remove the video amp.

1-23   BEZEL KEYS

1-23.1 Bezel Key Removal

    1. Perform sections 1-16 and 1-17.

    2. Cut the tie wrap that secures the connector where the clear cable from the bezel keys and the blue ribbon cable meet. This is located under the analog chassis.

    3. Cut away the black shrink tubing from the connector and remove the bezel key cable from the connector.

    4. Pull the bezel key pad from the bezel.

1-24   CONVERGENCE ADJUST BOARD

1-24.1 Convergence Adjust Board Removal

    1. Perform section 1-16.

    2. Unsnap the 4 latches that hold the board to the bezel.

    3. Disconnect the convergence cable.

1-25   LIGHT PEN

1-25.1 <u>Light Pen Removal</u> (Fig. 1-19)

1. Perform section 1-16.

2. Remove the two phillips screws from the retainer plate that holds the connector to the rear of the light pen housing.

3. Pull the cable and light pen out the rear of the housing through the hole.

4. Disconnect the light pen from the cable.
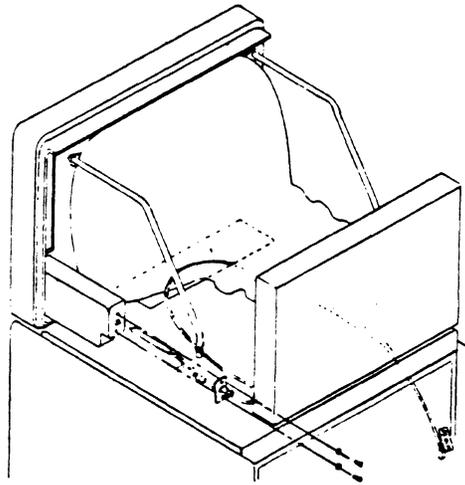
Figure 1-19

CHROMATICS, INC.

CGC 7900 COLOR GRAPHICS COMPUTER SYSTEM

cu PATCH

Chromatics Idris Addendum Update

Ver_3z

Document Number 070244

Printed February, 1984

NAME

cu - call up a computer

SYNOPSIS

cu -[s* l* w# h e]

FUNCTION

cu connects your terminal to another tty file, referred to as a "link". Each character you type is written to the link, and a receive process started by cu reads each character from the link and writes it to your terminal. To another computer this link line appears to be a terminal; the link can be hardwired or connected via modem.

cu is mostly transparent, except that some escape sequences you can type cause local action. You may send or receive files over the link, which is done with or without an error checking protocol, depending upon whether you are talking to another Idris system or to alien software. You may also run local Idris commands by invoking a shell process, much the same as from the editor.

The flags are:

-s* set the speed of the link to *. The link speed must match the speed of the remote computer and your terminal. The speed can be one of the baud rates {0, 50, 75, 110, 134.5, 150, 200, 300, 600, 1200, 1800, 2400, 4800, 9600, exta, or extb}. The default is 1200 baud.

-l* define the name of the link file to be *. The default is /dev/lnk0, which is usually an alias for a free tty file.

-w# write # characters per second to the link when transmitting a file (< file, described below). Default is 100, meaning that cu will write 100 characters then sleep for one second. This value depends on the link speed, and the ability of the remote computer to absorb the characters.

-h places cu into half duplex mode. This mode can be used when the host computer does not echo the characters sent by cu back to cu (full duplex). The default is full duplex.

-e causes cu to place the link file into the following mode: 7 data bits, even parity, 1 stop bit, and raw mode (unbuffered). The default is raw mode; 8 data bits, no parity, 1 stop bit.

-o causes **cu** to place the link file into the following mode: 7 data bits, odd parity, 1 stop bit, and raw mode (unbuffered). The default is raw mode; 8 data bits, no parity, 1 stop bit.

Escape sequences begin with a backslash '\'. Nothing is echoed when you type the backslash; **cu** waits for the next character typed. The following escapes are recognized by **cu**, but not by the receive process:

\<filename write the file filename on the local system to the link. The sending speed is governed by the '-w' flag described above. **Cu** takes its input from this file instead of your terminal, until end of file. The characters are sent with no protocol. There need be no cooperating software in the remote computer; you appear to be a very fast typist. This sequence should be used when uploading (sending) files to the NIH/IBM computer.

\ctl-Q # turn throttling on or off. If the digit # is 1 to 9, # is the number of seconds between the automatic transmission of ctl-S and ctl-Q. The delay between them is always one second. If # is 0, or anything else, throttling is turned off. Throttling can be a useful feature if your system is slow, or if you are reading into a file (see **\>** file below), provided that the remote computer honors the throttling protocol.

\u -[u l* o* p* a*] <files> send <files> from your system "uplink" to the remote Idris system in a packet format, with error checking. At the remote end, you must invoke the **up** utility first, which receives the filenames and packets and builds the files in the remote computer. The **\u** command actually starts the **dn** program to do the file transfer. **Dn** can deal with multiple files, and can construct new pathnames based on the flags. See the manual page on **dn** for details.

\q   quit. The link is closed and **cu** exits.

\!<command> execute a shell command. All characters you type after **\!** up
     to the next carriage return or line feed are assembled into a command
     line with "sh -c" prepended and passed to a shell process. **cu** waits
     for the invoked shell to terminate.

The following escape sequences are recognized by the receive process.
These must be presented by the remote computer either by running a program
or by causing them to be echoed:

\> **[>*]file** read all input from the link into the file named. A leading **>**
     means append to the end of the file, don't clear the parity bit of
     each character received. This permits binary files to be transferred,
     provided the data link is transparent to eight-bit bytes.

All output from the remote computer is sent to the file named on your
system; if the file cannot ve created, the output comes to the terminal.
Once output is redirected to a file, the only escape sequence recognized
is **\.** which closes the file and resumes output to the terminal.

RETURNS
     cu returns success if the link was established.

EXAMPLE
     % **cu** -s9600 login:

FILES
     /bin/dn for **\u** command, **/odd/alarm** for read timeout, **/odd/recv** for
     receiving the link, **/odd/throttle** for sending ctl-S and ctl-Q
     automatically.

SEE ALSO
     dn, up

BUGS
     Interrupting packet mode transmission can be a problem. The **delete** key
     interrupt will stop the **\u** command; however you may need to type **\.** twice
     to get the remote up utility to exit. The **delete** key will interrupt the
     remote system during **\>** (receive into local file); however you cannot see
     anything at your terminal until you get **\.** echoed. **\q** will fix everything
     -- it exits **cu** and disconnects the link.

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CHROMATICS, INC.

CGC 7900 COLOR GRAPHICS COMPUTER SYSTEM

INSTRUCTIONS FOR INSTALLING EPROMS

Document Number   070231A

Printed November 9, 1984

PRODUCT LINE: CGC 7900

PROCEDURE   :   INSTRUCTIONS FOR INSTALLING EPROMS

_____

- Each EPROM you have received has an address marked on it. Example: 800K E

- Find an appropriate corresponding address for each EPROM on the enclosed diagrams.

- Open back door of 7900 to expose the appropriate computer circuit board(s) you need.

- Disconnect any flat cable(s) from the board(s) you need after making sure that power to the unit is OFF. Remember the order they are in so that you can replace them properly when necessary to do so.

- Remove the board(s) from the computer card cage by pulling the ejector handles and sliding the board(s) straight out.

- Locate the appropriate EPROM socket(s) you need by comparing the board(s) with the enclosed diagrams.

- If there is already an EPROM installed in the socket(s) you need, remove it. Return to Customer Service Department at Chromatics, Inc.

- Install the new EPROM(s) into the corresponding address socket(s). Make sure you push the new EPROM(s) in EVENLY AND FIRMLY to ensure that they make good contact with the socket without any pins getting bent or broken.

- Now check the newly installed EPROM(s) for bent or broken pins and loose connections.

- Reinstall the circuit board(s) into the computer card cage. The board(s) may be difficult to put back, but press firmly until the card locks into the cage.

- Reconnect any flat ribbon cable(s) that were removed earlier.

- Close back door.

- Turn power ON and do a master RESET. (Press M1-M2-CTRL-SHIFT RESET immediately to set the unit to operate with the new software.)

If you run into a problem or have questions on this procedure, please do not hesitate to contact the Customer Service Department at the factory for assistance.

PARTS LAYOUT

	RP1A	UB7		
	RP0A	UB8		
	RP2A	UB9		
IDRIS or ACT, GTCO	UE12	80EK Even	80EK Odd	UF12
DOS or CAEMODS	UE13	80CK Even	80CK Odd	UF13
MONITOR	UE15	80AK Even	80AK Odd	UF15
OPMODS	UE18	808K Even	808K Odd	UF18
	UE20	806K Even	806K Odd	UF20
	UE21	804K Even	804K Odd	UF21
TermEm	UE22	802K Even	802K Odd	UF22
	UE24	800K Even	800K Odd	UF24

ASSY 100388 (old PN 100063)
RASTER PROCESSOR © 1980
CHROMATICS, INC.
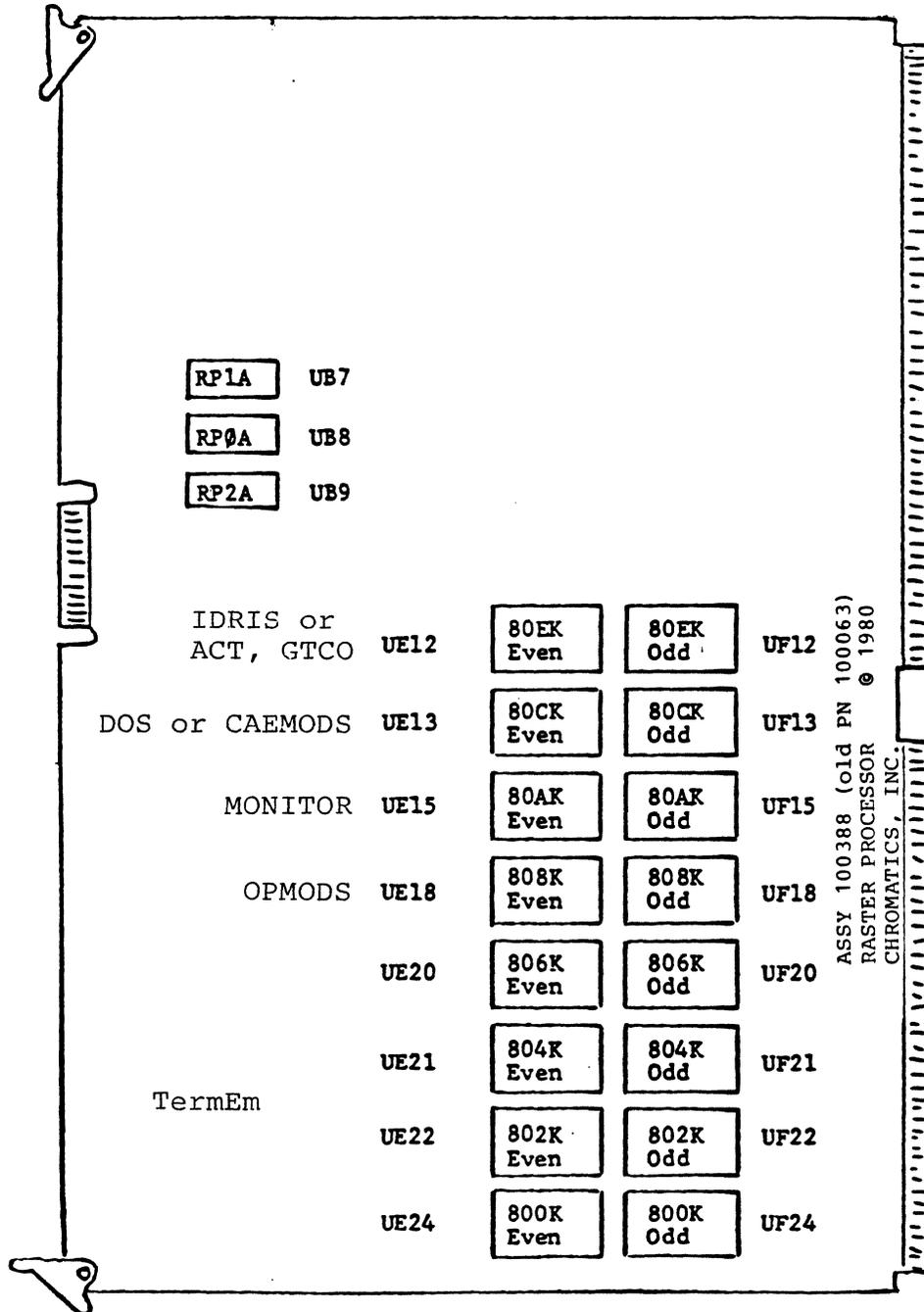
CHROMATICS

CGC 7900 COLOR GRAPHICS COMPUTER SYSTEM

OPTION 7920-01

128K BITMAP REFRESH MEMORY BOARD

Field Installation Instructions

Document Number 070243

Printed February 15, 1984

PRODUCT LINE: CGC 7900

OPTION   : 7920-01 - 128K BITMAP REFRESH MEMORY BOARD

PROCEDURE   : FIELD INSTALLATION INSTRUCTIONS

REFRESH RAM CARD

Description:

These instructions are for adding or swapping a bitmap
refresh memory card in the CGC 7900. Please follow these
instructions carefully as there are six jumpers and a switch
that need to be configured properly in order for the board to
work correctly.

The mother board that the digital cards plug into is a
universal bus. Therefore, the refresh card can be plugged
into any card slot. The switch setting and jumper plug
locations determine which address range that card will
respond to and therefore which plane that card will be. The
planes are numbered zero through 15. That is, planes zero
through seven in image 0 and planes eight through 15 in image
1. Determine for which plane you want the card to be set and
then follow the procedure outlined below for the proper
configuration of the card.

Procedure:

   1. Turn the power off.

   2. Open the back door of the 7900.

   3. If a refresh card is being replaced, then locate and
       remove that card.

   4. Refer to figure 1 for the location of the rotary switch
       and the jumper plugs.

J1 ——————— J2

J3 ——————— J4

switch ———————▶ This switch can appear in
                 either of these positions
                 depending upon the rev of
                 the board.
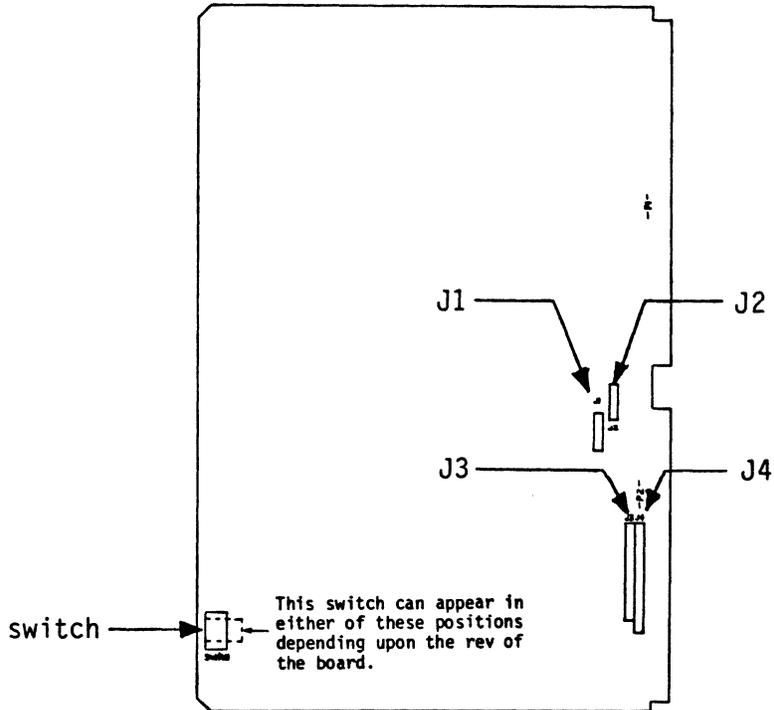
figure 1

5. Rotate the switch until the arrow points to the number
    of the plane you are configuring (0-7 for image 0 or
    8-F for image 1).

6. Refer to figure 2.   Locate header J1 (image 0) and move
    the shorting plug to the pins that correspond to the
    plane number (i.e., pin 5 for plane 4).   Be careful to
    note that the pin number is not the same as the plane
    number.   This selection must be for the same plane
    number that the switch is set for.   Header J2 is for a
    second image. There should be no shorting plugs on this
    header if the card is being set for image 0.
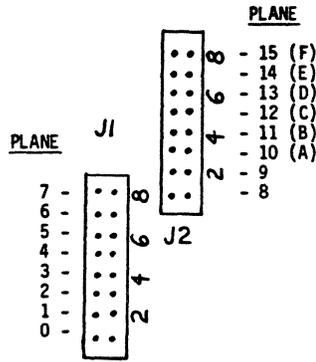
figure 2

7. Refer to figure 3. Locate header J4 and jumper pin 1 to select image 0 or pin 2 for image 1.
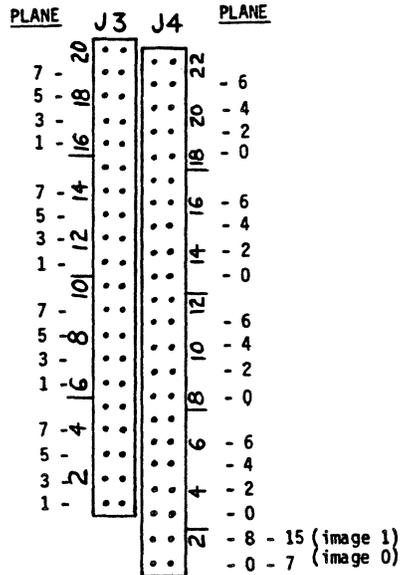
figure 3

8. Now move the shorting plugs to the appropriate pins on J3 or J4 to configure it for the plane you have selected.

9. If this procedure was used to swap a refresh card, then go to step 10.   If a new card is being added, you will need to remove the Color Lookup board.   This board will be the fourth board from the left.   Refer to figure 4. Locate header J9.   This header has eight sets of pins, one set for each plane.   The shorting plugs should be installed in the proper pin location if that plane is NOT installed in the system.   If a plane is being added, then remove the shorting plug which corresponds to that plane number.   Reinstall the Color Lookup board into the system.
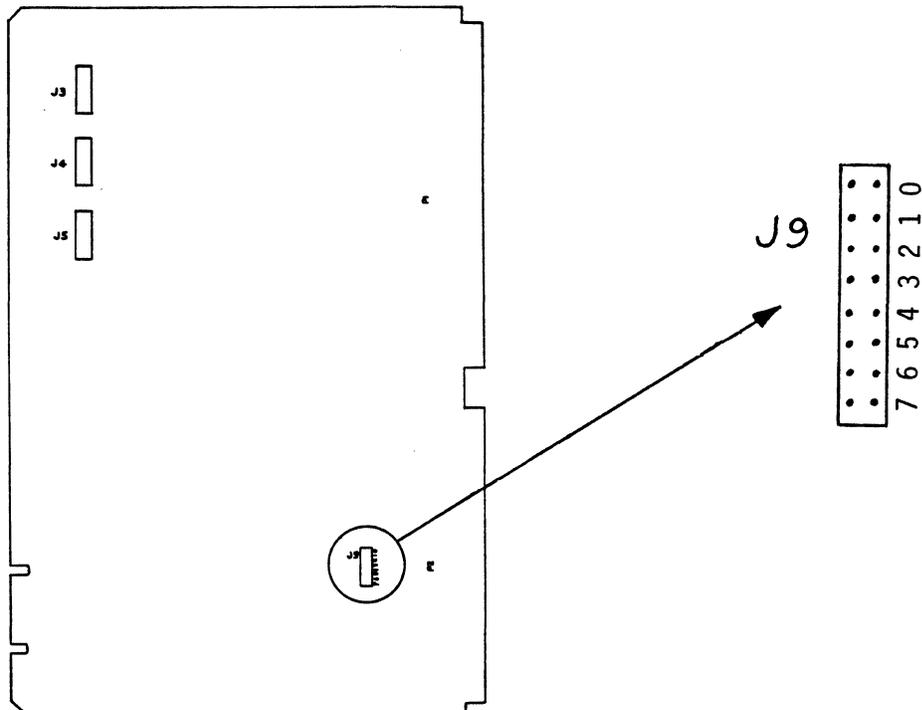
figure 4

10. Turn   the   power   on.   Go   into   bitmap   by   pressing
     <SHIFT><OVERLAY>.   The light in the OVERLAY key should
     go out and the cursor on the screen should be very small.
     The screen should be black except for the cursor.   Do
     the following sequence: <SHIFT><SET><WHITE><ERASE PAGE>
     and the screen should be all white.   If you have the
     joystick   option,   do   the   following   sequence:
     <USER><\><1> and use the joystick to move the cursor
     around the screen.   Make sure that when the cursor moves
     it does not leave a trail of cursors behind it.   Now,
     hold down the <M1> key and move the joystick, making
     sure that the color of the screen changes.   If you do
     not have the joystick option, then do the following
     sequence: <CHANGE><WHITE><255,0,0,> and the screen
     should change from white to red.

If any of the tests in step 10 do not seem to function
properly, then recheck the switch and jumper settings you
made on the refresh or color lookup cards.   If these were
done correctly and step 10 still does not work, call
Technical Services for assistance.

CHROMATICS

CGC 7900 COLOR GRAPHICS COMPUTER SYSTEM

OPTION 7921-01

128K MEMORY MODULE

Field Installation Instructions

Document Number 070236A

Printed September 2, 1983

PRODUCT LINE: CGC 7900

OPTION   :   7921-01 - 128K MEMORY MODULE

PROCEDURE   :   FIELD INSTALLATION INSTRUCTIONS

Configuring Buffer Memory Cards

The two rotary switches on the edge of the Buffer Memory card determine the card's address. To set up a card, perform the following steps:

1. Determine what the memory address of the card should be.   One card must have address 000000; and if other cards are installed, they normally will have consecutive addresses following the first card. Consult the table below to see what switch settings correspond to the card's desired memory address.

    NOTE: The 7900 memory map requires that Buffer Memory cards be addressed below 800000.

    NOTE: All possible memory addresses require that the first switch be set to a number between 0 and 7. THE SYSTEM WILL FAIL if the left-hand switch on the card is set to 8 or higher!

2. Arrange the card so that the component side is up, and the gold edge connector is pointing away from you. The two rotary switches should now be visible on the right side of the card's rear edge.

3. Using a small screwdriver, set the two switches so that the arrow on the left switch is pointing to the first digit of the required setting, and the arrow on the right switch is pointing to the second digit. For example, if you are installing a card at address 020000, the table says that the correct setting is 01. Set the left switch to 0 and the right switch to 1.

    (Some switches may not be marked at the odd-numbered positions. If yours is not, assume that Position 1 lies halfway between 0 and 2, and so on.)

7921-01 - 128K Memory Module
Page Two

BUFFER MEMORY CARD ADDRESS SELECTION

Switch Position	Memory Address	Switch Position	Memory Address	Switch Position	Memory Address
00	000000	2C	580000	58	B00000
01	020000	2D	5A0000	59	B20000
02	040000	2E	5C0000	5A	B40000
03	060000	2F	5E0000	5B	B60000
04	080000	30	600000	5C	B80000
05	0A0000	31	620000	5D	BA0000
06	0C0000	32	640000	5E	BC0000
07	0E0000	33	660000	5F	BE0000
08	100000	34	680000	60	C00000
09	120000	35	640000	61	C20000
0A	140000	36	6C0000	62	C40000
0B	160000	37	6E0000	63	C60000
0C	180000	38	700000	64	C80000
0D	1A0000	39	720000	65	CA0000
0E	1C0000	3A	740000	66	CC0000
0F	1E0000	3B	760000	67	CE0000
10	200000	3C	780000	68	D00000
11	220000	3D	7A0000	69	D20000
12	240000	3E	7C0000	6A	D40000
13	260000	3F	7E0000	6B	D60000
14	280000	40	800000	6C	D80000
15	2A0000	41	820000	6D	DA0000
16	2C0000	42	840000	6E	DC0000
17	2E0000	43	860000	6F	DE0000
18	300000	44	880000	70	E00000
19	320000	45	8A0000	71	E20000
1A	340000	46	8C0000	72	E40000
1B	360000	47	8E0000	73	E60000
1C	380000	48	900000	74	E80000
1D	3A0000	49	920000	75	EA0000
1E	3C0000	4A	940000	76	EC0000
1F	3E0000	4B	960000	77	EE0000
20	400000	4C	980000	78	F00000
21	420000	4D	9A0000	79	F20000
22	440000	4E	9C0000	7A	F40000
23	460000	4F	9E0000	7B	F60000
24	480000	50	A00000	7C	F80000
25	4A0000	51	A20000	7D	FA0000
26	4C0000	52	A40000	7E	FC0000
27	4E0000	53	A60000	7F	FE0000
28	500000	54	A80000		
29	520000	55	AA0000		
2A	540000	56	AC0000		
2B	560000	57	AE0000		

CHROMATICS, INC.

CGC 7900 COLOR GRAPHICS COMPUTER SYSTEM

OPTION 7922-01

4K CMOS RAM & RTC

Installation Procedure

Document Number 070260

Printed November, 1984

INSTALLATION PROCEDURE 7922-01
4K CMOS RAM & RTC; BATTERY BACKUP

1a. Remove CPU Board Assy from card cage.

1b. Remove 8 each 2114 type IC's at locations UD4, UD5, UD6, UD7, UD8, UD9, UD10, and UD11 from sockets and replace with new 6514 type.

1c. Install IC type 58167 at location UC6.

1d. Move the shorting plug at location J12 from VCC postion to CMOS position. Remove the shorting plug at location J14.

1e. Reinstall CPU Board Assy into card cage.

2.   Install IC type HCPL-3700 into location U2 on the 60 Cycle Sync Board Assy (located in the AC Module below the card cage).

3.   Install the 060 64 Cable Assy between the CPU Board Assy (plug connector marked P15CPU into J15 on board) and the 60 Cycle Sync Board Assy (plug connector marked P3CY into J3 on board).

PARTS LIST

8 each 6514   IC Chromatics Part No. 200150
1 each 58167   IC Chromatics Part No. 200152
1 each HCPL-3700 IC Chromatics Part No. 200167
1 each Cable Assy   Chromatics Part No. 060064

SIZE	CODE IDENT NO.	DRAWING NO.		
		(7922-01)		
SCALE			SHEET 1 of 1	

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CHROMATICS

CGC 7900 COLOR GRAPHICS COMPUTER SYSTEM

OPTION 7923-01

512K Buffer Memory

User Information

Document Number 070242A

Printed July 27, 1983

Telephone (404) 493-7000
TWX 810-766-8099

PRODUCT LINE: CGC 7900

OPTION   :   7923-01 - 512K BUFFER MEMORY

PROCEDURE   :   USER INFORMATION

_____

DESCRIPTION: The 1/2 megabyte buffer memory card consists of one
                standard size CGC 7900 digital circuit board containing
                512K bytes of user space for the 7900 programs. The
                board uses 64K dynamic RAMs arranged in four separate
                128K-byte banks. The board has single-bit parity error
                detection on each and every byte of each 128K bank.
                This board, with no other buffer memories in the system,
                satisfies the minimum system requirements for the Idris
                Operating System.

PURPOSE: To describe how to configure the 1/2 megabyte Buffer
                Memory for use in the CGC 7900 operating under standard
                Chromatics versions of DOS and TERMEM or Idris.

PRODUCT TESTING: The 1/2 megabyte buffer memory will be tested like
                any other buffer memory in the system.

SPECIAL PRODUCT NOTE: The single-bit parity detection will operate
                correctly only under TERMEM 1.2 and all successive
                releases of TERMEM. Any unit already in the field must
                first have the above mentioned version of TERMEM and a
                jumper installed at location J6 in the circuit board.

SWITCH SETTINGS: The board has five rotary switches along the card edge
                which are used for positioning the board in the
                desired location in the system memory map. Switch S1
                positions the entire board inside one of the eight
                available two-megabyte memory pages of the 7900 memory
                map. Each of the four 128K banks can then be switched
                anywhere inside the two-megabyte page by the use of
                switches S2 thru S5. The switch settings versus memory
                page selections are as follows:

Switch Settings for Switch S1
1/2 Megabyte Buffer Memory

Switch Position	Memory Page Address Boundaries
0	000000-1FFFFF (hex)
1	200000-3FFFFF (hex)
2	400000-5FFFFF (hex)
3	600000-7FFFFF (hex)
4	800000-9FFFFF (hex)
5	A00000-CFFFFF (hex)
6	D00000-DFFFFF (hex)
7	E00000-FFFFFF (hex)

Switches S2 thru S5 position each of the four 128K memory banks on the board somewhere within the two-megabyte memory page selected by S1. The switch settings versus memory map position are as follows:

Switch Position	Memory Address Within Page
0	(x)00000-(x)1FFFF (hex)
1	(x)20000-(x)3FFFF (hex)
2	(x)40000-(x)5FFFF (hex)
3	(x)60000-(x)7FFFF (hex)
4	(x)80000-(x)9FFFF (hex)
5	(x)A0000-(x)BFFFF (hex)
6	(x)C0000-(x)DFFFF (hex)
7	(x)E0000-(x)FFFFF (hex)
8	(x+1)00000-(x+1)1FFFF (hex)
9	(x+1)20000-(x+1)3FFFF (hex)
A	(x+1)40000-(x+1)5FFFF (hex)
B	(x+1)60000-(x+1)7FFFF (hex)
C	(x+1)80000-(x+1)9FFFF (hex)
D	(x+1)A0000-(x+1)BFFFF (hex)
E	(x+1)C0000-(x+1)DFFFF (hex)
F	(x+1)E0000-(x+1)FFFFF (hex)

x=2,4,6,8,A,C,E as selected by switch S1 above.

JUMPER OPTIONS DEFINITIONS: There are five jumper pad designations which must be considered when configuring a 1/2 megabyte buffer board:

J6   Install only if single bit parity detection is desired. **

J7   Has four jumpers associated with its designation. Each of the four defines the type of access which can be made to this particular 128K bank of memory. Refer to Figure 1 for the types of accesses versus jumper position.

J8   Has four jumpers associated with its designation. Each of the four defines the type of access which can be made to this particular 128K bank of memory. Refer to Figure 1 for the types of accesses versus jumper position.

J9   Has four jumpers associated with its designation. Each of the four defines the type of access which can be made to this particular 128K bank of memory. Refer to Figure 1 for the types of accesses versus jumper position.

J10   Has four jumpers associated with its designation. Each of the four defines the type of access which can be made to this particular 128K bank of memory. Refer to Figure 1 for the types of accesses versus jumper position.

SD   Supervisory Data
SP   Supervisory Program
UD   User Data
UP   User Program

Access Type Versus Jumper Position

1/2 Megabyte Buffer Memory

(Refer to the following page for jumper
pad designation)

USER DATA
USER PROGRAM
SUPERVISORY DATA
SUPERVISORY PROGRAM

USER DATA
USER PROGRAM
SUPERVISORY DATA
SUPERVISORY PROGRAM

UF1   UH1

139

J7   J8

UF2

J9   J10

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Figure 1

Circuit Side   Component Side

S1

S2

S3

S4

S5
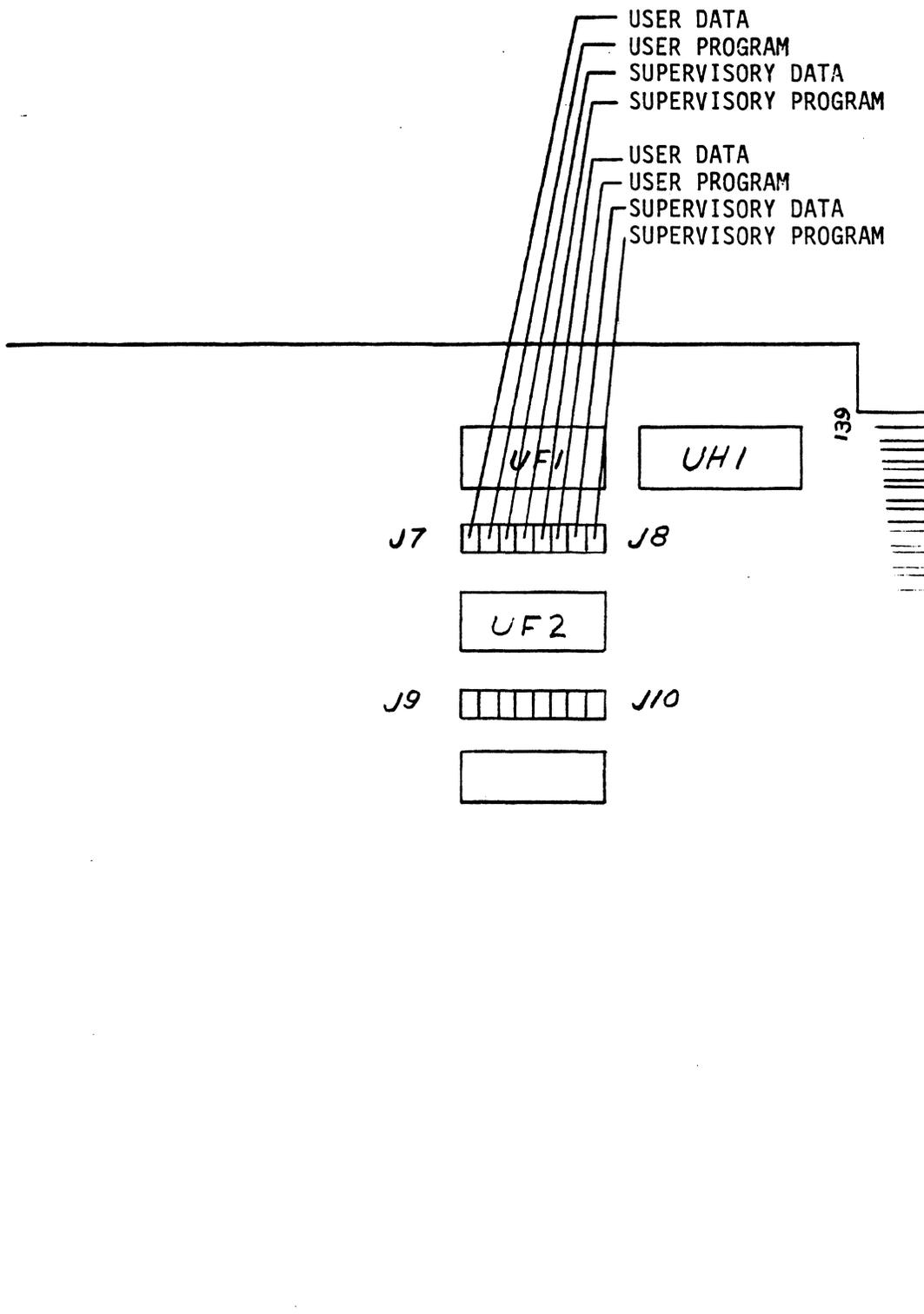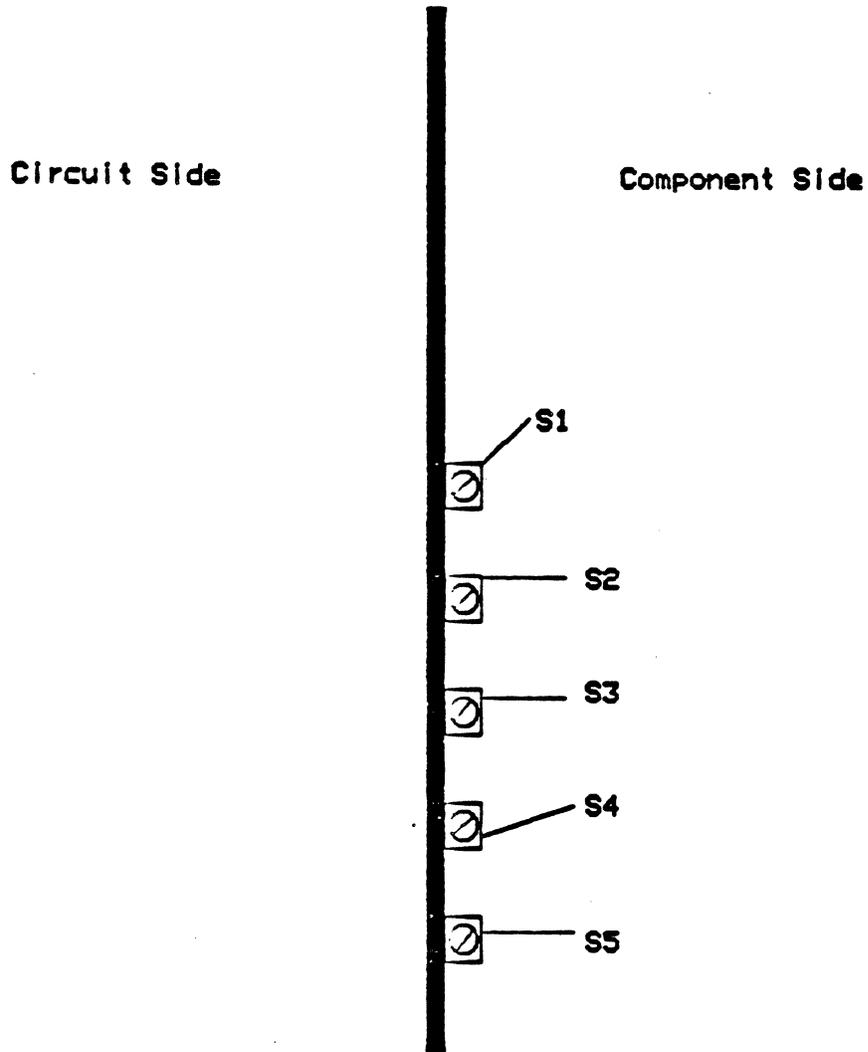
Card edge view of the 1/2 Megabyte Buffer Memory

CHROMATICS

CGC 7900 COLOR GRAPHICS COMPUTER SYSTEM

OPTION 7924-01

7900 ROM EXPANDER

Installation and Configuration

Document Number 070220A

Printed August 10, 1983

PRODUCT LINE: CGC 7900

OPTION   : 7924-01 - 7900 ROM EXPANDER

PROCEDURE   : INSTALLATION AND CONFIGURATION

_____

Section 1 - Introduction

1.1 General

The CGC 7900 ROM Expander is intended to expand the present EPROM capacity of the 7900 beyond the 64k contained on the Raster Processor board. The ROM Expander board accepts up to 128k of memory in two banks of EPROM sockets; each bank has a capacity of 64k bytes and can be located inside the 7900 memory map from 800000 to 880000 hexadecimal. Up to four ROM Expanders may reside in one 7900 system, allowing a possible 1/2 megabyte of EPROM. The board uses 350 nanosecond (or faster) 2532 EPROMs, a 4k by 8 bit part.

The ROM Expander also can be optioned to accept up to 64k of 4016-20NP 200 nanosecond 2k x 8 static RAMs instead of EPROMs. Each bank can contain up to 32k of RAM. This could be used as a small scratchpad memory for the CPU or for developing programs which eventually will be burned into EPROM. The jumpers located at positions J3 through J10 on the circuit board decide whether a bank is going to be static RAM or EPROM. One bank can be configured for static RAM and the other for EPROM. See Figure 1 for the locations of the jumper sockets.

One of the banks can be set to be used by the 68000 at power up instead of the EPROM located on the Raster Processor. Jumpers J1 and J2 control this action for the lower and upper banks, respectively. The procedure is described further in Section 2.

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Figure 1 - ROM Expander Board Layout
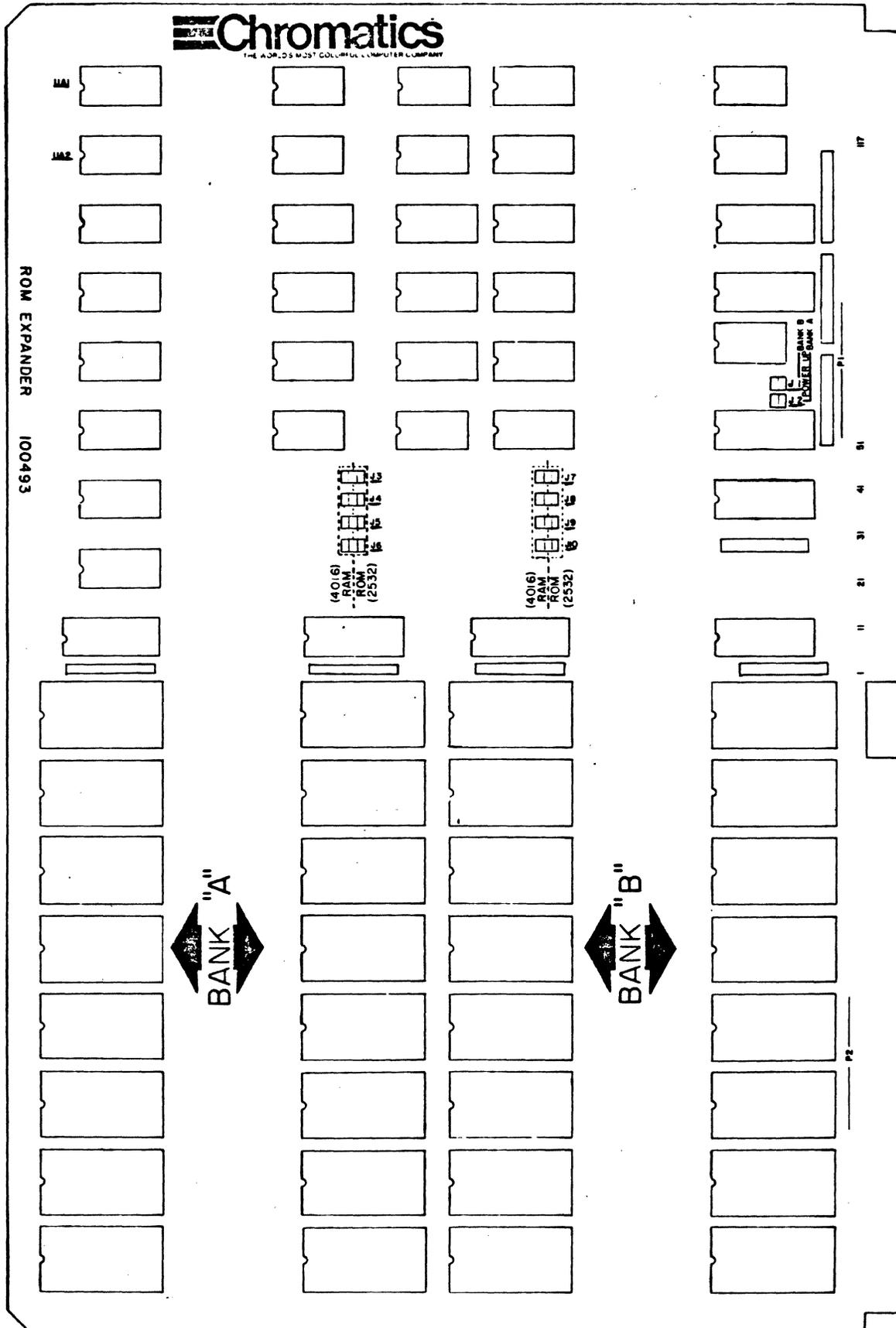
Section 2 - Installation Procedures

2.1 Installation Procedure (without Power-up)

The following is a step-by-step procedure for configuring and install-
ing the ROM Expander.

1. Put static RAMs or EPROMs in one or both banks of the ROM
    Expander board. Do not put both EPROMs and static RAM chips in
    the same bank.

2. Configure each memory bank for RAM or EPROM operation as shown in
    Table 2.

3. Set the base address for each bank by setting switches UA1 and
    UA2 as shown in Table 1. NOTE: Setting both banks to the same
    base address will cause system failure!

4. Insert the board into an empty slot on the 7900 card cage. Make
    sure it is aligned properly and that it is seated firmly in the
    backplane.

2.2 Installation Procedure (with Power-up)

If the ROM Expander is to be used by the 68000 at power-up instead of
the EPROM on the Raster Processor, a jumper on the Raster Processor
must also be changed.

At power-up (or external RESET), the 68000 fetches its stack pointer
and program counter as two 32-bit words from addresses 000000 and
000004, respectively. Circuitry on the Raster Processor maps
addresses 800000 and 800004 into this space. Thus, these two long
words should contain the initial values of the stack pointer and the
program counter. If one of the banks of the ROM Expander board is to
be used at power-up, the same format must be followed by the program
placed in that bank.

If the ROM Expander is to be used at power-up, follow this procedure:

1. Remove the Raster Processor board from the card cage.

2. Locate UE2 on the Raster Processor board and pull UE2 pin 11 through to the top of the board.

3. Connect pin 11 of UE2 to pin 14 of UE2. The Raster Processor EPROM is now disabled.

4. Return the Raster Processor board to its slot in the card cage.

5. Put the EPROMs in the bank on the ROM Expander board which will be used at power-up. The other bank can hold either static RAM or more EPROM.

6. Follow steps 2 and 3 of Section 2.1.

7. Depending on which bank is to be used at power-up, install either jumper J1 or J2 as shown in Table 2.

8. Insert the board into an empty slot in the 7900 card cage. Make sure the board is aligned properly and that it is seated firmly in the backplane.

2.3 ROM Installation

When putting EPROMs in the board, follow this format. Put the board in front of you as you see it in Figure 1.

1. ROMs marked "EVEN" go in the left-hand sockets of the bank. "ODD" ROMs go in the right-hand sockets.

2. The base address for each bank is determined by switches UA1 and UA2. The ROMs in the bottom sockets are located at this base address.

Switch locations are at UA1 and UA2.
Switch UA1 sets Bank B, UA2 sets Bank A.

Switch Setting (UA1 or UA2)	ROM Base Address	RAM Base Address
0	800000	800000
1	-NA-	808000
2	810000	810000
3	-NA-	818000
4	820000	820000
5	-NA-	828000
6	830000	830000
7	-NA-	838000
8	840000	840000
9	-NA-	848000
A	850000	850000
B	-NA-	858000
C	860000	860000
D	-NA-	868000
E	870000	870000
F	-NA-	878000

NOTE: Odd switch settings should not be used for EPROM.

Table 1. Switch Settings Vs. Memory Map Position

Configuration	RAM	ROM	Power-up (ROM ONLY)
BANK A	J3-J6 Up	J3-J6 Down	J2 In
BANK B	J7-J10 Up	J7-J10 Down	J1 In

Table 2. Jumper Options

CHROMATICS, INC.

CGC 7900 COLOR GRAPHICS COMPUTER SYSTEM

OPTIONS 7930-01 / 7930-03

USER-D PATCH

User's Guide

Document Number 070238

Printed November 9, 1984

I. INTRODUCTION

The **USER D** firmware patch contains a software modification that will enhance the current **DMA** driver in the Terminal Emulator(**TermEm**) to allow it to be used with timesharing versions of **Digital Equipment Corporation(DEC)** equipment using the **DR11** interface. Previously, only single-user versions of this equipment were compatible with the CGC 7900. Currently, our customer base is expanding to the use of the **VAX** machines.

The problem arises from a protocol error occurring during the handshaking sequence between the CGC 7900 and the **DEC** host. This sequence dictates that before the **DMA** transfer begins, the **DEC** must assert a special signal on the interface known as **READY**. The assertion of this signal informs the user device(CGC 7900) that the **DR11** interface is initialized and is ready to begin a **DMA** transfer. If the user device initiates a transfer before the **DR11** interface is ready, then this interface will not "see" the request from the user device and not complete the handshaking sequence. This symptom would usually produce a time-out error condition in the **DEC** operating system environment. This problem has been resolved thru the release of this new firmware with it replacing the corresponding driver in **TermEm**.

II. DESCRIPTION OF USE

This new firmware is activated by the same code sequence that the **TermEm** version uses. Table 1.0 gives this code sequence and explains how to use it. The user can now issue this code sequence via either the keyboard or the serial interface and the firmware will wait on the **DR11** interface to become ready before requesting the first transfer to begin.

It is important to note here that for best results, we recommend that the operator use a 25 foot run of shielded cabling obtained from the **Digital Equipment Corporation**. Use of any other cabling arrangements can not be guarrenteed by Chromatics to produce successful results.

III. INSTALLATION

Installation of this new firmware comes in two flavors: Read-Only-Memory(ROM) and diskette. The ROM firmware provides the user with the advantage of a once-only installation but requires socket space on either the Raster Processor board or thru ROM expansion(CGC option 7924). If the user purchased DOS(CGC option 7962-01) and another ROM-based option(such as Idris - CGC option 7965-01), the diskette firmware may be used. This version of the new firmware makes use of the RAM module concept of TermEm.

Whichever flavor is chosen, the **USER D** patch will supercede the **DMA** software driver in TermEm and may be accessed using the same code sequence.

A. ROM INSTALLATION

1. **Be sure that the power being supplied to the CGC 7900 is turned off.**

2. Open the back door of the CGC 7900 to expose the Raster Processor Board left-most board, slot #1).

3. Disconnect the small flat ribbon cable from the Raster Processor Board. Please note the installation of this cable so that proper reconnection may be quickly implemented.

4. Remove the Raster Processor Board from the CGC 7900 card cage by pulling the ejector handles out and sliding the board toward you. The tip of the upper ejection handle should be pulled out and up, and the tip of the lower ejection handle should be pulled out and down.

5. Locate the first available empty column of PROM sockets. These sockets may be either UE13/UF13 or UE12/UF12. The latter set of sockets should only be used if the former set are already being occupied. Insert the PROM labeled **EVEN** in the upper socket(**UE13** or **UE12**). Also insert the PROM labeled **ODD** in the lower socket(**UF13** or **UF12**). Please refer to Figure 1.0 for the layout of parts on the Raster Processor Board. Make sure that pin #1 of the PROMs is in the upper left-hand corner, and please check the newly installed PROMs for bent or broken pins and loose connections.

6. Reinstall the Raster Processor Board into the CGC 7900 card cage. If this process proves to be difficult to perform, press firmly until the board locks into the card cage.

7. Reconnect the small flat ribbon cable to the Raster Processor Board.

8. Close the back door of the CGC 7900 and turn the unit on. Wait until the green light(on the keyboard) goes out.

9. Simultaneously, press **CNTRL-SHIFT-RESET** to link in the newly installed firmware. Remember to release the **RESET** key before releasing the other keys.

B. <u>DISKETTE INSTALLATION</u>

1. Turn on the power to the CGC 7900.

2. Be sure that the **THAW** table has been properly prepared for DOS use. Table 2.0 gives a list of suggested values to be used in setting up the **THAW** table.

3. Enter DOS by pressing the **DOS** key. Follow this action by pressing the **RETURN** key. If DOS is entered by simultaneously pressing **SHIFT-DOS**, then no password entry will be required.

4. Insert the **USER** D diskette into the left floppy drive and type the following:

   FETCH/1 DMA.ABS 1F000<RETURN>

5. After receiving the **DOS** prompt, simultaneously press the following:

   CNTRL-SHIFT-RESET
   Remember to release the **RESET** key before releasing the other keys.

6. The software is now linked into **TermEm** and will supercede the existing **DMA** software driver. This driver will remain active until the power to the CGC 7900 is turned off. When the power is turned on again, this process must be repeated.

Table 1.0

USER D CODE SEQUENCE DEFINITION

USER D <Address> "," <Nwords> "," <I/O>

<Address> := hex address on even(word) boundry
                [24 bits - hex address]
<Nwords>   := number of word to be transferred
                [decimal number - range => 1 to 65,536]
<I/O>   := "1" => from CGC to Host(output)
             := "0" => to CGC from Host(input)

IMPORTANT DMA ADDRESSES:(AS SHIPPED FROM FACTORY, X = 0)

Interrupt Mask(IMASK) := $FF84x3
Extended Address Register(XAR) := $FF84x4
   bits 23-16 of DMA address
Control Register(CNTRLREG) := $FF84x5
Word Count Register(WCREG) := $FF84x6-7
   bits 7-4 => $FF84x6
   bits 3-0 => $FF84x7
Bus Address Register(BAR) := $FF84x8-9
   bits 15-8 => $FF84x8
   bits 7-0 => $FF84x9
DMA Data Word(DMADAT) := $FF84xA-B
   bits 15-8 => $FF84xA
   bits 7-0 => $FF84xB
DMA Status Byte(DMASTAT) := $FF84xD

DMA JUMPER OPTIONS:(WITH CORRESPONDING INTERFACE)

Option 1:	DR11-w	J8(cycle request)	= B(assert=1)
		J9(busy)	= A(assert=1)
Option 2:	DRv11-b	J8(cycle request)	= B(assert=1)
		J9(busy)	= B(assert=0)
Option 3:	DR11-b	J8(cycle request)	= A(assert=0)
		J9(busy)	= A(assert=1)
Option 4:	—	J8(cycle request)	= A(assert=0)
		J9(busy)	= B(assert=0)

RP1A   UB7

RP0A   UB8

RP2A   UB9

UE12	80EK Even	80EK Odd	UF12
UE13	80CK Even	80CK Odd	UF13
UE15	80AK Even	80AK Odd	UF15
UE18	808K Even	808K Odd	UF18
UE20	806K Even	806K Odd	UF20
UE21	804K Even	804K Odd	UF21
UE22	802K Even	802K Odd	UF22
UE24	800K Even	800K Odd	UF24

ASSY 100388 (old PN 100063)
RASTER PROCESSOR © 1980
CHROMATICS, INC.

Figure 1

Table 2.0

SUGGESTED THAW PARAMETERS: USE WITH THE USER D DISKETTE

1.	DOSTranZ	4000
2.	DOSBuffZ	1A00
3.	#Windows	03
4.	KeyBuffZ	0040
5.	Fnk Nest	0080
6.	232 InZ	0800
7.	232 OutZ	0800
8.	449 InZ	0800
9.	449 OutZ	0800
10.	Esc ArgZ	0400
11.	StackZ	0800
12.	UpperRam	0001F000
13.	FnkStart	00E40900
14.	FnkEnd	00E40BFF
15.	CaseTble	00E40BFF
16.	DefltPrg	00802008
17.	RAM MDLE	0001F000
18.	232 Mode	7A
19.	449 Mode	7A
20.	232Hands	01
21.	449Hands	01
22.	232 Baud	0E
23.	449 Baud	0E
24.	Planes	00FF
25.	WinTable	763C
26.	StackTop	AAFC
27.	StackBtm	A2FC
28.	CreaStrt	AAFC
29.	CreatEnd	0001EFF8
30.	Boot$	<usr>I1L<usr>01LZZZ
31.	Reset$	<usr>IOK<usr>00AKZZ<mode>J1

NOTE: Item numbers 1, 2, 12, and 17 are critically associated with the installation of the USER D diskette. Not all of the THAW parameters have been listed(i.e. Idris parameters). Please refer to the CGC Operators Manual for additional details regarding THAW. If these suggested values are entered, the user needs to simultaneously press CNTRL-SHIFT-RESET so that the system memory can be reallocated.
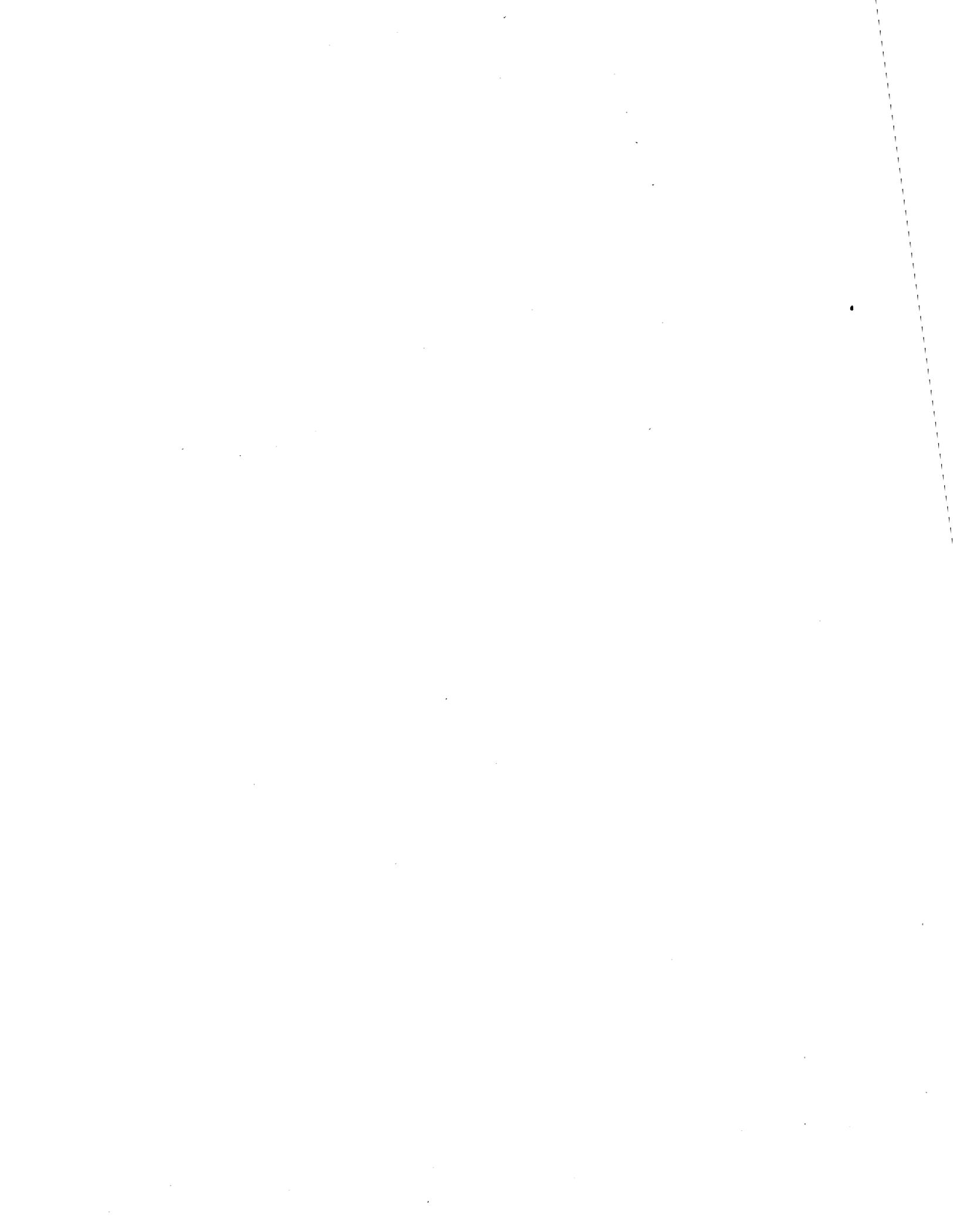
CHROMATICS

CGC 7900 COLOR GRAPHICS COMPUTER SYSTEM

OPTION 7931-01

VIDEO CAMERA INTERFACE

Field Installation Instructions

(For Units at Configuration 8 and Lower)

Document Number 070230A

Printed September 6, 1983

PRODUCT LINE: CGC

OPTION   :   7931-01 - VIDEO CAMERA INTERFACE

PROCEDURE   :   FIELD INSTALLATION INSTRUCTIONS
                (For Units at Configuration 8 and Lower)

_____

Introduction

The purpose of this procedure is to inform the factory technician, as
well as the customer in the field, how to install the Dunn Camera
Interface Circuit into a fully assembled CGC 7900 Color Graphic
Computer.   The assembly will be mounted on the top right side of the
card cage with three video coax cables channeled up to the Analog
Video Amplifier Circuit Board, one sync signal cable plugged into the
Digital Memory Controller Circuit Board and a +5V and Ground Cable
plugged into the Mother Board.   The following steps will inform the
technician on how this is accomplished.

Step 1: BACK DOOR REMOVAL

         The technician should first start with a CGC 7900 unit
         running at top performance before attempting to install the
         Dunn Camera Interface.

         The unit must be turned off and the AC line cord
         disconnected.   The technician should have the rear of the
         unit facing him or her.   Remove the rear door completely,
         first by opening the door at the latch and then lifting the
         door upwards until it is lifted off its hinges.   Place the
         door to one side.

         At this time, DO NOT remove any signal cables from any
         circuit boards.

Step 2: DISMOUNTING THE CARD CAGE

         The card cage is mounted in such a way that it can slide out
         of the chassis for easy access to difficult areas.   The cage
         is held in place by two "Z" brackets on the upper left and
         right sides of the cage.   Each "Z" bracket has four mounting
         screws:

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> Two (2) 8-32 x 1/2" Phillips Flat Head Screws
> Two (2) 8-31 x 1/2" Phillips Pan Head Screws
>   with two (2) #8 internal tooth washers.

Remove the "Z" brackets and all of the mounting screws.   Be careful not to drop any hardware into the unit.   Place the hardware to one side, away from the unit.

At this time the card cage is free to slide out of the chassis toward the technician.   Do this slowly   until   the mother board is past the floppy disk drives (above the mother board).   Care should be taken to push aside the ribbon cables and other cables which could get caught in the sliding action and become damaged.   The floppy disk   drive ribbon cables might also slide off the card edge;   remember to reconnect them to their proper locations before turning the unit on.   When the fast-on type terminals are in full view, stop sliding the cage forward.   (Do not attempt to remove the cage assembly from the chassis.)

Step 3:   CIRCUIT MOUNTING AND CABLE HOOK-UP

At this time mount the Dunn Camera Interface Assembly to the right top side of the card cage (see drawing # 060085) using two (2) 6-32 x 1/4" Phillips head screws and two (2) #6 internal tooth washers.

Plug the +5V and Ground Wire Assembly (# 060075) to +5V and ground on the designated areas of the mother board (see detail "A" of drawing # 060085).

Remove the woven cable end marked "P5MC" from the Memory Controller Board (in the left side of the card cage). Remove the "P5MC" identification tie wrap (do not injure the cable) and place the new identification tie wrap labeled "P2DCI" onto the cable.   Plug this cable end into "J2" on the Dunn Interface Circuit Board.

Examine the additional sync signal cable (assembly # 060072) and plug the end marked "P5MC" into "J5" on the Memory Controller Circuit Board.   Take the other end of the   sync signal cable which is marked "P1DCI" and plug it into   "J1" of the Dunn Camera Interface Circuit Board.   Stop at   this point.

Step 4:   REMOVING THE TOP COVER OF TH4E ANALOG SECTION

Remove the two (2) 10-32 x 3/4" Phillips head screws located at the rear of the unit and put them to one side, away from the unit. Remove the top cover by sliding it off of the top chassis, away from the unit. Place the cover away from the unit in a safe place.   Locate the three (3) video coax cables attached to the Dunn Camera Interface Circuit Board and channel them up to the analog section toward the Video Amplifier Circuit Board.   Plug in the corresponding video coax cables to their respective locations on the Video Amplifier Circuit Board: plug the green coded coax cable into .''J1", plug the blue coded coax cable into "J2", and plug the red coded coax cable into "J3".

(See Figure No. 1)
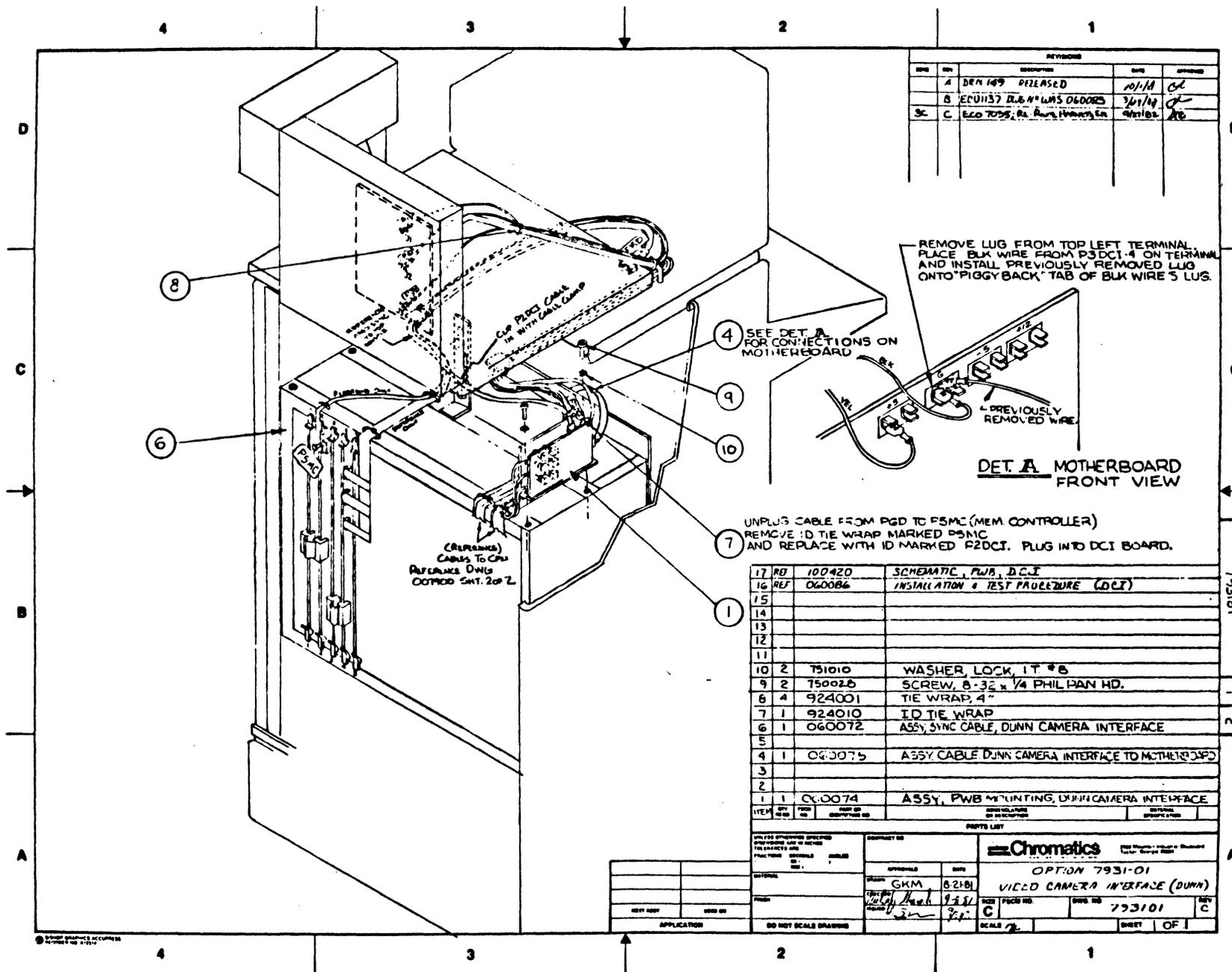
REMOVE LUG FROM TOP LEFT TERMINAL.
PLACE BLK WIRE FROM P3 DCI-4 ON TERMINAL
AND INSTALL PREVIOUSLY REMOVED LUG
ONTO "PIGGY BACK" TAB OF BLK WIRE 5 LUG.

SEE DET A
FOR CONNECTIONS ON
MOTHERBOARD

PREVIOUSLY
REMOVED WIRE.

DET A MOTHERBOARD
FRONT VIEW

CLIP P3DCI CABLE
TIE WITH CABLE CLAMP

(REFERENCE)
CABLES TO CPU
REFERENCE DWG
007ROD SHT. 2 OF 2

UNPLUG CABLE FROM PGD TO P5MC (MEM CONTROLLER)
REMOVE ID TIE WRAP MARKED P5MC
AND REPLACE WITH ID MARKED P2DCI. PLUG INTO DCI BOARD.

ITEM	QTY	PART NO	NOMENCLATURE OR DESCRIPTION	
17	RO	100420	SCHEMATIC, PWB, D.C.I	
16	REF	060086	INSTALLATION & TEST PROCEDURE (DCI)	
15				
14				
13				
12				
11				
10	2	751010	WASHER, LOCK, IT #8	
9	2	750028	SCREW, 8-32 x 1/4 PHIL PAN HD.	
8	4	924001	TIE WRAP, 4"	
7	1	924010	ID TIE WRAP	
6	1	060072	ASSY, SYNC CABLE, DUNN CAMERA INTERFACE	
5				
4	1	060075	ASSY CABLE DUNN CAMERA INTERFACE TO MOTHERBOARD	
3				
2				
1	1	060074	ASSY, PWB MOUNTING, DUNN CAMERA INTERFACE	

PARTS LIST

Chromatics

OPTION 7931-01
VIDEO CAMERA INTERFACE (DUNN)

DRAWN GKM 8-21-81

DWG NO 753101

SHEET 1 OF 1

Figure No. 1

Step 5:   TESTING THE DUNN CAMERA INTERFACE CIRCUIT

After all of the above connections are made, testing of the clock, vertical, horizontal and video outputs are essential. Plug the AC line cord into the receptacle and turn on the unit. The following waveforms should be checked by a technician with an oscilloscope:

CLOCK OUTPUT (SET SCOPE TO 5V/DIV, .5u SEC/DIV)

≈5V

ØV

.6μSec.
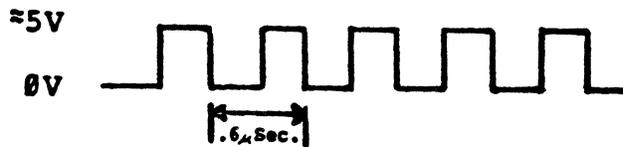
VERTICAL OUTPUT (SET SCOPE TO 5V/DIV, 1m SEC/DIV)

≈5V

ØV

16.66mSec.
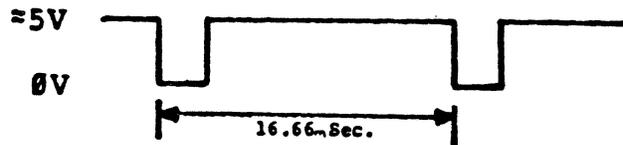
HORIZONTAL OUTPUT (SET SCOPE TO 5V/DIV, 5u SEC/DIV)

≈5V

ØV

42μSec.
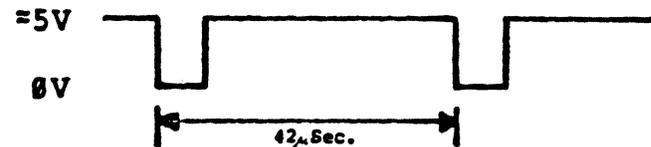
RED, GREEN AND BLUE VIDEO OUTPUT WITH A WHITE(ERASE PAGE) SCREEN, SET BRIGHTNESS POT TO FULL INTENSITY (SET SCOPE TO 1V/DIV, 10uSEC/DIV)

ØV

-1.4V

42μSec.
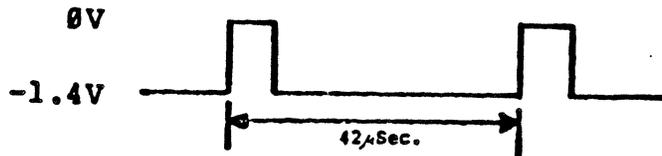
Turn off the unit and disconnect the AC line cord.

Step 6:   PUTTING THE CGC BACK TOGETHER

After the Dunn Camera Interface has been tested, the final
step is to put the unit back into its original form.

Slide the card cage back into the unit and be careful not to
damage the cables while doing this.   Make sure the floppy
disk drive flag cables are connected to their proper card
edge locations.   Return the two (2) "Z" brackets to the card
cage and chassis locations and secure them with the four (4)
sets of screws for each side (see Step 2).   Place the rear
door back onto its hinges, shut the door and turn the latch
to lock the door.

CGC 7900 SYNC SIGNALS

SUPPLEMENT TO THE DUNN CAMERA INSTALLATION INSTRUCTIONS

The CGC 7900 uses interlaced scan. Odd-numbered raster lines are scanned during one field, and even-numbered lines are scanned during the next field. The fields are synchronized to the 60-cycle power line so that each field lasts 1/60 second and it takes 1/30 second to display an entire frame. Interlacing is achieved by delaying the start of vertical sweep on odd fields.

The display scans 768 lines with 1024 pixels per line. Each pixel is scanned for 35.11 nanoseconds. Three 8-bit digital-to-analog converters receive red, green, and blue data from the Digital Chassis and convert this data into three video signals. RGB video output is available.

All of the sync signals are available at the Dunn Interface Circuit mounted at the top of the card cage.

All sync signals are TTL level. When terminated with 50 ohms, the levels will drop to approximately +1.5 volts peak to peak.

(1) CLOCK: a 1.78 mega hertz square wave from which all other sync signals are derived. When video is active, 16 pixels are scanned during each cycle of this clock.

(2) HORIZONTAL RESET: the sync signal which triggers each horizontal line. Video begins 912.9 nanoseconds after HORIZONTAL RESET goes high.

(3) VERTICAL RELEASE: the sync signal which triggers vertical sweep, and inhibits sweep at the proper times to provide interlace. On even fields, this signal rises simultaneously with a HORIZONTAL RESET rising edge. On odd fields, it is delayed by 20.79 microseconds for interlace. The falling edge of this signal is triggered by power line frequency (60 hertz).

(4) ANALOG VIDEO: these three signals originate at the Video
Amplifier Card on the back wall of the analog chassis. P1
provides green, P2 provides blue, and P3 provides red. These
signals are transferred by a 50 ohm coaxial cable to the BNC
connectors located on the circuit board bracket mounted on top of
the card cage. They are designated red, green, and blue,
respectively. For best results, a 50 ohm load should be provided
at the user's end of the cable. The voltage levels at each of
these connectors are: zero for black, and minus 0.6 volts (open
circuit) for maximum intensity. This level may not be adjusted
without disturbing the 7900 video alignment.

(See Figure No. 2)
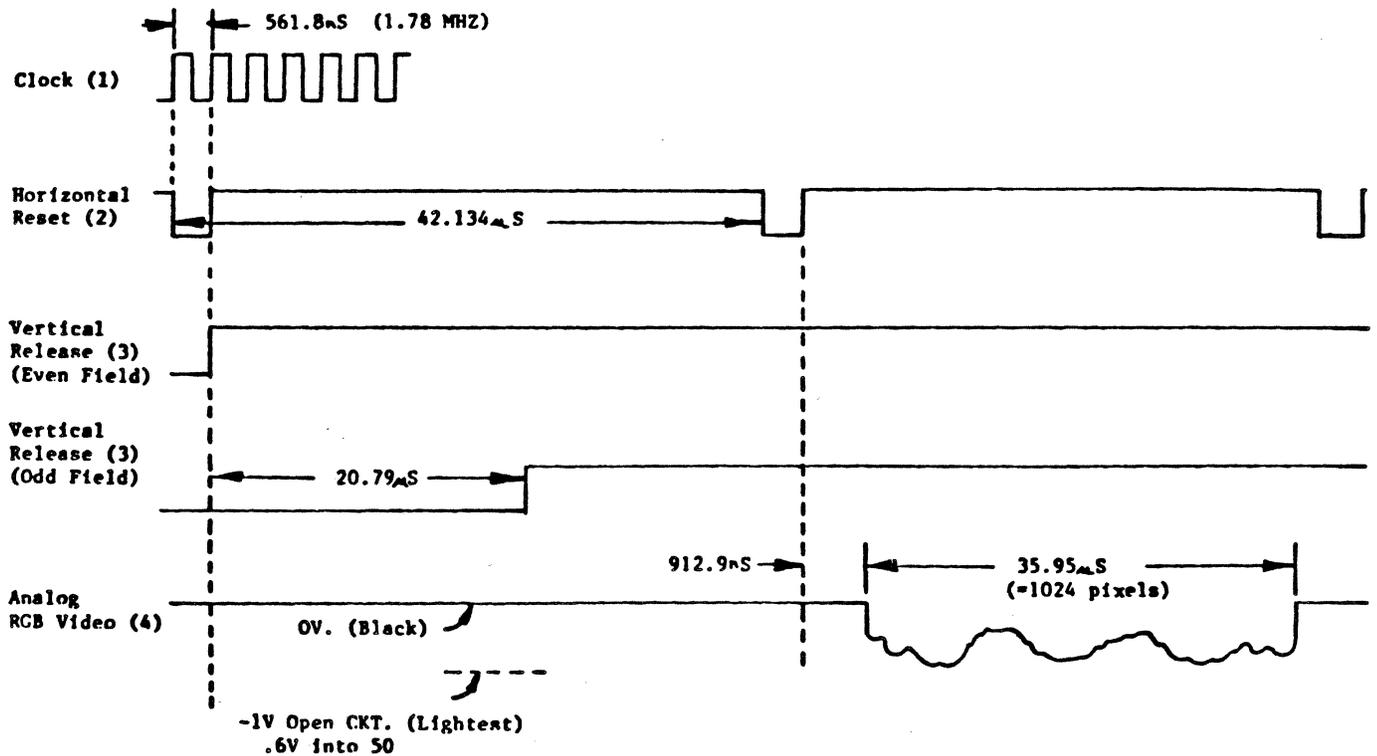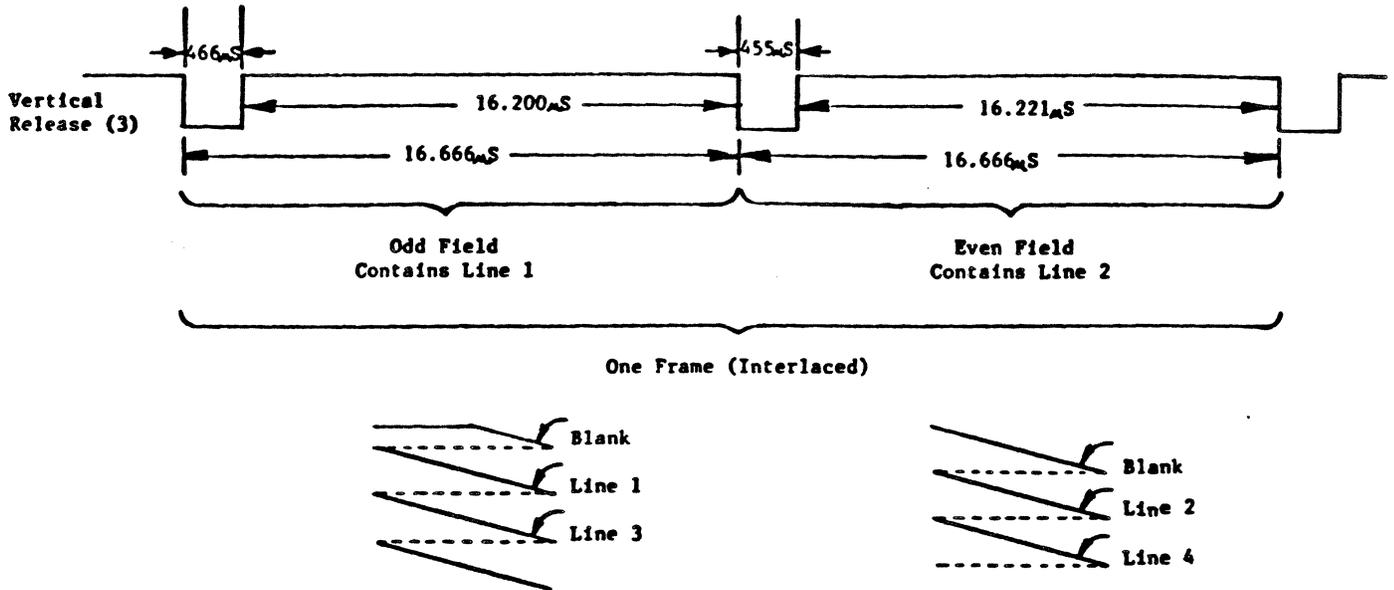
Figure No. 2

CHROMATICS

CGC 7900 COLOR GRAPHICS COMPUTER SYSTEM

OPTION 7933-01

DR11-B INTERFACE

Field Installation Instructions

Document Number 070232A

Printed September 2, 1983

PRODUCT LINE: CGC 7900

OPTION   :   7933-01 - DR11-B INTERFACE

PROCEDURE   :   FIELD INSTALLATION INSTRUCTIONS

———————

ITEMS REQUIRED:

    1 each CGC 7900 unit (Chromatics supplied)
    1 each DR11-B unit (DEC supplied)
    1 each PIO/DMA Interface PWB, Assy, 100409 (Chromatics supplied)
    1 each DR11-B Interface PWB, Assy, 100428 (Chromatics supplied)
    2 each cable assemblies (DEC supplied P/N BC08R-XX; XX = Length:
                            1, 6, 10, 12, 20, 25, 50 Ft.)

STEP 1:   Insert the DR11-B Interface PWB Assembly into the DEC DR11-B
          UNIBUS (located within the main frame of unit) at locations
          C-4 and D-4.

STEP 2:   Install one end of both cable assemblies onto the DR11-B
          Interface board assembly at locations J1 and J2.   Connect
          the other end of the cable assemblies to the PIO/DMA
          Interface PWB Assembly as follows:

          J1 of DR11-B Interface to P6 of PIO/DMA Interface
          J2 of DR11-B Interface to P7 of PIO/DMA Interface

IMPORTANT NOTEE: Be sure to align the arrow on the board connector
                   with the arrow of the cable connector to ensure
                   proper orientation when installing the cables.

STEP 3:   Install the PIO/DMA Interface PWB Assembly into a spare slot
          in the CGC 7900 card cage via the rear door. Lay the cables
          flat against the card cage and close rear door.

CHROMATICS, INC.

CGC 7900 COLOR GRAPHICS COMPUTER SYSTEM

OPTION 7934

VERSATEC V-80 INTERFACE

Installation and Operating Instructions

Document Number 070228B

Printed October, 1983

Introduction

This is the installation and user's manual for the CGC 7900 Versatec Interface (option 793401). The Versatec V-80 is a high-resolution black and white printer/plotter manufactured by Versatec, a division of Xerox Corporation.

System Requirements

To use the Versatec Interface, your 7900 system must have a PIO/DMA card and either the Chromatics Disk Operating System (DOS) or Idris. The Versatec V-80 must be purchased from another source.

Parts List

The Versatec Interface consists of the following parts:

- Versatec adapter board -- a small circuit board (P/N 100479).

- 50-pin ribbon cable from PIO/DMA to Versatec adapter board (P/N 060102).

- Software driver on DOS diskette (P/N 080271).

A second cable is required to connect the Versatec adapter board to the V-80. This cable is not supplied; however, a pinout of the cable is shown on page 4.

Installation Procedure

1) Install four jumpers at position <u>J6</u> on the PIO/DMA card. This enables the bidirectional parallel port. The rest of the board is properly configured as shipped. If the configuration has been altered, make sure that the Base Address is set to $FF8400 (set all four switches on SW/F3 to zero -- see section 2.1 in the PIO/DMA Manual). Install the PIO/DMA card in the slot to the left of the CPU in the CGC 7900 card cage.

2) Attach the 50-pin ribbon cable to **P4** on the PIO/DMA card (the bottom edge connector), with the blue line at the bottom. Attach the other end to the Versatec Adapter Board, making sure the blue line is at pin 1.

3) Attach the small connector of the 25-pin cable to the "D" connector on the Versatec Adapter Board. Attach the large connector to the V-80 printer.

4) Turn on the Versatec and insert the Versatec Driver diskette in the left-hand disk drive. Enter DOS and type:

   VERSATEC <u>RETURN</u>

   The printer will eject some paper; it is then ready to accept data.

Operation

The DOS driver software uses Z image mode (described in detail in the CGC 7900 Hardware Reference Manual). Pixels with color numbers other than 0 translate to black on the Versatec printout. The background must be color 0 to show anything but a solid black field.

Because the CGC 7900 has a resolution of about 70 pixels/inch, compared to 200 pixels/inch for the Versatec, each pixel in the Bitmap is sent out in a 2 x 2 block to the V-80.

With the printer and DOS driver software installed, copy the Bitmap to the screen by pressing SHIFT COPY. This works under either DOS or Idris.

Under DOS, the printer can make listings by assigning the output of logical device 1 to physical output device "P" and putting the unit in half duplex.

ASSIGN OUTPUT 1 A K P Z

USER H

Assembly listings can be made by specifying the T option in the Assembler.

ASMB ^T <file> RETURN

Under Idris, send text to the V-80 by redirecting output to /dev/vprint:

cat textfile > /dev/vprint

NOTE:

/dev/vprint is part of Idris; the DOS driver need not be installed if the V-80 is only being used as a printer. However, if screen copies are needed, either install the DOS software or write a program to copy the Bitmap from Idris.

A second Idris device driver, /dev/vplot, allows a user to send plot data in "raster" form to the V-80. Each write to /dev/vplot also terminates the raster line; however, the Versatec does a wraparound after the 264th byte. This driver does NOT directly copy screen memory.

Versatec Cable

The following pinout is for the cable between the Chromatics CGC 7900 Versatec Interface and the Versatec printer. This cable can be purchased from:

Data Set Cable Company
722 Danbury Road
Ridgefield, Conn.   05877
Telephone (203) 438-9684

Chromatics Versatec   Versatec Printer
      Interface
(25-pin D connector)   (37-pin D connector)

                   D0 1 ------------ 1 D0

                   D1 14 ------------ 2 D1

                   D2 2 ------------ 3 D2

                   D3 15 ------------ 4 D3

                   D4 3 ------------ 5 D4

                   D5 16 ------------ 6 D5

                   D6 4 ------------ 7 D6

                   D7 17 ------------ 8 D7

                Ground 7 ------------ 33, 34, 37 Ground

               On Line 8 ------------ 32 On Line

   Remote Line Terminate 9 ------------ 18 Remote Line Terminate

Simultaneous Print/Plot 10 ------------ 12 Printer

   Parallel Input Clock 19 ------------ 10 Parallel Input Clock

                 Ready 20 ------------ 11 Ready

              No Paper 21 ------------ 19 No Paper

             +5 Volts 22 ------------ 14 Simultaneous Print/Plot

          Remote Reset 23 ------------ 15 Remote Reset

CHROMATICS, INC.

CGC 7900 COLOR GRAPHICS COMPUTER SYSTEM

OPTIONS 7937-01 and 7937-02

ACT II PRINTER INTERFACE

Installation and User's Manual

Document Number 070218B

Printed April, 1984

ACT II Interface Manual
Change Packet
27 Mar 84

This manual replaces the previous ACT1 Printer Interface Manual. This change will upgrade the manual from Revision A to Revision B. Most of the changes in the manual are stylistic; others occur because Chromatics now supports the ACT II instead of the ACT I. Usage under Idris is also spelled out more clearly.

Table of Contents

Chapter 1 -- Introduction

Chapter 2 -- Installation Procedures

Chapter 3 -- Using the ACT II Interface

Chapter 1 -- Introduction

1.1. General

This manual describes the installation and use of the ACT II ink-jet printer interface.

You must have a PIO/DMA card (#7930-01) in your system to run the ACT II interface. Otherwise, everything needed is included in this package (except for the ACT II printer itself, and a cable which is supplied with the printer). You should have the following items in your package:

1) ACT II Interface board (see Figure 1).

2) Ribbon cable, PIO/DMA board to ACT II Interface board.

3) Diskette or ROM-based software.

4) Four 2-position jumper plugs.

5) User's manual (this one).

NOTE:

The ACT I and the ACT II are nearly identical. Therefore, the ACT I software provided with this interface works with the ACT II as well.

1.2. ACT II Printer -- Description and Features

The **ACT II Color Copier** is a non-impact ink jet color printer capable of printing raster images or ASCII characters from the CGC 7900 computer. The ACT II can generate high resolution (1024 x 768) or medium resolution (512 x 384) 125-color images on a 12 by 8 inch sheet of paper.

The ACT II is connected to the CGC 7900 through the PIO/DMA card and the ACT II Interface board. RAM based software allows TERMEM to use the printer as an assignable device. This allows an assembly-language program under DOS to control the ACT II directly. This also allows use of the printer from a host machine or from EDIT or ASMB under DOS. The SHIFT COPY key will generate a raster copy of the **visible** Bitmap image from DOS or Idris. All zoom levels are supported and various pan positions will appear on the copier as they do on the screen.

Features of the ACT II include:

1) Fast copy time with bi-directional printing. A 512 x 384 image takes about 2 minutes to print; a 1024 x 768 image takes less than 3 minutes.

2) Uni-directional printing can be used for better clarity.

3) Large ink bottles lengthen maintenance-free printing time.

4) Sophisticated test plots can be invoked from the front panel.

5) Small, quiet desktop design is ideal for office environments.

Chapter 2 -- Installation Procedures

2.1. Hardware Installation

This procedure need only be followed when installing the ACT II Interface for the first time.

1) If your system does not have a PIO/DMA card, obtain one before proceeding. Remove the PIO/DMA card from your system and install jumpers in all 4 positions at location J6. Also, make sure that all switches at location SW/F3 are set to 0. Return the PIO/DMA card to the card cage.

2) Connect one end of the supplied cable to the ACT II Interface board. The other end goes to the bottom edge connecter on the PIO/DMA card (P4). The blue line on the ribbon cable should be facing down on the PIO/DMA end.

3) Connect the cable provided with the ACT II printer to the connecter provided on the ACT II interface card and to the printer.

4) Install the software and run the test plots as described in the **ACT II User's Manual**.

2.2. Software Installation (ROM-based -- Option 7937-01)

If you have the diskette-based option, ignore this section and proceed to section 2.3.

1) Install ROMs 210268 (even) and 210269 (odd) in any spare slots on the Raster Processor board. The Raster Processor board is located in Slot #1 in the 7900 card cage.

2) If your system is equipped with a ROM Expander board, install these ROMs in positions UD16 (even) and UE16 (odd) on the ROM Expander (second from the bottom). Set switch UA1 to position 2 and return the card to its slot in the 7900 card cage.

2.3. Software Installation (Diskette-based -- Option 7937-02)

If you have the ROM-based option, ignore this section and use section 2.2. If you intend to use the ACT II exclusively under Idris, you need not load the driver software.

After the printer has been connected and the test plots have been run successfully, load the software as follows:

1) From TERMEM, enter THAW and make sure the RAMMDLE parameter is set to 1F000. This is the default.

2) Place the diskette labelled "ACT1 Software" (sic) in the left-hand disk drive and enter DOS.

3) Type the following command:

    FETCH/1 ACT1.SYS+0 RETURN

4) Press CTRL SHIFT RESET to link the modules into TERMEM. The software is now ready to use. It will remain in the system until the power is turned off.

Chapter 3 -- Using the ACT II Interface

3.1. Using the ACT II as a Printer

The following procedure works only under DOS. For Idris operation, see section 3.2.

The physical device driver Y, when assigned properly, will send any data received to the ACT II printer. The ASSIGN OUTPUT function in TERMEM handles this function.

Format:

    ASSIGN OUTPUT nYZZZ

        - OR -

    USER O nYZZZ

Where **n** is the logical device number (usually 1).

Example:

To send an assembler listing to the ACT printer, type:

    TERMINAL
    ASSIGN OUTPUT 1YZZZ
    SHIFT DOS
    ASMB ^+T <filename> RETURN

3.2. Printing Under Idris

The Idris device driver, **/dev/act1print**, works for both the ACT I and ACT II. If you are using Idris exclusively, the DOS driver need not be loaded. To send any text file to the ACT II under Idris, type:

    cat **file** > /dev/act1print

Where **file** is the name of one or more files to be sent out. Of course, using the ACT in this fashion is not limited to cat.

3.3. Making Hard Copies (DOS Version)

Format:

SHIFT COPY

  - OR -

USER h

The hardcopy routine copies the visible 7900 Bitmap image to the ACT II printer. The image data will be represented on the ACT II in 125 colors.

Even zoom factors (i.e. 2,4,6,...) will generate a full page image. Odd zoom factors will generate images of varying sizes. The following table gives resulting sizes for varying zoom factors:

Zoom Multiple	Size in Inches
1	11 3/4 x 8 7/8
2	11 3/4 x 8 7/8
3	8 1/8 x 6
4	11 3/4 x 8 7/8
5	9 5/8 x 7 1/8
6	11 3/4 x 8 7/8
7	10 3/8 x 7 5/8
8	11 3/4 x 8 7/8
9	10 3/4 x 8
10	11 3/4 x 8 7/8
11	11 x 8 7/8
12	11 3/4 x 8 7/8
13	11 1/8 x 8 1/4
14	11 3/4 x 8 7/8
15	11 1/4 x 8 3/8
16	11 3/4 x 8 7/8

Example -- To copy a .BUF file:

DOS
DRAW <picture> RETURN
TERMINAL
REDRAW

(Make sure the ACT II is on line.)

SHIFT COPY

If you RESET the 7900 while printing on the ACT II, you must also Reset the ACT II printer before sending another print.

3.4. Making Hard Copies (Idris Version)

In Idris versions 2.0 and above, a program called **actdump** is provided by Chromatics. It takes the place of the SHIFT COPY procedure required in DOS. Using the ACT II under Idris does not require loading the DOS driver.

To copy the Bitmap under Idris, type the following:

Demo **picture** RETURN
actdump RETURN

Where **picture** is some graphics file (either **.buf** or **.rle**).

NOTE:

The actdump program hangs Idris (and stops the Idris clock) while running. If this is a problem, type: cmosdate -cmos RETURN after the copy is done.

3.5. Shrinking Full-sized Images

The shrink routine is provided in the DOS driver software for the ACT II. It reduces a full screen image (1024 x 768) to a quarter screen (512 x 384).

Format:

MODE w

Example:

DOS
DRAW <picture> RETURN

TERMINAL
REDRAW
MODE w
SHIFT COPY

NOTE:

4 pixel averaging is used to reduce the image. Thus, colors may not remain consistent around edges of color areas. Thin lines will usually be lost.
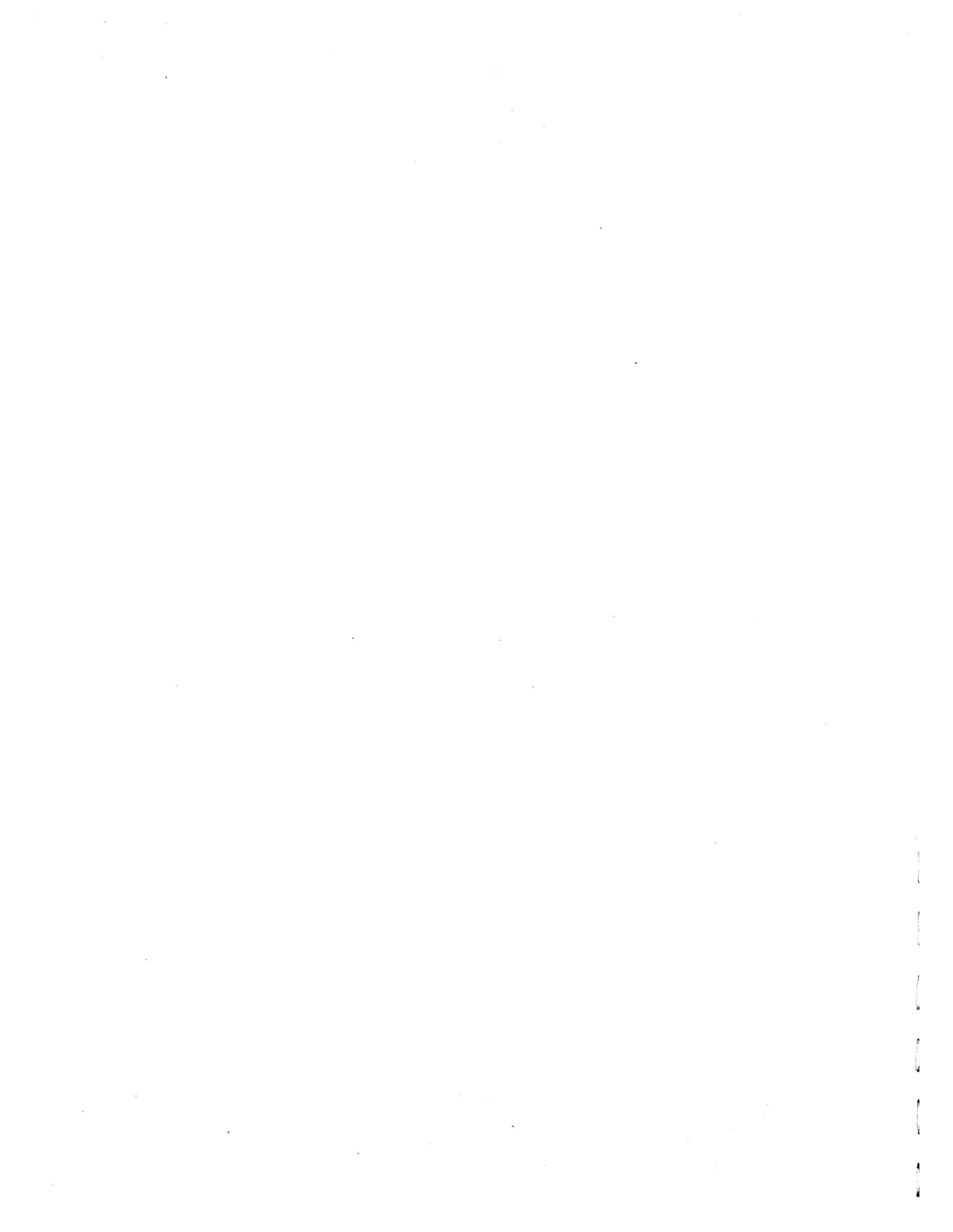
Dear CGC Customer:

Enclosed in this shipment is the 9-Track Tape Interface (Option 7938-01) for your CGC 7900. Installation and operation instructions are found in the 9-Track Tape Interface Manual (also enclosed).

It is important to note that only Release 3 or higher of Idris supports the 9-Track Tape Interface. This release must be installed in order to use the tape interface.

It is also important to note that the device entries for tape drivers must be present in the /dev directory. If they are not present, a user must perform the following (must have superuser privileges):

```
# cd /dev

# mkdev -c14 -u0 rmt

# mkdev -c14 -u64 rmt16

# mkdev -c14 -u128 nrmt

# mkdev -c14 -u192 nrmt16
```

If you have any questions, please contact a member of Chromatics' Marketing Technical Support group.

CHROMATICS

CGC 7900 COLOR GRAPHICS COMPUTER SYSTEM

OPTION 7942-01

40 Mbyte Hard Disk Upgrade Procedures Manual

Installation Instructions

Document Number 070223

Printed August 9, 1983

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PRODUCT LINE: CGC 7900

OPTION   : 7942-01 - 40 MBYTE HARD DISK UPGRADE
                 PROCEDURES MANUAL

PROCEDURE   : INSTALLATION INSTRUCTIONS

_____

Section 1 - Introduction

1.1 General

This manual describes the procedure to upgrade the CGC 7900 hard disk
from 10 Mbytes to 40 Mbytes.

NOTE: This upgrade can be done <u>only</u> on units which have two disk
              access holes in the bottom of the frame. If your frame has
              only one hole, you must purchase a new frame before
              proceeding with the upgrade. Frames are not field-
              upgradable.

The following materials are required from the original drive:

   1.   OMTI Disk Controller

   2.   The following hardware:

         (1)   051020 Mounting bracket
         (1)   051021 Mounting bracket
         (1)   060037 Cable - Floppy Disks to Controller
         (8)   750028 8-32 x 1/4" Phillips pan head screws
         (8)   750010 #8 Lock washer

Reference Drawing # 060043 for a Shugart 10 Mbyte Disk; Drawing #
060117 for the Quantum disk.

Your upgrade kit should contain the following:

   1.   40 Mbyte Hard disk

   2.   The following hardware:

         (1)   750079 #6 x 3/8" sheet metal screw
         (5)   754002 Hex nut 6-32 nylon insert
         (5)   754033 Stand off 6-32 nylon

(5) 754034 Screw, 6-32 x 1/4", nylon
(1) 754035 Spacer, 1" x 5/16" aluminum

Reference Drawing # 060096 (Quantum 40Mbyte disk drive).

1.2 Handling Precautions

Be very careful with the hard disks. The new disk drive should be locked down when you receive it; leave it that way until you have finished installing it. Before you remove the old disk, lock it down, too.

DO NOT TILT THE HARD DISK ASSEMBLY! It MUST remain upright at all times!

Section 2 - Installation Procedure

2.1 10 Mbyte Hard Disk Removal

The drawing shown in Figure 1 is a flowchart of this procedure. Look it over before proceeding.

1. Boot up your system and save any files you wish to keep on floppy disks. Turn the computer OFF and unplug it.

2. Open the back door of the 7900. Locate the speaker cable and disconnect it from the CPU board. The speaker connector is at J3 on the CPU board; it is a 2-conductor cable.

3. Remove the two Phillips screws at the top of the speaker panel (see Figure 2).

4. Push the two spring-loaded latches toward the center of the speaker panel. Carefully remove the panel - make sure the speaker cable does not catch on anything.

5. Two Phillips screws at the top of the front panel should now be visible. Remove these screws and lift the panel straight up until it clears the two retainer pins at the bottom.

6. Remove the AC power cord from the unit. Remove the Phillips screws at each corner of the filter panel and remove the panel.

7. In the back of the unit, locate the two card cage retainers at the top corners of the card cage. Remove the four Phillips screws from each retainer and very gently pull the card cage out until the disk drive is clear (see Figure 3).

8. Remove the two Phillips screws at the back of the hard disk that secure it to the frame. Push the card cage back far enough to expose two more Phillips screws on the other side of the drive; remove these screws also.

9. Remove the cables from J1, J6, and J9 of the disk controller and from J1, J5, and J4 of the hard disk.

10. Keeping the hard disk level, lift it out of the 7900.

11. Remove the OMTI disk controller from the 10 Mbyte drive and attach it to the 40 Mbyte drive (see Figure 4).

12. Reverse steps 1 through 10 and reassemble the 7900 with the 40 Mbyte drive in place of the original drive.

Figure 1. Procedure Flowchart.

```
┌──────────────────────┐
│  REMOVE SPEAKER PANEL │
└──────────┬───────────┘
           ↓
┌──────────────────────┐
│  REMOVE FRONT PANEL   │
└──────────┬───────────┘
           ↓
┌──────────────────────┐
│  REMOVE FILTER PANEL  │
└──────────┬───────────┘
           ↓
┌──────────────────────┐
│  UNFASTEN CARD CAGE   │
└──────────┬───────────┘
           ↓
┌──────────────────────┐
│   REMOVE HARD DISK    │
└──────────┬───────────┘
           ↓
┌──────────────────────┐
│ REMOVE DISK CONTROLLER│
└──────────────────────┘
```
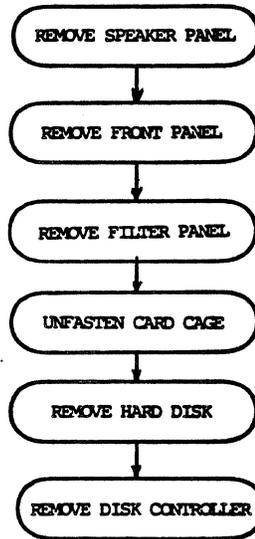
Figure 2. Speaker Panel.
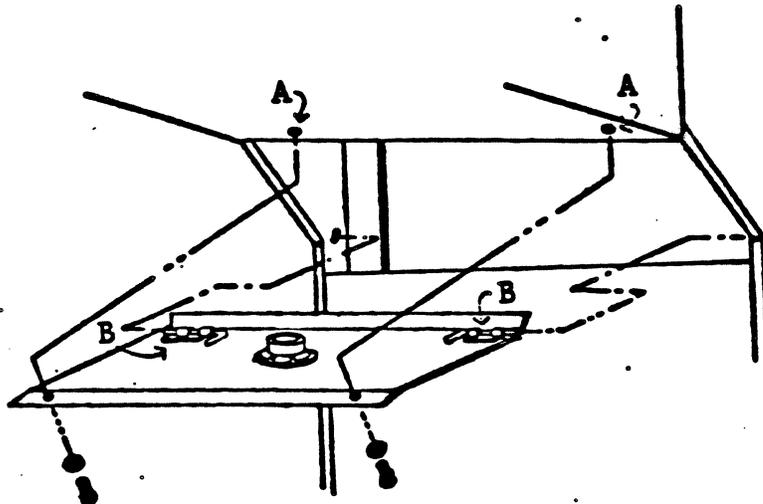
Figure 3. Card Cage Retainers.
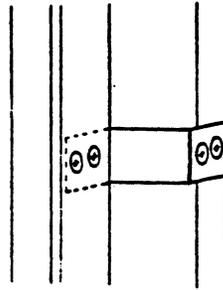
Figure 4. Disk Controller.
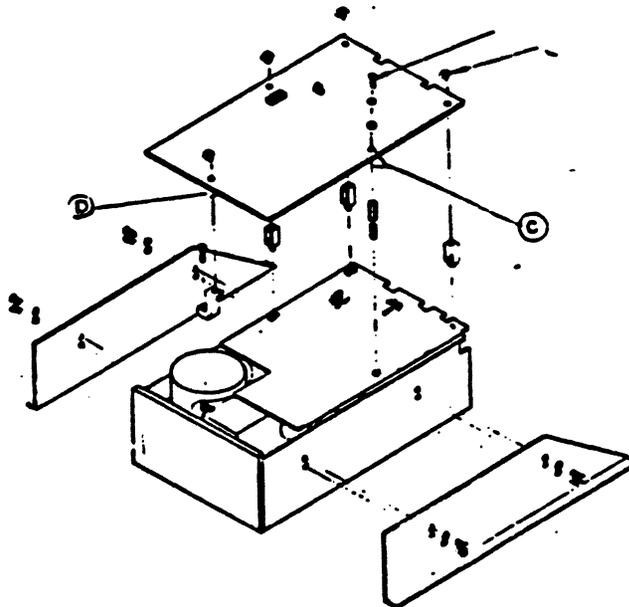
CHROMATICS, INC.

CGC 7900 COLOR GRAPHICS COMPUTER SYSTEM

OPTION 7962-01

DOS 1.7 RELEASE NOTES

Document Number   070257

Printed November 12, 1984

DOS 1.7 RELEASE NOTES

1. Introduction

The 1.7 release of DOS for the CGC 7900 contains both new features and bug fixes. The new features include:

- support for the disk DMA hardware,
- variable length directories,
- a "coalesce" option to the COMPRESS transient, and
- user-specified interleave factor on the FORMAT transient.

Bugs fixed include:

- the kernel now checks "volume overflow" correctly (this had impacted the STORE and COPY transients), and
- several assembler problems (listed below).

This release is intended to be completely compatible with existing DOS systems. Barring a dependence on any of the corrected bugs, users should be unaffected by the installation of the new proms. To take advantage of the new features, however, some additional options are at their disposal.

2. New Features

A. FORMAT - Two new options are recognized by the FORMAT transient. The first allows a disk to be formatted with a variable number of directory slots. Although intended to address the 1024 file limit on fixed disks, the option is available for diskettes also; however, it is necessary that a floppy be formatted with at least 68(hex) slots to avoid files crossing the density barrier.

The second option permits a user to specify an interleave factor when formatting a disk. The FORMAT command thus takes the form:

    FORMAT [name] /<n> [;<opt>]

where <opt> can now include

    C <number of slots in hexidecimal>
    I <interleave factor>

An example using both options might be

    FORMAT /2;C A0 I 4

which would format drive two with interleave code 4, and 160 directory slots.

B. COMPRESS - A new form of disk compression which allows contiguous .KIL or .FRE files to be coalesced into one large free area is available. No file relocation is performed; the directory is simply modified to allow access to these contiguous pieces as one large free area. The primary advantage of this technique is that it provides a very quick and safe means of regaining usable space on a disk. This is particularly important in the case of a fixed disk which may take the better part of an hour to compress. The main drawback of the techique is that it is ineffective if the disk contains several non-contiguous free areas. Under normal "edit-assemble-test" cycles, however, large numbers of contiguous .KIL generally result.

When a file is created, DOS always uses the largest available free area. This means that when a "coalesced" free area becomes the largest available free area, it will now be used.

The "coalesce" option is specified with the "C" option on the COMPRESS transient.

        COMPRESS/<n>;C

C. VERSION - The VERSION transient works exactly as it did before; in addition, on the new .SYS files, both a date and version number will be returned. Of course, that version number will be 1.7. The new VERSION transient will work with all 1.6 files, but the 1.6 VERSION transient will not work with the 1.7 transients.

3. **Bugs Fixed**

The following are the bugs fixed in Release 1.7:

A. The assembler duplicates the last statement.

B. LEA -1(Ax,Dz.L),Ay produced overflow in ASMB.

C. MOVE.B #'.',0(A4,D7.L) assembled incorrectly.

D. BSR doesn't check for overflow in ASMB.

E. The kernel did not check for "volume overflow" for all disks.

F. In EDIT, MODIFY command confuses line terminators after a GET overflows input buffer.

G. In EDIT, if PUT writes all lines in a file to disk, the next EXIT will zero the file on disk. Now, EXIT will leave file intact.

5/25/83
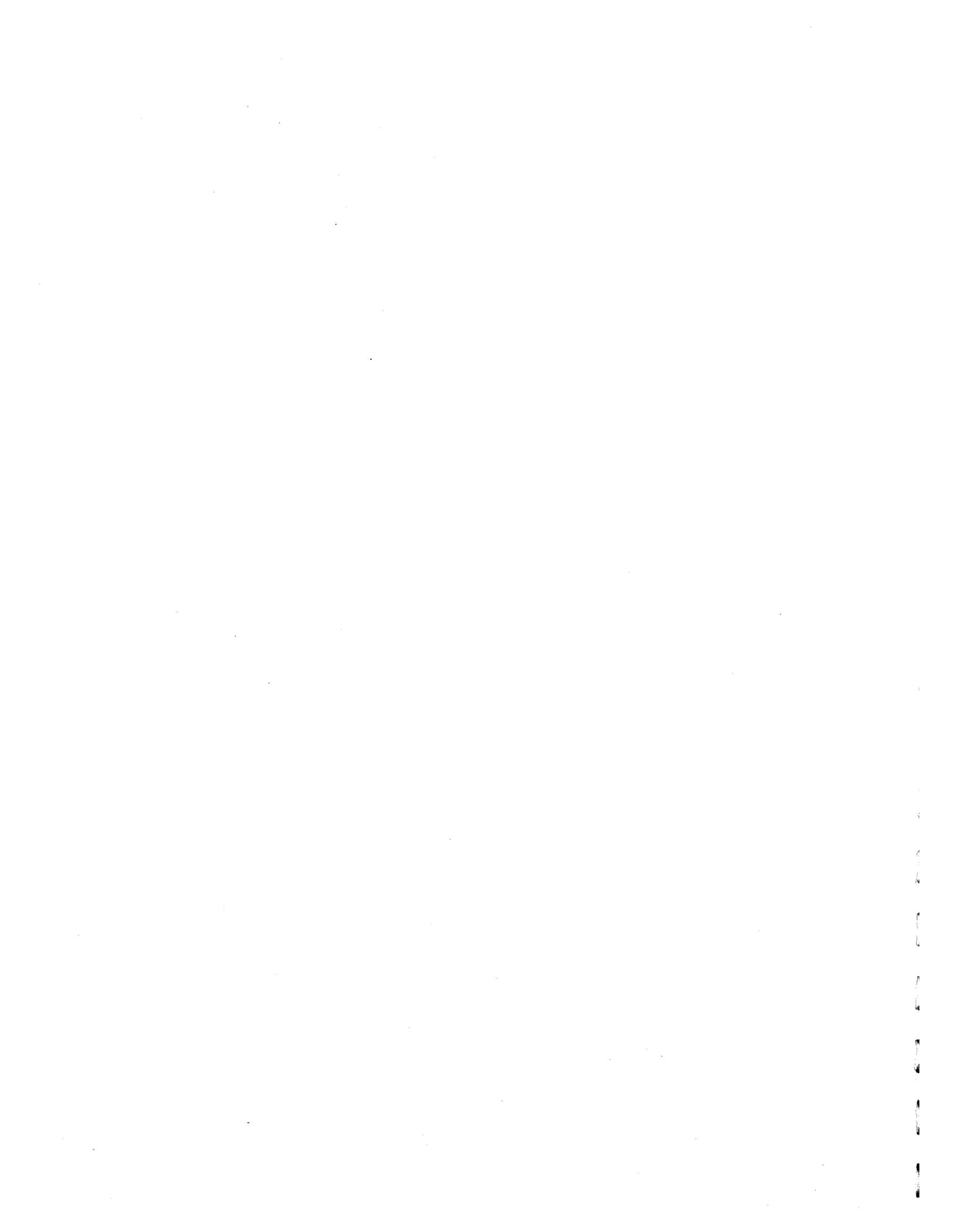
Dear CGC 7900 Idris Customer:

Chromatics, Incorporated is pleased to deliver the Idris Operating System,
Option 7965-01, for the CGC 7900. If you are receiving a new CGC 7900,
Idris is installed on the system and can be invoked by pressing the IDRIS
key. Please note that you must first unlock the hard disk before powering
up the CGC 7900.

To ensure that Idris will operate properly on the CGC 7900, the following
are the minimum requirements for running the Idris system. If your system
does not meet these requirements, contact Technical Support at Chromatics'
home office.

> CGC 7900 Model 2 or 3
> Minimum 384k bytes of Buffer Memory (640K bytes for FORTRAN)
> Dual Flexible Disk Drives with Disk Controller
> 10 or 40 megabyte Hard Disk
> 4k CMOS RAM and Real Time Clock

There are three steps to take before bringing up the Idris system. First,
the Whitesmiths, Ltd. License Agreement must be completed and returned to
the attention of Order Entry. Second, read the Idris documentation care-
fully before beginning. The Chromatics Idris Addendum contains a roadmap
to the Idris documentation. For customers that are not familiar with the
Idris Operating System, please reference the CGC 7900 Bibliography containing
books that supplement the tutorial information in the manuals.

Third, it is important that someone take responsibility for system
administration of the CGC 7900. This responsibility includes installing
new users on the system, maintaining and backing up the Idris filesystem,
upgrading existing CGC 7900 options and adding new features. Please
reference Section IV of the Idris Users Manual.

For the delivered Idris sytem, there are two logins or entries in the
/adm/passwd file. The first login is root which is the "superuser" logname.
The password for root is cgc. This login has the ability to access and
modify any file in the system and can be potentially dangerous in the hands
of an Idris beginner. We recommend that the system administrator change the
root password and keep it secure.

The second login is proto; this can be used as an initial user login and
also as a template for creating new user login entires in the /adm/passwd
file. There is no password for proto.

When Idris is operational, the operating system uses a cache mechanism for
the disk. This means that disk blocks are kept in main memory in anticipation
of being re-used. It is important to make sure that all memory images of
disk blocks are written to the disk before exiting or powering down. The
recommended Idris shutdown procedure is (% is the default user prompt):

```
% sync
% ctrl-shift-RESET
Power Off
```

The above sync command flushes all disk buffers. When the prompt is returned after sync, it is safe to exit from Idris. In addition, in the standard Idris configuration, there is a process spawned at boot time under the login, daemon, that flushes the disk buffers (issues sync) every 15 seconds. This process can be disabled or modified by editing the /adm/init file. We recommend that you leave this process in your configuration.

We look forward to working with you throughout your CGC 7900 system development. The Idris operating system is a milestone in the development of the CGC 7900 and a strong system builder for color graphic applications.

CHROMATICS, INC.

CGC 7900 COLOR GRAPHICS COMPUTER SYSTEM

OPTION 7965-01

IDRIS 3.0 RELEASE NOTES

Document Number 070256

Printed November 9, 1984

NAME
     Intro - Introduction to the third release of Idris

SYNOPSIS

     The major feature of the third release is support of new hardware. Both
     the 9-track magnetic tape interface and the disk DMA interface are
     supported under the third release. As well as supporting the DMA
     interface, the new disk software is capable of dealing effectively with
     media defects (bad blocks). This is accomplished by a **powerful new disk
     formatter** that not only can map around media defects, but also repartition
     the hard disk to allow multiple filesystems and user-defined disk
     partitions.

     With the addition of the Disk DMA option, the optimal interleave factor
     for the hard disk has changed. The hdformat program chooses, by default,
     the appropriate interleave factor for the device selected, based on
     whether the Disk DMA interface is present. The optimal interleave factors
     are 13 with the Disk DMA interface and 6 without the Disk DMA interface.

     The Idris kernel and its mode of distribution have also changed. It is
     now possible for customers to add their own device drivers. A number of
     other features have been added to the kernel, including a lock-in-core
     mechanism and visible indicators for serial i/o error conditions.

     Many of the compiler support library routines have been rewritten for
     efficiency. In particular, double precision floating point operations now
     take much less time.

     A new and very powerful utility has been added. Unix users will recognize
     make as a tool to rival a screen editor in importance.

     For the most part, the "Whitesmiths' proper" software, except for bug
     fixes, has not changed. Nor has the Whitesmiths manuals changed. This
     release reflects the changes Chromatics has made to the Idris Operating
     System, primarily in the Idris device driver support and the Chromatics
     utilities (/cbin/*). The Chromatics Idris Addendum is the only manual
     that has changed.

     It is our recommendation that, after updating the third release, that a
     dump be performed on the root filesystem, normally /dev/hard00, to a set
     of diskettes. In this way, it will be possible to perform an incremental
     dump of the disk, minimize the number of diskettes involved, and keep the
     hard disk backed up. For information on maintaining the Idris filesystem,
     there are two System Notes available from Chromatics titled, "The
     Structure of the Idris Filesystem" and "Backing Up the Idris Disk System".

     Finally, it is important to note that in order to take advantage of the
     new support for media defects on the hard disk, it will be necessary to
     perform a full **dump** to diskette, re-**format** the hard disk, make new
     filesystems (see **mkfs** and /dev/disk), and a full **restor**. Please note that
     the standard (default) partition size for /dev/hard00 on both the 10 and
     40 megabyte disk drives has decreased slightly (13552 blocks instead of
     14000 for the 10MB drive and 61488 blocks instead of 62000 for the 40MB
     drive). This means that caution must be taken to avoid dumping a standard

Release 2 filesystem that is completely full to a standard Release 3
filesystem; not everything may fit in the new partition.

NAME
    Requirements - Requirements for the third release of Idris

SYNOPSIS
    The third release software requires the new Idris boot PROM pair (iboot 2.0). This is made necessary by their common support of the DMA disk interface and their common ability to handle media defects.

    Other than that, the third release software requires nothing more than that required by the second release software.

NAME
      Features - Features contained in the third release of Idris

SYNOPSIS

      The following list highlights the significant new features:

  ● **DMA Disk Support**

      A major new feature of the third release is support for the DMA disk
      interface (Option 7939-01). Both the Idris boot PROM and the Idris
      kernel probe the system for the presence of a disk DMA board. If
      present, the DMA device becomes the disk interface, otherwise the
      normal polled i/o interface is used. With the disk DMA interface, as
      much as a 2-to-1 performance improvement can be realized for i/o bound
      processes. Of course, maximum throughput cannot be realized unless the
      disk is properly formatted. For users upgrading to a disk DMA system,
      we recommend a full dump followed by a re-formatting of the hard disk
      and a full restor. Please note that the standard (default) partition
      size for /dev/hard00 on both the 10 and 40 megabyte disk drives has
      decreased slightly (13552 blocks instead of 14000 for the 10MB drive
      and 61488 blocks instead of 62000 for the 40MB drive). This means that
      caution must be taken to avoid dumping a standard Release 2 filesystem
      that is completely full to a standard Release 3 filesystem; not
      everything may fit in the new partition.

  ● **9-Track Magnetic Tape Support**

      Although previously available as a software patch, support for
      industry standard 800/1600 bpi 9-Track magnetic tape has been
      integrated into the third release. The driver will attempt to recover
      from media dropout during read and write operations. The hardware is
      capable of any type of tape transport adhering to the PERTEC interface
      standard; however, Chromatics currently only supports the Control Data
      Corporation T-45B with embedded formatter. Other tape drives known to
      be operational are the Kennedy 9000F-3 with embedded formatter and the
      Cipher 910 Dual Density with embedded formatter.

  ● **Support for Media Defects**

      A sector replacement strategy is employed by the Idris kernel and the
      Idris boot PROM in order to avoid uncorrectable areas of a hard disk.
      The replacement information is stored along with the disk partitioning
      information in block 0 of the disk. A sophisticated standalone hard
      disk formatter has been supplied which assists in the discovery of bad
      sectors. Drive manufacturer's media defect data may also be entered.

● **Miscellaneous Kernel Enhancements** ·

A number of enhancements have been made to the Idris kernel. Primary among them is the ability for customers to add their own device drivers. Thie files and tools required to re-link the kernel either to add or delete device drivers are found in the /stage directory. A user process lock-in-core mechanism has been provided and several overlay cells are now used to give visible sign of serial i/o errors. Finally, many potentially fatal TERMEM modules have been stubbed out to help prevent the loss of Idris control.

● **Library Enhancements**

Significant speed improvements have been made to the compiler support routines in the C library. These include routines for integer 32-bit multiplication and division as well as all double precision floating point operations. In addition, a facility has been provided to replace all double precision routines with single precision routines.

● **Make**

A very popular and nearly indispensable Unix facility, make, has been provided with the third release. Make is a software development tool which orchestrates the construction and maintenence of large programs. A hierarchical network of roughly 30 makefiles were used in the construction of this Idris release.

● **ACT1 Color Copier Device Drivers**

Two new device drivers have been added to drive the ACT1 Color Ink Jet printer, **/dev/act1plot** and **/dev/act1print**. Both can be used in conjunction with the PIO/DMA interface (Option 7930-01) to drive the ACT1 both as a graphics copier and as line printer.

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NAME
     Bugs Fixed - Bugs fixed in the third release

SYNOPSIS
     A number of small bugs have been fixed in the third release. They are:

Misc. Kernel Bugs

A more elegant solution to the 512K limitation with Ver_2 (4Meg with Ver_2a)
has been found. There is no longer an upper limit of user space supported.
Another sneaky scheduler deadlock has been fixed. This one showed up during
heavy swapping. The link and unlink system calls no longer update the
modtime of files. This is to allow the VPATH facility of make to work. The
check on read/write addresses has been removed. One can now perform a read
into any portion of memory (including screen RAM). The internal kernel
buffer move has been sped up considerable. Finally, TERMEM's input buffer is
cleaned-out at boot time, so as to prevent the system from booting itself
twice in rapid succession.

Misc. Utility Bugs

A number of small utility bugs have been fixed. cp now copies more than 512
bytes at a time. cu now strips its high order bit in conversation mode. The
dump -h flag now works. The link library table has been extended. The shell
has been fixed to ignore interrupts for background processes, as well to
close all its open files before performing the 'exec' command. grep has been
fixed to allow 10 -o flags properly. tp has been fixed to not complain of
checksum errors. dd has been taught to stop when 0 is returned from a write
call. cgdos and cgcdos have been taught to rename files to ".KIL" when
overwriting. A number of bugs have been fixed in the assembler as68k. A
small bug in the "inline" routines have been fixed in the utilities ne and
thaw. Finally, a bug in restor prevented the use of 64Kbyte tape blocks.

FLOATING POINT ENHANCEMENTS

INTRODUCTION

The double precision floating point routines used by the Whitesmiths C and Pascal compilers have been optimized for speed. Single precision floating point routines have also been provided.

The program listed in Appendix A (integ.c) was run using the math routines as supplied by Whitesmiths, the optimized double precision routines, and the new single precision routines. The execution times are given in the following table, along with the execution time of the equivalent FORTRAN program for comparison.

Whitesmiths C	14.70 minutes
Enhanced Double Precision	3.39 minutes
Single Precision	1.94 minutes
FORTRAN Double Precision	4.41 minutes
FORTRAN Single Precision	1.83 minutes

DOUBLE PRECISION

By definition of the C language, all floating point operations are performed in double precision. Double precision values have a range of $-3.6e+308$ to $3.6e+308$ and about 14 digits of accuracy; but they are computed very slowly by the code supplied by Whitesmiths. These routines have been optimized and are now about 4.5 times faster than before.

No changes to a C program are necessary to use these enhanced routines — simply compile and re-link your program(s) with the new libraries supplied by Chromatics.

Example

To compile and execute the program in Appendix A (named integ.c) using
the fast double precision routines:

```
% c integ.c
% setb -b 10000 xeq
% xeq
```

To compile a Pascal program:

```
% pc pasprg.p
```


SINGLE PRECISION

For programs requiring greater speed but less accuracy, you may elect to
have C perform all of its floating point calculations in single precision.
The single precision routines have a range of -6.8E+38 to 6.8E+38, with
about 7 digits of accuracy.

Use cfl to compile and link your C programs to take advantage of the
single precision routines. No changes to your program should be
necessary, unless your code assumes knowledge of the format of floating
point numbers. You must also re-compile any user libraries which contain
floating point constants!

Example

To compile and execute the program in appendix A (named integ.c) using
the single precision routines:

```
% cfl integ.c
% setb -b 10000 xeq
% xeq
```

To compile a Pascal program:

```
% pcfl pasprg.p
```

a) Keep in mind that your C and Pascal programs can perform floating arithmetic in either single precision or double precision, but not both! This restriction comes from the definition of both languages.

b) With the double precision routines, variables declared double are stored in IEEE double precision format. Variables declared float are stored in IEEE single precision format, and are widened to double when used in an expression.

c) With the single precision routines, variables declared double are stored in 64 bits - the first 32 are the number stored in IEEE single precision format, the last 32 are meaningless. Variables declared float are stored in IEEE single precision format. The "widening" to double operation occurs when floats are encountered in an expression. This essentially null operation does take a little time.

   This means that declaring something double gives slightly greater speed at the expense of storage, while declaring something float saves storage at a small decrease in speed.

d) Although IEEE format is used, no provision is made for NaN's (Not A Number), denormalized zero, or infinity. Arithmetic overflow results in the largest representable number with the correct sign (see the manual page for _huge). Underflow quietly goes to zero. Divide by zero gives positive _huge.

e) The double precision routines are about 4.5 times faster than those supplied by Whitesmiths; the single precision routines are about 9.5 times faster. Their use, however, is not guaranteed to result in the same factor of improvement in the execution time of a program - simply because most programs don't spend all of their time performing floating point operations.

```
/*  CALCULATE THE AREA UNDER THE CURVE
 *
 *  The area under the function "efunc", from -1 to 1,
 *  is first computed using a power series, then
 *  by the trapezoidal rule.  Taken from:
 *  Introduction to Numerical Methods, Peter A. Stark,
 *  The Macmillan Co., 1970, pgs. 227-229
 */

#include <std.h>

#define PI 3.1415926
#define efunc(x) (exp(-(x) * (x) / 2.0) / sqrt(2.0 * PI))

VOID main( )
    {
    IMPORT DOUBLE exp(), sqrt();

    ARGINT i, j, nodiv;
    DOUBLE a, area, width, xl, xr;

    putstr(STDOUT, "integration of the power series\n", NULL);
    area = 2.0 * (1.0 - 1.0 / 6.0 + 1.0 / 40.0 - 1.0 / 336.0
        + 1.0 / 3456.0 - 1.0 / 42240.0 + 1.0 / 599040.0
        - 1.0 / 9676800.0) / sqrt( 2.0 * PI );

    putfmt("\n                        %10.7f\n", area);

    putstr(STDOUT, "\nintegration by the trapezoidal rule\n", NULL);
    for(i = 1; i <= 13; ++i)
        {
        nodiv = 1 << (i - 1);
        area = 0.0;
        width = 2.0 / nodiv;
        for (j = 1; j <= nodiv; ++j)
            {
            xl = -1.0 + (j - 1) * width;
            xr = -1.0 + j * width;
            a = (width / 2.0) * (efunc(xl) + efunc(xr));
            area = area + a;
            }
        putfmt("with %6i trapezoids, the area is %11.7f\n", nodiv, area);
        }

    }
```

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SYSTEM NOTE

Subject: Backing Up the Idris   Date   : July 5, 1983
          Disk System
                                         Product: CGC 7900

                                         File # : CGC-11

Abstract

It is always good programming practice to keep the CGC 7900
Idris filesystem backed up. The procedure for creating an
archive should be easy to implement and performed on a regular
basis. This system note suggests a procedure for dumping and
restoring the Idris filesystem to diskette or tape and recommends
the utility arguments appropriate for a standard fixed disk par-
tition configuration.

Backing Up the Idris Disk System

1. INTRODUCTION

The Idris Operating System is packaged as a collection of 5 to 9 diskettes (/dev/rx1d) depending on the associated options, C Compiler, Pascal Compiler and FORTRAN Compiler. In order to run Idris on the CGC 7900, it is necessary to install the operating system software on the CGC 7900 hard disk. This procedure is well documented in the Chromatics Idris Addendum [3]. New CGC 7900 systems with the Idris Operating System are delivered with Idris already installed on the hard disk; it should only be necessary to unlock the hard disk and press the IDRIS key.

Once installed, the hard disk can **only** be used by Idris and will dynamically change over time with use. It is important to note that the Idris filesystem requires regular maintenance to insure the integrity and performance of the overall system. This maintenance includes 1) checking the filesystem regularly for damage [1], 2) cleaning up unused files for maximum disk utilization, 3) installing users and application filesystems and 4) backing up the hard disk files.

This note describes a procedure for backing up the Idris hard disk using **dump** and **restor** [2]. The next section sketches a recommended management procedure for using **dump** and **restor**. Many variations exist for how the disk should be managed, but hopefully this section can provide a useful recommendation.

The following sections describe the **dump** and **restor** procedures using the standard hard disk partition configuration and diskettes for the back-up medium. Attached are the manual pages for **dump** and **restor**.

2. MANAGING THE BACK-UP PROCEDURE

When Idris is delivered, the distribution diskettes should be stored in a safe place with the write enable tabs removed. These diskettes should theoretically not need to be used, except for the boot diskette for use during **dump** and **restor**.

Upon first use of the system, it is recommended that a full **dump** be performed to diskette or tape. This is described in the next section. If a new version of Idris is to be applied to the system, an Update [3] should be performed first along with a cleanup of unused files (minimize the size of dump). From that point forward, an incremental **dump** should be performed regularly to reflect the changes since the last full **dump**. Depending on system use, this should be performed as often as once a day.

Periodically, it is recommended that a full **restor** be performed to reorganize the files on the disk and minimize the time and space required for incremental dumps. Note that an incremental dump is the difference between the last full dump, not the last incremental **dump**.

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The following list is a recommended procedure for managing the hard disk.

1. Store the Chromatics distribution diskettes in a safe place. Make sure that they are write-protected.

2. If Idris is not installed on the hard disk, follow the installation procedures outlined in the Chromatics Idris Addendum [3].

3. The state of the Idris filesystem and hard disk should be verified for integrity and completeness. There are several techniques for doing this. At a minimum, the following is recommended.

    a. icheck and dcheck the filesystem to be dumped, normally /dev/hard00. Remember, only Idris filesystems can be dumped.

    b. If there is concern about the integrity of the Idris Operating System software, it may be desireable to **Verify** [3] the contents on the hard disk against the distribution diskettes.

4. Perform a full **dump** of the filesystems to be saved. The procedure for dumping the root filesystem is outlined in the next section. Depending on the amount of files on the root filesystem, this can take from 4 to 60 diskettes (60 is for a full 40 megabyte disk; a tape drive is recommended in this case).

5. Perform daily maintenance of the filesystem using the check utilities documented in the Idris Users Manual (icheck, dcheck, ncheck, fcheck) [1, 2].

6. Perform incremental **dump**'s and **restor**'s on a regular schedule. The incremental procedures are also described in the next section.

3. USING dump AND restor ON THE ROOT FILESYSTEM

This procedure describes how to **dump** and **restor** the "standard" partitions of either a 10 or 40 megabyte disk. What is meant by "standard", is that the arguments used in the following examples are for the Idris disk system as shipped from the factory, i.e. the filesystem to be dumped was produced by the standard Makehard procedure. Any changes that have been made to the hard disk filesystem(s) to be dumped must be reflected in the **dump** and **restor** command arguments.

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Dumping the Hard Disk to Diskettes

1. Obtain a number of blank diskettes (double density, single sided, soft sectored). A lightly loaded 10 megabyte system will probably require about 6 diskettes, but a heavily loaded 40 megabyte system may require as many as 60 diskettes. Therefore, it is important to: 1) remove unused files from the filesystem before dumping and 2) consider dividing a 40 megabyte disk into several smaller filesystems and maintain them separately. The -t flag on **dump** will cause **dump** to only report the number of diskettes (called "tapes" by **dump**) required.

2. If the diskettes are not already formatted, do so. We recommend formatting with an interleave factor of 1 and using the rx[0 or 1]d device driver.

        # format -i1 /dev/rx1d

   This interleave factor has been observed to be the best performer for diskette i/o.

3. Read each diskette to verify that all blocks are readable by the disk controller. This can be accomplished by performing the following command for each diskette. There are 988 blocks (512 bytes) on a diskette.

        # dd -c988 /dev/rx1d > /dev/null

4. Before dumping the filesystem, another "safeguard" should be performed. Enable write checking for the floppy device driver with the following command. This will force the disk driver read every block written to a diskette and compare the data written. The **dump** will take a little longer, but it will help ensure the integrity of the data written.

        # dparam +w /dev/rx1d

5. Place a diskette in the right drive and perform:

        # dump -b26 -r37 -o/dev/rx1d /dev/hard00

   The -b26 flag specifies 26 512-byte blocks per record. The -r37 flag specifies 37 records per diskette. These parameters will use 962 blocks from the available 988 blocks on an rx1d diskette. If a 9 track magnetic tape drive is being used instead of diskettes, the following **dump** command can be used. Here, -b10 specifies 10 blocks per record.

        # dump -b10 -o/dev/rmt16 /dev/hard00

-3-

dump should write a few blocks to the disk, inform you how many "tapes" will be required (interpret "tapes" to mean diskettes), then begin the actual dump. As it fills diskettes, it will ask you to mount new ones. Make sure you label the diskettes so as to not get them confused. Each diskette will take about 4 minutes to fill. This time can be halved by increasing the stack size for dump as follows:

        # setb -b20000 /etc/dump

This need only be done once, not every time you do a backup.

Restoring the Idris Hard Disk

The restore procedure is accomplised by running Idris from the boot floppy and restoring the root filesystem on the hard disk from the dump diskettes using the right floppy drive. The following are the steps required to fully **restor** the hard disk.

1. Put the 7900 in the power up state by performing a CTRL-SHIFT-RESET. Type:

        user i

    At this point, you should get a yellow asterisk prompt. Now put the Idris boot diskette in the left drive and type:

        */dev/rx0d/boot/idris

    The left diskette will be read and Idris will boot after approximately 45 seconds. At this point you will have possibly re-formatted the hard disk; though re-formatting is not necessary.

2. Instead of typing **Makehard**, type:

        # mkfs -s13552 -m5 /dev/hard00

    The -s13552 flag is the standard partition for a 10 megabyte disk system. For a 40 megabyte disk system, use -s61488. Remember, if you have changed the size of the root filesystem or are dumping a user-defined filesystem, the appropriate changes need to be made to the above mkfs command. The -m5 flag specificies the optimal organization the newly created free list.

Now the **restor** can proceed. Place the first dump diskette in the right drive and type:

        # restor -a -b26 -f/dev/rx1d /dev/hard00

The -a flag specifies that a full **restor** is requested. The incremental **dump** and **restor** procedures are described in the next section.

Once the **restor** is complete, RESET the 7900 and boot **IDRIS**.

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4. INCREMENTAL dump AND restor

There is an option for performing an "incremental dump" of the hard disk. This is the -i flag. If it is added to the above **dump** command, only files that have changed since the last complete dump of the specified filesystem (as indicated in the dump history file, /adm/dlog) are included in the current dump. If there is no entry in the dump history file for the specified filesystem, then a full dump will be performed.

When restoring, there are several flags that can be applied. In the above example, the -a flag is used to restore an entire filesystem from a <u>full</u> dump. This should only be done to an empty filesystem of the appropriate size (as produced by **mkfs**) when a <u>full</u> **dump** is used.

The -a flag can also be used on an incremental **dump**; however, it is important to **restor** the filesystem to the state of the last <u>full</u> **dump** before restoring the incremental dump.

CONCLUSION

With the facilities of **dump** and **restor**, it is possible to both back up the Idris filesystem, as well as move a filesystem from one disk partition to another. When an incremental **dump** gets sufficiently large because of numerous file changes since the last full **dump**, it is advisable to perform a full **dump** and begin the incremental back up procedures from a new point in time.

It is important to keep a current back up copy of the hard disk image when using the CGC 7900 under Idris. Though there are several techniques for storing copies of files on diskette, the procedure outlined in this paper provides a simple yet comprehensive procedure for backing up the Idris hard disk.

REFERENCES

[1] "The Structure of the Idris Filesystem", Chromatics System Note, CGC-2.

[2] <u>Idris Users' Manual</u>, Release 2.1, March, 1982.

[3] <u>Chromatics Idris Addendum</u>, Release 3, May 18, 1982. 6/83
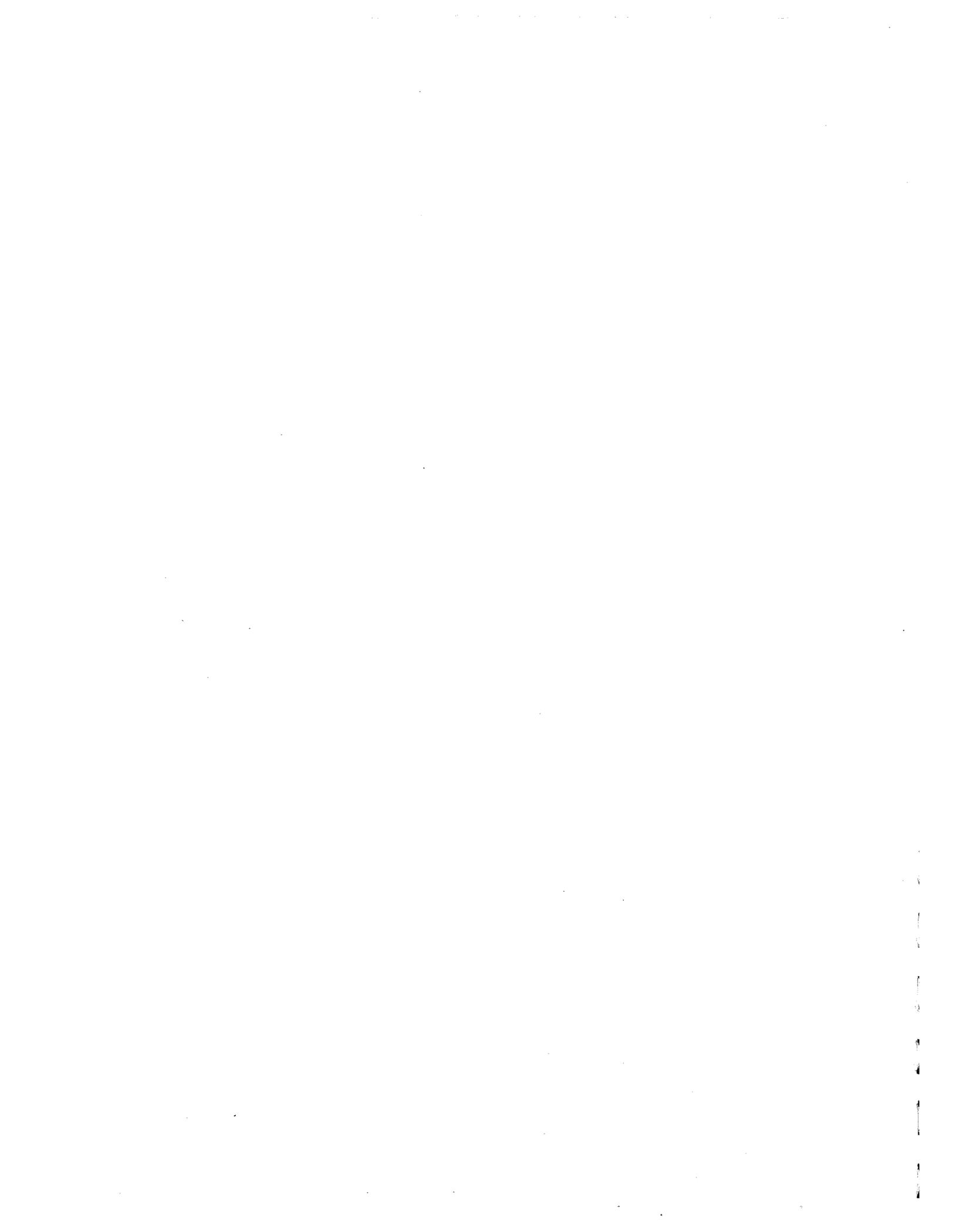
SYSTEM NOTE

Subject: Using Floating Point   Date   :   July 5, 1983
Libraries in Whitesmiths'
C and Pascal   Product: CGC 7900

File # :   CGC-12

Abstract

The Idris floating point library was originally introduced in a
portable form and was used by both the C and Pascal compilers.
These portable library routines could be used in other Idris
run-time environments but were found to be somewhat slow. In
Idris release 3.0, these floating point routines have been
optimized for speed and as a result have been divided into two
complete libraries: double precision and single precision.
This system note explains the differences between these two
libraries and gives examples for their respective compilations.

USING FLOATING POINT LIBRARIES IN WHITESMITHS' C AND PASCAL

INTRODUCTION

The double precision floating point routines used by the Whitesmiths C and Pascal compilers have been optimized for speed. Single precision floating point routines have also been provided.

The program listed in Appendix A (integ.c) was run using the math routines as supplied by Whitesmiths, the optimized double precision routines, and the new single precision routines. The execution times are given in the following table, along with the execution time of the equivalent FORTRAN program for comparison.

Whitesmiths C	14.70 minutes
Enhanced Double Precision	3.39 minutes
Single Precision	1.94 minutes
FORTRAN Double Precision	4.41 minutes
FORTRAN Single Precision	1.83 minutes

DOUBLE PRECISION

By definition of the C language, all floating point operations are performed in double precision. Double precision values have a range of -3.6e+308 to 3.6e+308 and about 14 digits of accuracy; but they are computed very slowly by the code supplied by Whitesmiths. These routines have been optimized and are now about 4.5 times faster than before.

No changes to a C program are necessary to use these enhanced routines - simply compile and re-link your program(s) with the new libraries supplied by Chromatics.

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Example

To compile and execute the program in Appendix A (named integ.c) using the fast double precision routines:

```
% c integ.c
% setb -b 10000 xeq
% xeq
```

To compile a Pascal program:

```
% pc pasprg.p
```

SINGLE PRECISION

For programs requiring greater speed but less accuracy, you may elect to have C perform all of its floating point calculations in single precision. The single precision routines have a range of -6.8E+38 to 6.8E+38, with about 7 digits of accuracy.

Use csp to compile and link your C programs to take advantage of the single precision routines. No changes to your program should be necessary, unless your code assumes knowledge of the format of floating point numbers. You must also re-compile any user libraries which contain floating point constants!

Example

To compile and execute the program in appendix A (named integ.c) using the single precision routines:

```
% csp integ.c
% setb -b 10000 xeq
% xeq
```

To compile a Pascal program:

```
% pcsp pasprg.p
```

GENERAL NOTES

a) Keep in mind that your C and Pascal programs can perform floating arithmetic in either single precision or double precision, but not both! This restriction comes from the definition of both languages.

b) With the double precision routines, variables declared double are stored in IEEE double precision format. Variables declared float are stored in IEEE single precision format, and are widened to double when used in an expression.

c) With the single precision routines, variables declared double are stored in 64 bits - the first 32 are the number stored in IEEE single precision format, the last 32 are meaningless. Variables declared float are stored in IEEE single precision format. The "widening" to double operation occurs when floats are encountered in an expression. This essentially null operation does take a little time.

   This means that declaring something double gives slightly greater speed at the expense of storage, while declaring something float saves storage at a small decrease in speed.

d) Although IEEE format is used, no provision is made for NaN's (Not A Number), denormalized zero, or infinity. Arithmetic overflow results in the largest representable number with the correct sign (see the manual page for _huge). Underflow quietly goes to zero. Divide by zero gives positive _huge.

e) The double precision routines are about 4.5 times faster than those supplied by Whitesmiths; the single precision routines are about 9.5 times faster. Their use, however, is not guaranteed to result in the same factor of improvement in the execution time of a program - simply because most programs don't spend all of their time performing floating point operations.

APPENDIX A

```
/*  CALCULATE THE AREA UNDER THE CURVE
 *
 *  The area under the function "efunc", from -1 to 1,
 *  is first computed using a power series, then
 *  by the trapezoidal rule.  Taken from:
 *  Introduction to Numerical Methods, Peter A. Stark,
 *  The Macmillan Co., 1970, pgs. 227-229
 */

#include <std.h>

#define PI 3.1415926
#define efunc(x) (exp(-(x) * (x) / 2.0) / sqrt(2.0 * PI))

VOID main( )
    {
    IMPORT DOUBLE exp(), sqrt();

    ARGINT i, j, nodiv;
    DOUBLE a, area, width, xl, xr;

    putstr(STDOUT, "integration of the power series\n", NULL);
    area = 2.0 * (1.0 - 1.0 / 6.0 + 1.0 / 40.0 - 1.0 / 336.0
        + 1.0 / 3456.0 - 1.0 / 42240.0 + 1.0 / 599040.0
        - 1.0 / 9676800.0) / sqrt( 2.0 * PI );

    putfmt("\n                        %10.7f\n", area);

    putstr(STDOUT, "\nintegration by the trapezoidal rule\n", NULL);
    for(i = 1; i <= 13; ++i)
        {
        nodiv = 1 << (i - 1);
        area = 0.0;
        width = 2.0 / nodiv;
        for (j = 1; j <= nodiv; ++j)
            {
            xl = -1.0 + (j - 1) * width;
            xr = -1.0 + j * width;
            a = (width / 2.0) * (efunc(xl) + efunc(xr));
            area = area + a;
            }
        putfmt("with %6i trapezoids, the area is %11.7f\n", nodiv, area);
        }

    }
```

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CATALOG OF AVAILABLE SYSTEM NOTES

Product: CGC 7900

File #   Title of System Note

CGC-1   Explanation of the Disk Device Names Used Under Idris

Describes the disk device drivers under the Idris Operating
System, detailing /dev entries and minor device numbers.

CGC-2   The Structure of the Idris Filesystem

Describes the Idris filesystem architecture, discusses at-
tributes of a filesystem that can sustain damage, gives
example of and discusses a damaged filesystem and how to
repair it.

CGC-3   Separate Compilation of Procedures in Pascal

Describes the format of "library" files in Pascal and how to
use them.

**CGC-4   Obtaining Assembly Language Code Listings of Compiled FORTRAN
Programs**

Describes a method of listing the assembly language code
generated by the FORTRAN compiler.

CGC-5   Vector-Drawn Characters

Describes how the firmware operates with Vector-Drawn Charac-
ters option, and how custom character sets can be defined.

CGC-6   RESET Levels for CGC 7900: Functional Description and Use

Discusses the different reset levels, in ascending order of
severity, that exist on the CGC 7900.

CGC-7   Programming the CGC 7900 Hardware Vector Generator

Explains the HVG and discusses utilizing its full potential; gives programming examples.

CGC-7A   Addendum to System Note CGC-7

Contains additional precautions and considerations for programming the HVG, with examples.

CGC-8   Joystick Application Programming Under Idris

Gives examples in "FORTRAN", "C", and "Pascal" of how joystick application programs can be created utilizing the device name "/dev/joy".

CGC-9   Keystuff/Scankey: Reprogramming the Keyboard Under TermEm

Describes in detail two TermEm routines, Keystuff and Scankey, and demonstrates how they can be utilized to reprogram the CGC 7900 keyboard.

CGC-10   Programming the Interrupt Mask Under Idris

Suggests a procedure for manipulating the Interrupt Mask and gives a programming example following this procedure.

CGC-11   Backing Up the Idris Disk System

Suggests a procedure for dumping and restoring the Idris filesystem to diskette or tape and recommends utility arguments appropriate for a standard fixed disk partition configuration.

CGC-12   Using Floating Point Libraries in Whitesmiths' C and Pascal

Explains differences between double precision and single precision libraries of Idris release 3.0 floating point routines, giving examples for their respective compilations.

CGC-13   Introduction to CGC 7900 TermEm Graphics Under Idris

Describes how to access TermEm graphics from the keyboard under Idris, how to use the create buffer, and how to use the standard Idris tool for demonstrating create buffer (.BUF) and DOS run length encoded (.RLE) graphics files; also discusses cgcdos, a tool for reading and writing DOS diskettes.

CGC-14   CGC Demo Tips

Introduces operation of the CGC 7900 graphics function through TermEm.

CGC-15   How the CGC 7900 Handles MC68000 Exceptions

Explains how to interpret system trap information on bottom
line of screen when system makes funny noise and dies.

CGC-16   Fast FORTRAN Graphics Routines

Details methods required to write your own custom assembly
language subroutines to FORTRAN programs, with examples.

GDG-17   RS-232 Application Note

Describes signals which make up an RS-232 serial communi-
cations interface, gives details on Chromatics' usage of these
signals in our various products, and describes how the signals
might be used to interface to other equipment.

CGC-18   Use of Serial Ports under Idris

Adds further information to System Note CGC-17 (the RS-232
Application Note) by discussing use of serial ports under
Idris, gives details on difficulties encountered when reading
data from external serial devices, and suggests solutions
which may alleviate these difficulties.

CGC-19   CMOS and Disk Drives in the CGC 7900

Explains how CMOS parameters determine which type of disk
drive is installed in the system.

Rev. 08/29/84

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CHROMATICS, INC.

CGC 7900 COLOR GRAPHICS COMPUTER SYSTEM

OPTION 7968-01

FORTRAN 77, VERSION 3a RELEASE NOTES

Document Number 070255

Printed November 9, 1984

INTRODUCION

This document describes the Release 3a of the Chromatics FORTRAN 77
Compiler (Option 7968-01). These notes accompany the new Release 3a
FORTRAN Manual and describe the compatibility, new routines, feature
additions, changes and bug information.

COMPATIBILITY WITH PREVIOUS RELEASES

Please note that the .obj files produced by this release of the FORTRAN
compiler are **incompatible** with the .obj files produced by releases 1 and
2. Mixing these .obj files will produce various strange results. It is
recommended that all FORTRAN source files (.f77) be compiled using the new
compiler so that no problems occur.

The **$F66** compiler directive is no longer recognized by the compiler. Its
replacements are described below.

NEW ROUTINES

Several new subprograms have been added to the FORTRAN system. They are:

argcop	operate on **argc**
argvop	operate on **argv**
bpeek	byte peek
cptime	compute elapsed real time
date	get system date and time
delay	suspend execution
fstat	get status of open file
ftoif	pass FORTRAN file to Idris
gtty	get tty status
iaddr	determine address
ibit	set/clear bit
igtclk	read Real-Time Clock
itime	get system time
lpeek	long peek
m1m2cs	poll state of M1/M2/CTRL/SHIFT keys
stty	set tty status
wpeek	word peek
xecl	execute file with argument list

Documentation for each of these routines may be found in Appendix C of
the revised FORTRAN manual.

FORTRAN MANUAL UPDATED

The FORTRAN Reference Manual, document number 070213, has been extensively revised. The Release Notes for the previous release of the compiler have been incorporated into the manual; Chapter 13 has been updated; documentation for the new routines has been included; and several manual pages in Appendix E (most notably fortran) have been revised.

FORTRAN 66 SUPPORT/COMPILER DIRECTIVES

The $F66 directive has been removed from this release of FORTRAN. In its stead are the directives:

● $F66DO,

● $CHAREQU,

● $INT2

Each of these directives are described in the fortran manual page in Appendix E of the revised manual.

Additionally, the $SEGMENT directive is no longer required when compiling large programs.

INTEGERS AND THE A FORMAT DESCRIPTOR

FORTRAN now permits output of integers using the "A[w]" format descriptor. This program fragment will output 'ABC' to the console:

```
i = $41424300
write(*, '(A3)') i
```

or, alternately:

```
$CHAREQU
    data i/'ABC'/

write(*, '(A3)') i
```

SCRATCH FILES

Each time a file was opened with "STATUS='SCRATCH'", FORTRAN would create a file in the current directory with the name "TMPxx", where "xx" was "00", "01", ... depending on the number of scratch files currently open. FORTRAN now places scratch files in the "/tmp" directory, with names of the form "/tmp/t#####xx", where "#####" is the unique process-id of the executing program and "xx" is as before. Further, these scratch files will be automatically deleted by FORTRAN upon normal program termination.

CLOSING FILES WITH STATUS='DELETE'

As stated in the FORTRAN manual, all files were closed with "STATUS='KEEP'", regardless of the option specified in the CLOSE statement. FORTRAN will now delete files closed with STATUS='DELETE'.

BUG NOTES

- FORTRAN was unable to open a file that did not have READ and WRITE permissions. It now tries to open a file for UPDATE (READ and WRITE); if this fails it tries to open the file READ only; and if this fails it tries to open the file WRITE only. If these fail, the file cannot be opened and FORTRAN returns an error code.

- The compiler now accepts statements of the form:

  CHARACTER*(*) ARRAY(1)

- The math package will now compute X ** Y when X is less than 0.0 and does not contain a fractional part (e.g. '-3.0 ** 2.0'). Previously, it gave an "r**r" error message.

- The FORTRAN system now permits external routines written in C to make calls on the alloc routine.

- If an OPEN(unit, file=..., status='OLD' ...) failed, it was impossible to re-use unit in another OPEN attempt. This has been fixed.

- If an OPEN(IUNIT, ... failed, an INQUIRE(IUNIT, opened=od ... would set od to .TRUE., which is patently false. This has been fixed.

- Declaring an argument to a subroutine to be an array, without ever referencing that argument, would sometimes a) cause fortran to halt with a bus error, b) generate error #2002 in fcode, or c) work perfectly. The FORTRAN compiler now always chooses option c.

- The DATAN2 function never worked correctly, but has now been fixed.

- External functions used in a PRINT statement must be declared external; otherwise, the compiler will treat the functions as arrays.

FORTRAN .OBJ LIBRARIAN

The program library, described in Appendix E of the new FORTRAN manual, permits the creation of libraries of .obj files.

CHANGE TO ILINKER

The -s flag has been removed from the ilinker command line.

FORTRAN TO C LINKAGE

fclink is a utility which aids in the generation of the assembly language code required to mate FORTRAN and C subroutines. Its manual page appears in Appendix E of the new FORTRAN manual.

INSTALLATION

FORTRAN requires the Idris Operating System with at least 256K bytes of user space. To install the compiler, first ensure that you have superuser privileges (i.e. logged in under root), then insert the FORTRAN distribution disk in the right hand floppy drive.

Type:

```
# mount -r rx1d /x
# /x/Install
# /x/Verify
# mount -u rx1d
```

If you are updating an earlier release of the FORTRAN compiler, type /x/Update instead of /x/Install in the example above. Error messages of the form "filename not found" generated by the Update procedure are no cause for alarm and should be ignored. The version utility, used to determine the status of the individual programs in the FORTRAN system, is simply reporting that a program is not present. The Update procedure will then install the program.

If desired, the operation of the FORTRAN system can be checked by compiling and executing the demo program wc.f77. This program was copied to the directory /usr/demo if said directory exists (if it does not, copy /x/usr/demo/wc.f77 to a directory of your choice). To compile, type:

```
# ff /usr/demo/wc.f77
```

Idris should respond with:

```
/usr/demo/wc.f77:
ilinker:
link:
#
```

To execute, type:

```
# xeq /usr/demo/wc.f77
```

The program, which counts the number of lines, words, and characters in a file, will respond with:

```
57 lines    189 words   1390 chars
```

Finally, remove the residual files /usr/demo/wc.obj and ilinker.o.

CHROMATICS

CGC 7900 COLOR GRAPHICS COMPUTER SYSTEM

OPTION 7974-01

HARDWARE VECTOR GENERATOR

Field Installation Instructions

Document Number 070233

Printed October 4, 1983

PRODUCT LINE: CGC 7900

OPTION   :   7974-01 – HARDWARE VECTOR GENERATOR

PROCEDURE   :   FIELD INSTALLATION INSTRUCTIONS

A 7900 which uses the HVG must have the following parts:

        HVG card
        2 EPROMs, marked "808K E" and "808K O"

Install the HVG in the card cage.   Install the 2 OPMOD EPROMs on the
Raster Processor card, in the sockets next to the 806K pair. These
EPROMs will be necessary for any 7900 using TERMEM 1.3 or higher.
Install 808K Even in location UE18, and 808K Odd in location UF18.

On the memory controller, locate IC-UD2 and then turn the board over
to the back side (circuit side).   Cut the run at pin 10 and then
jumper 10 to pin 12. See the illustration below.

NOTE: Any HVG shipped in a system since January 1,   1982, will auto-
        matically have the memory controller modified.


```
                          ADD
                         JUMPER
                          HERE
                            |
                            v
              14 ☐    ☐ 1
     CUT          ☐    ☐
     THIS  ──────►☐12  ☐
     RUN       ╱  ☐    ☐
        •─┤├─☐10      ☐
              ☐    ☐
            8 ☐    ☐ 7

               UD2
           CIRCUIT SIDE
```
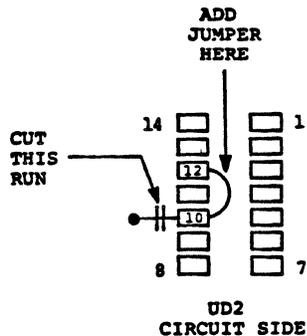
        SHIFT OVERLAY   (Note: HVGs ship from the
        FILL   factory in slot 21
        ARC 511,383,300,0,360,   or 22 of the unit.)

If the HVG is installed and operating properly, the arc should be
drawn in less than a second.   If the HVG is not installed,   the
software vector routines will require about 10 seconds to draw   the
arc.

NOTE: If the HVG card is not installed, the HVG EPROMs must not be
        installed or the system will TRAP.

CHROMATICS, INC.

CGC 7900 COLOR GRAPHICS COMPUTER SYSTEM

OPTION 7980

JOYSTICK INTERFACE REPLACEMENT INSTRUCTIONS

Document Number 070254

Printed November, 1984

Replacement Instructions for Joystick PCB Interface

The keyboard cover must be removed. Under the keyboard you will find a panel with the speaker in it. At the top of the panel are two screws which must be removed (refer to Figure A). The panel will now swing down. Remove the four screws in the corners of the keyboard cover (refer to Figure B). Slide the cover out.

The joystick interface is located behind the keyboard (refer to Figure C). Remove the cable that goes to the joystick. Remove the four screws at the corners of the board and lower the board from the unit. Remove the interface ribbon cable.

CAUTION: Before power is applied be careful to examine the positioning of the blue line on the interface cable. There are two versions of the interface card. Each version requires the interface cable to be plugged in backwards from the other. If it is plugged in wrong then some circuit boards will sustain some electrical damage.

To determine the way the cable should be connected, you must first determine the revision of the interface board. To do this, locate the part number on the foil side of the board. It is located in the lower right corner. The letter after the part number determines the revision of the board (see Figure D for the correct cable connection).

When replacing the joystick interface PCB, the board must be adjusted to operate properly with the joystick in your unit. It may be easier to adjust the interface board before it is attached to the frame. Connect both cables and use the following adjustment procedure:

On the interface board adjust R30 (refer to Figure E) fully counterclockwise. On the joystick, adjust the two black slide switches in the center of their range.

Put the scope or meter on TP1 and adjust R2 for Ø volts. Adjust R6 for +5 volts and -5 volts in conjunction with the joystick. Push the joystick left for -5 volts and then right for +5 volts. This is for the X axis.

Put the scope or meter on TP2 and adjust R3 for Ø volts. Adjust R5 for +5 volts and -5 volts in conjunction with the joystick. Push the joystick up for +5 volts and then down for -5 volts. This is for the Y axis.

Put the scope or meter on TP3 and adjust R1 for Ø volts. Adjust R4 for +4 volts and -4 volts in conjunction with the knob on the joystick. Turn the knob fully clockwise for +4 volts and then fully counterclockwise for -4 volts. This is for the Z axis.

After completion of the adjustments, attach the board to the frame and reassemble the unit.

FIGURE A
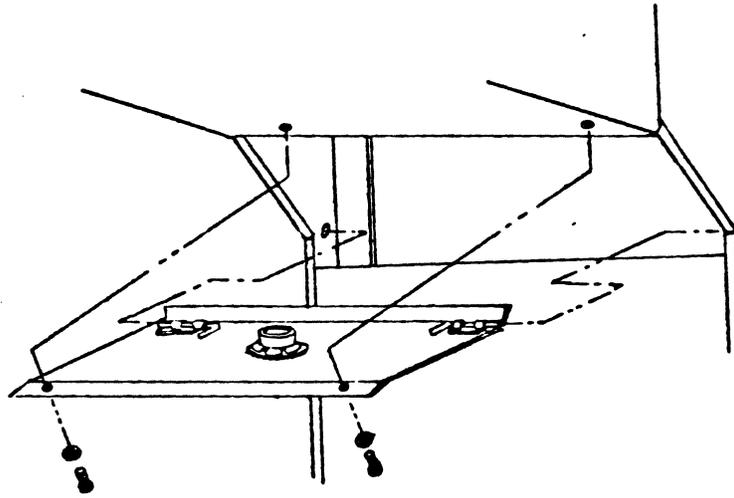
FIGURE A
SPEAKER PANEL REMOVAL

FIGURE B
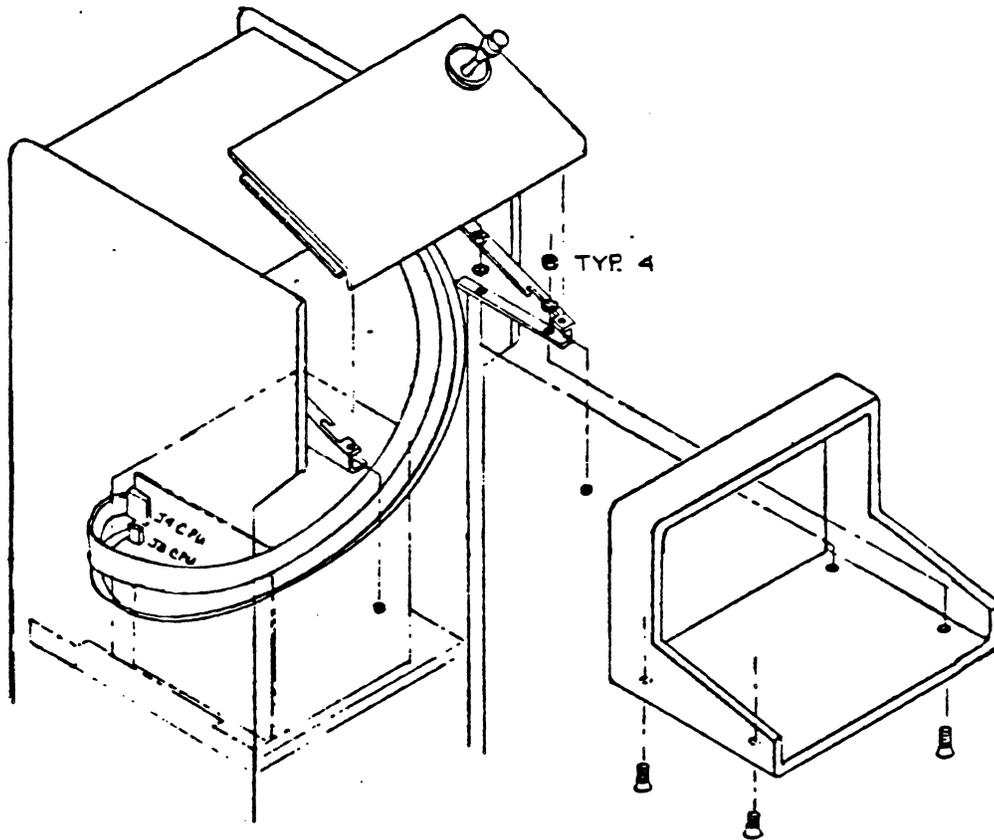
FIGURE B
KEYBOARD COVER REMOVAL

FIGURE C

MARKED "KEYBOARD"

PJ5

① ④ ③ ② ⑤
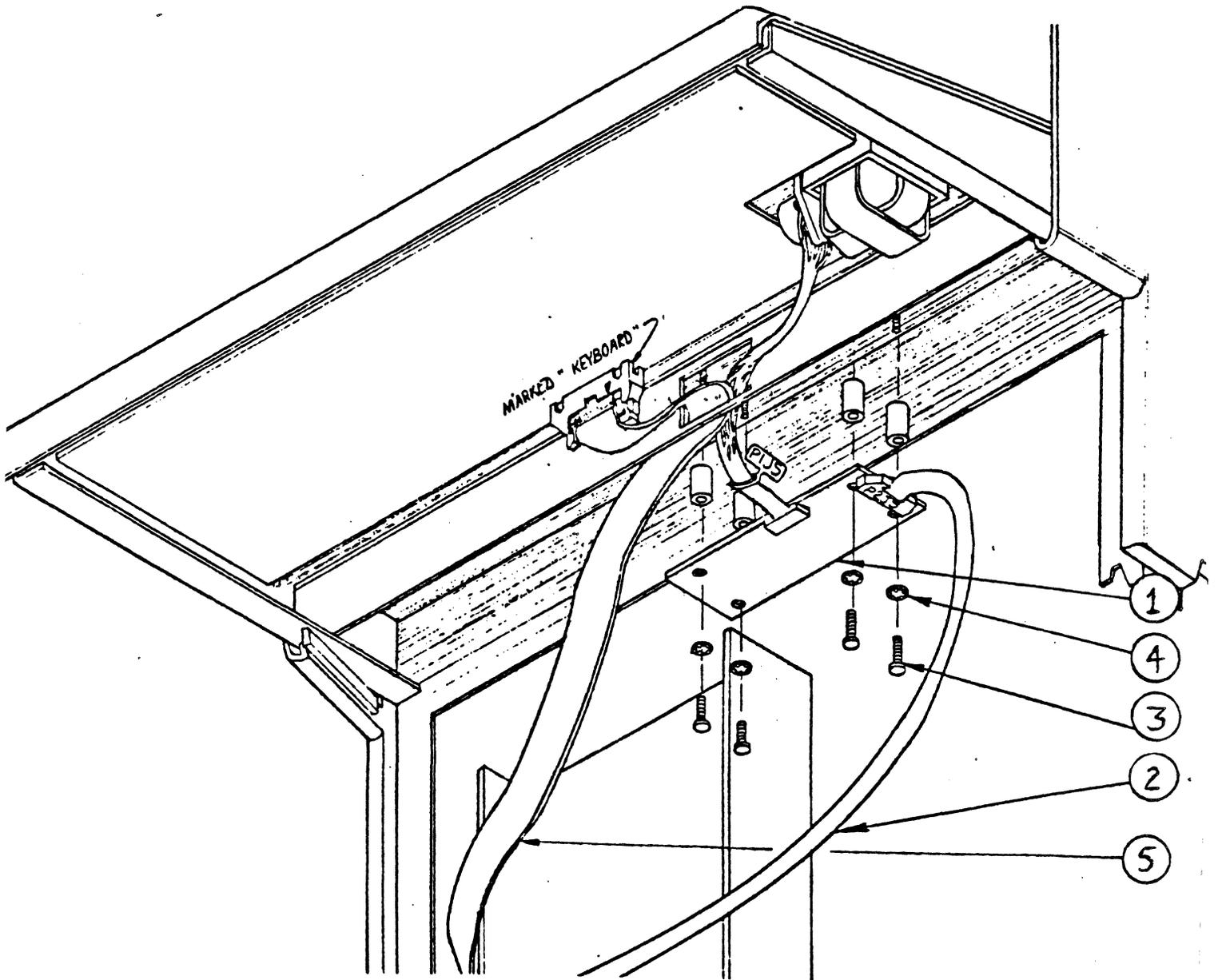
FIGURE C
JOYSTICK INTERFACE LOCATION

FIGURE D

Revisions A and below.

U5

part #

Blue line is
on this side.

Revisions B and up.

Blue line

U5

part #
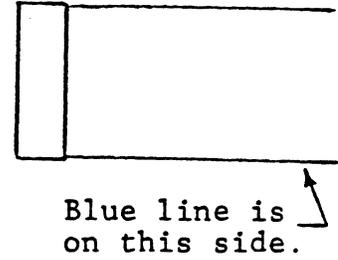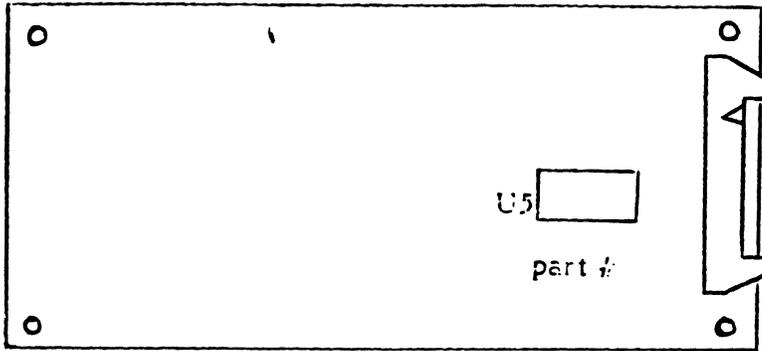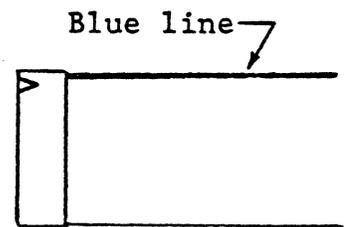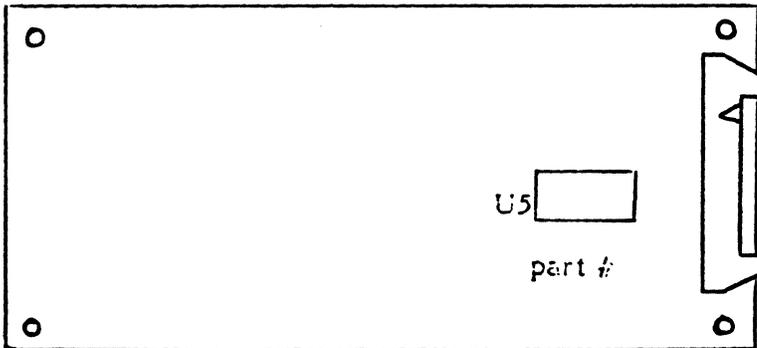
FIGURE D
CABLE CONNECTIONS

FIGURE E
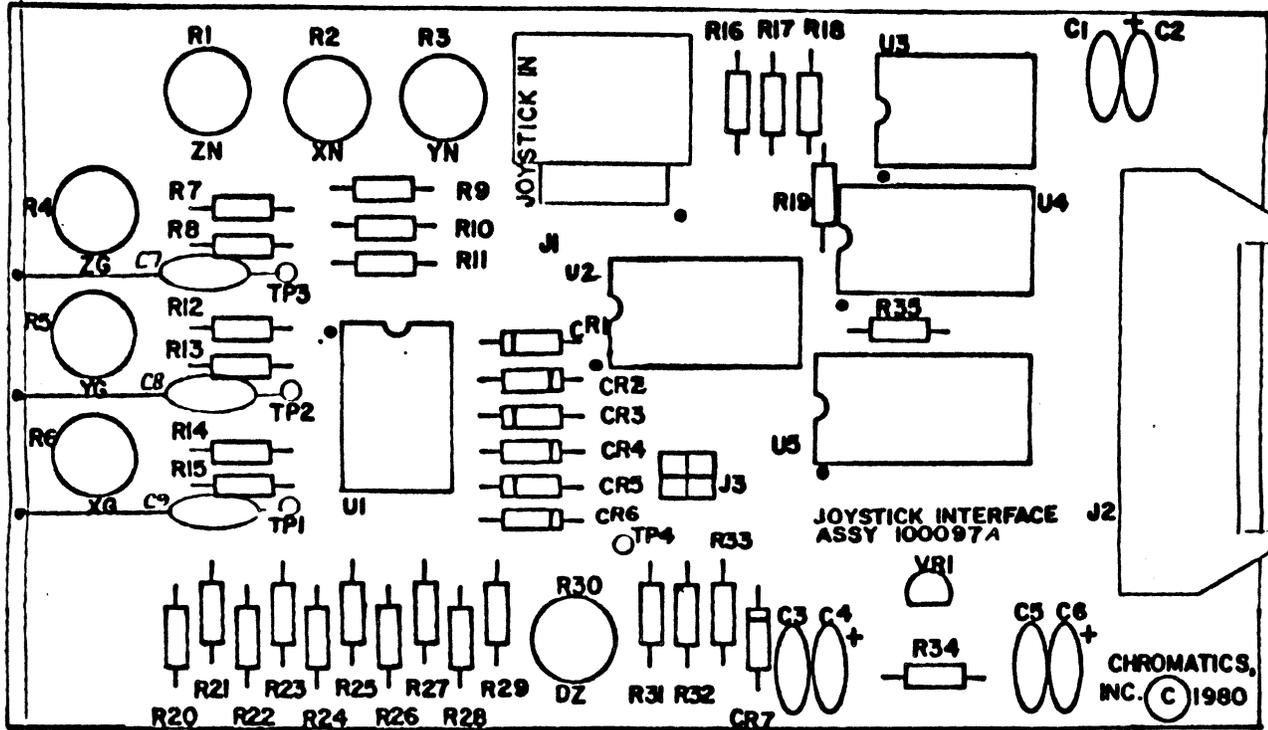
FIGURE E
TEST POINT AND POT LOCATIONS

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CHROMATICS

CGC 7900 COLOR GRAPHICS COMPUTER SYSTEM

OPTION 7982-01

LIGHT PEN INSTALLATION INSTRUCTIONS

Customer Service Information Sheet

Document Number 070234

Printed October 3, 1983

<u>WARNING</u>

This equipment generates, uses, and can radiate
radio frequency energy and if not installed and
used in accordance with the instructions manual,
may cause interference to radio communications. It
has been tested and found to comply with the limits
for a Class A computing device pursuant to Subpart
J of Part 15 of FCC Rules, which are designed to
provide reasonable protection against such
interference when operated in a commercial
environment. Operation of this equipment in a
residential area is likely to cause interference in
which case the user at his own expense will be
required to take whatever measures may be required
to correct the interference.

PRODUCT LINE: CGC

OPTION   :   7982-01 - LIGHT PEN INSTALLATION INSTRUCTIONS

PROCEDURE   :   FIELD INSTALLATION INSTRUCTIONS

<u>Light Pen Installation Instructions</u>

1)   The light pen housing is behind the door where the convergence
     adjustment area is. The top cover of the unit must be removed for
     the light pen installation. To do this, two screws must be
     removed from the back of the cover. These two screws are on
     either side of the black heat sinks on the back of the unit.
     After removing the screws, slide the top cover back and remove
     from the unit.

2)   Open the door at the right of the screen. Insert the light pen
     through the hole in the back of the housing (Figure 1). Do not
     feed the connector through the hole.

3)   Connect the internal cable to the light pen connector. Place the
     connector plate against the housing aligning the two screw holes.
     Mount the plate with two #4 screws.

4)   Open the door on the back of the unit to gain access to the
     digital section.

5)   Feed the internal cable under the analog card cage to the Overlay
     Memory digital board (Slot 3) (See Figure 2).

6)   Insert plug in connector P30LM on board.

7)   Replace top cover, button up unit, then test light pen.

     REMEMBER: POWER SHOULD BE TURNED OFF DURING INSTALLATION!

     <u>Kit Includes:</u>   <u>P/N</u>

     Light Pen   948007
   Cable Assembly   060034
   Screws (2)   750050
     Star Washers (2)   751012

1. LIGHT PEN
2. RETAINER PLATE
3. LIGHT PEN HOUSING
4. INTERNAL LIGHT PEN CABLE
5. STAR WASHERS
6. RETAINER PLATE SCREWS

Figure 1

Figure 2