

# INSTALLATION MANUAL

*for the*  
**IMAGINATOR**

MODEL I-100  
RETROFIT GRAPHICS  
DISPLAY BOARD

CLEVELAND CODONICS, INC.  
CLEVELAND, OHIO

REV A

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Addendum to: User's Guide Manual for the Imaginator Model I-100

June, 1983

CAUTION  
CAUTION  
CAUTION

If it is required to secure the coax shield's terminal to the ground (GND) on the Imaginator be certain that no part of the terminal comes in contact with any circuit traces except the ground plane. The thin green soldermask should not be considered sufficient insulation.





## **CAUTION**

The metal-oxide-semiconductors (MOS) supplied with this unit are highly susceptible to destruction from static discharge. Do not remove them from their protective black foam backing or anti-static enclosures until you have read the precautions in the assembly or installation portions of this manual.

## **WARNING**

Before removing or reconnecting any of the terminal's internal wiring harnesses be certain that the terminal is turned off and unplugged to prevent injury to both you and the terminal.

## **WARNING**

When power is applied to the terminal, do not touch the flyback transformer, the high voltage lead, or the anode socket. An electrical shock hazard exists in these areas.



# INTRODUCTION

The Imaginator is an intelligent, high efficiency, high resolution (504 by 247 pixel) graphics retrofit unit for your Heath/Zenith H/Z-19 terminal and H/Z-89 computer

The Imaginator has its own onboard microcomputer to perform graphics processing independent of the host computer. This reduces the burden placed on the host processor and therefore improves execution speed.

A 128 character communications buffer further improves execution speed. This buffer permits the terminal and the host computer to perform their tasks asynchronously.

A graphics command may be entered by typing on the keyboard when the terminal is OFF-LINE or it may be sent via RS-232C from the host computer when the terminal is ON-LINE.

The Imaginator's transparent operation leaves all of the terminal's normal escape functions intact. The terminal's normal alphanumerics are totally independent of the Imaginator's graphics. The two displays can be overlayed on one another and may be individually altered under software control. Both alphanumeric and graphics images can be created in memory and restrained from being displayed on the screen. Once created they can be displayed instantaneously. Alternatively, the images may be displayed as they are created.

The graphics command processor (GCP) can be invoked to accept commands in either ASCII or BINARY format. ASCII mode has the advantage of easy user implementation of the graphics command language. All of the commands can be directly output by high level language programs which are executed in the host computer (e.g., PL/I, FORTRAN, PASCAL, BASIC, and of course ASSEMBLY languages). Standard, off-the-shelf, interpreters and compilers are all that are required (those languages need not have any special graphics instructions). No machine language driver programs are required.

The BINARY mode has the advantage of high efficiency. A minimum of information must be sent to specify an operation. Again, no special interpreters or compilers are required but machine language drivers are suggested (even these are not required) for efficiency.

An additional memory-mapped socket is provided for memory expansion. Up to 16K of E/P/ROM can be mounted and addressed by the GCP, or 8K of E/P/ROM and 8K of R/W RAM can be used. Custom programs can be downloaded from the host computer into this memory for fast independent execution.

## GRAPHICS INSTRUCTION SET

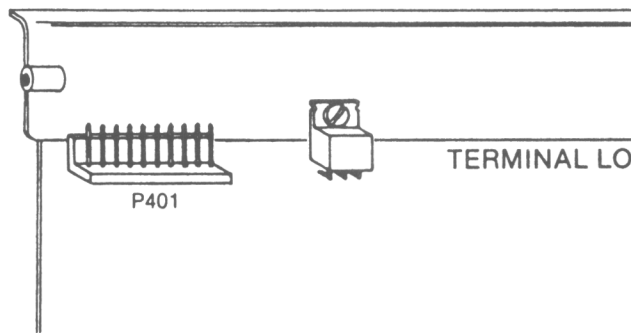
EnterGraphicsMode  
MoveTo (X,Y)  
PointAt (X,Y)  
LineTo (X,Y)  
AreaTo (X,Y)  
PriLineStyle (Z)  
    30 Unique styles  
SecLineStyle (Z)  
    30 Unique styles  
LineType (Z)  
    On  
    Off  
    Complement  
    Read Bit  
    Toggle to Alternate LineStyle at Boundary  
    Read Byte  
DisplayToggle (Z)  
    Enable/Disable Graphics  
    Enable/Disable Alphanumeric  
    Erase Graphics  
    or any of the eight combinations  
BringInProgram ( $Z_0, Z_1, \dots, Z_{127}$ )  
JumpToProgram  
ExitGraphicsMode

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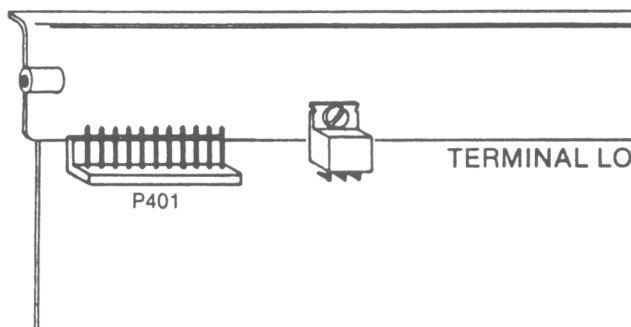
**NOTE:** Some of the following procedures differ depending on the type of terminal you have. Open the terminal's cover and take a look at the power harness connector on the **TERMINAL LOGIC** board (P401). Early models use a connector with 10 pins; later models use a connector with 11 pins. Count the pins (not wires) and determine which model you own. **10 PIN MODEL** and **11 PIN MODEL** will be used to denote the two types. Do only the procedures that correspond to your terminal. Leaf on ahead and cross out those sections that do not pertain to your terminal type.

#### PERFORM ON ALL MODELS

- ☐ Make certain the terminal is turned off. If it was on, wait a few minutes for the capacitors to discharge before proceeding.
- ☐ Unplug the power harness from connector P401 on the **TERMINAL LOGIC** board.

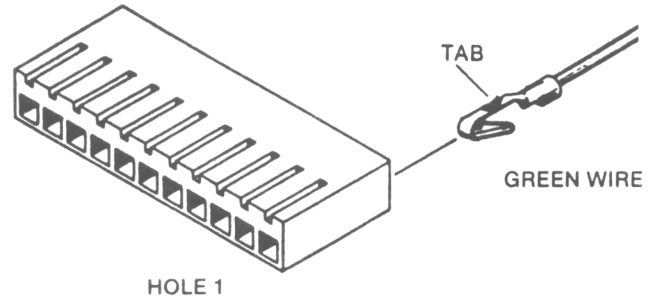


OR



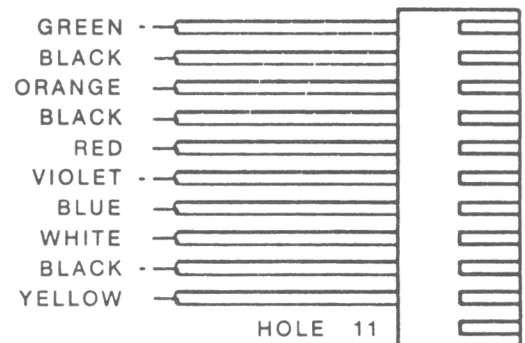
- ☐ Insert one end of the **GREEN** wire into hole one of an 11 hole connector shell. The small tab on the spring connector should face the slotted side of the connector shell. Gently tug on the wire to be certain that it is locked in place.

11 HOLE CONNECTOR SHELL



In a similar manner insert one end of each of the remaining wires into the same connector shell.

- ☐ A **BLACK** wire into hole 2
- ☐ The **ORANGE** wire into hole 3
- ☐ A **BLACK** wire into hole 4
- ☐ The **RED** wire into hole 5
- ☐ The **VIOLET** wire into hole 6
- ☐ Skip hole 7 (*H/Z-89's require the BLUE wire here.*)
- ☐ The **WHITE** wire into hole 8
- ☐ The remaining **BLACK** wire into hole 9
- ☐ The **YELLOW** wire into hole 10
- ☐ Skip hole 11

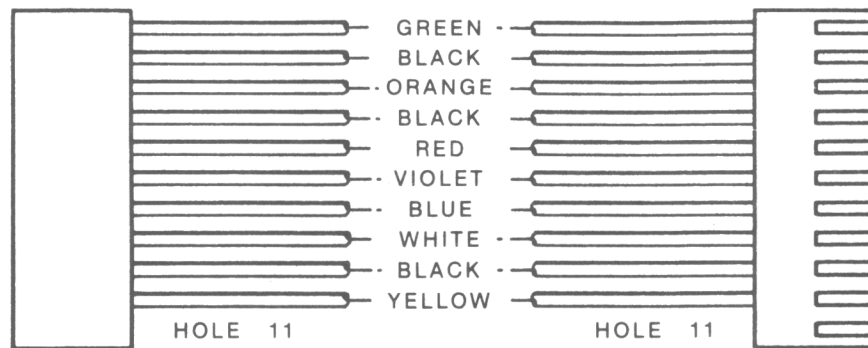


### PERFORM ONLY FOR 10 PIN MODELS

- ☐ Insert the free end of each wire into the remaining 11 hole connector shell. The wires should be inserted in the same order as above. Tug on each to insure they are properly engaged.

(TERMINAL LOGIC BOARD)

(IMAGINATOR GRAPHICS DISPLAY BOARD)



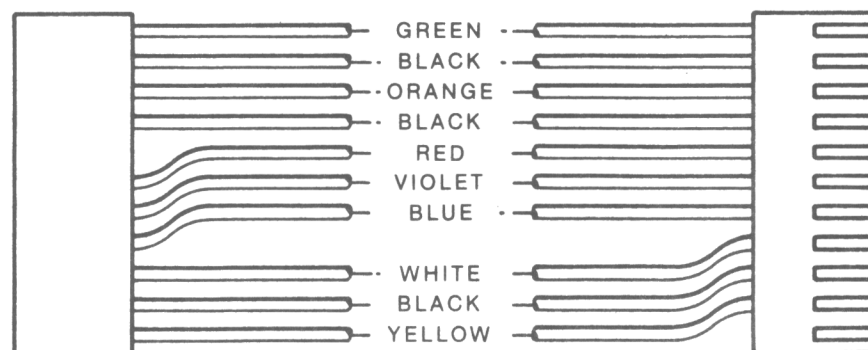
RELAY POWER HARNESS

### PERFORM ONLY FOR 11 PIN MODELS

- ☐ Insert the free end of each wire into the remaining 11 hole connector shell. The wires should be inserted in the same order as above except skip hole 5 and shift the remaining wires over one hole with the RED wire in hole 6 etc. Tug on each to insure they are properly engaged.

(TERMINAL LOGIC BOARD)

(IMAGINATOR GRAPHICS DISPLAY BOARD)



RELAY POWER HARNESS

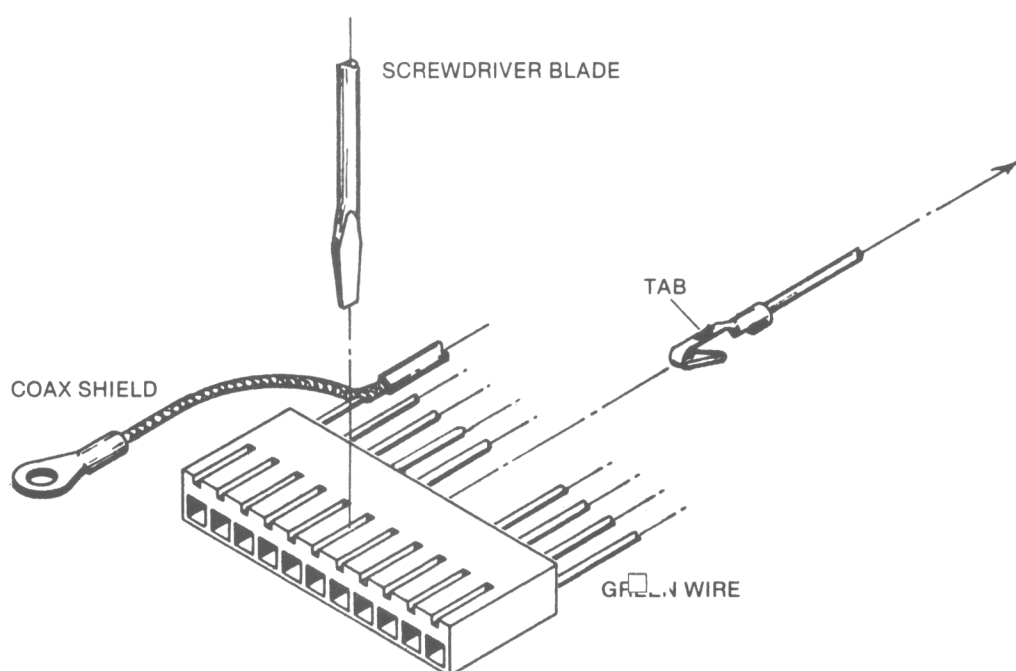
### PERFORM ON ALL MODELS

- ☐ Double check that none of the wires are criss-crossed.

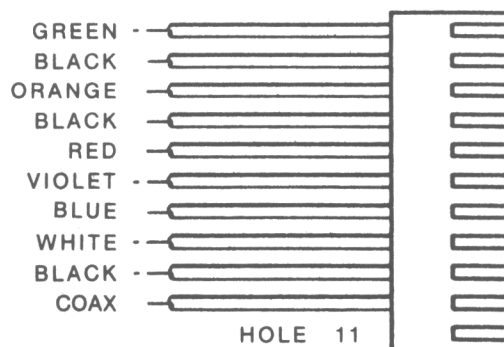
## PERFORM ONLY FOR 11 PIN MODELS

The power harness that was just unplugged from the TERMINAL LOGIC board needs to be slightly modified.

- ☐ Using a small flat blade screwdriver depress the crimp terminal's locking tab to release the RED wire from connector shell hole 6.



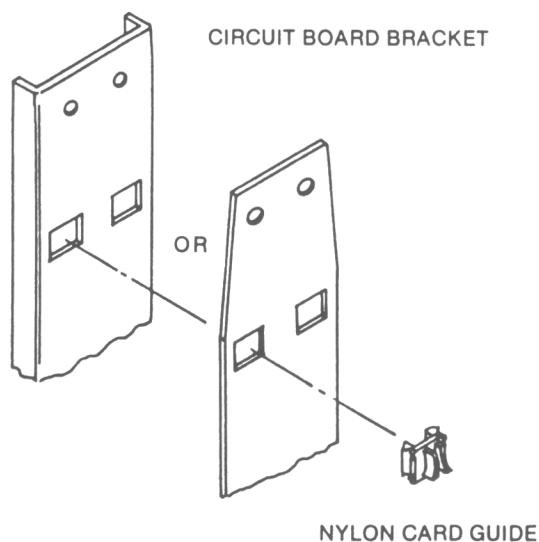
- ☐ Insert this RED wire into connector shell hole 5. Tug on the wire to be certain it is properly engaged.
- ☐ Similarly, remove the VIOLET wire from hole 7 and insert it into hole 6.
- ☐ Remove the BLUE wire from hole 8 and insert it into hole 7 (If BLUE wire is present, otherwise skip this step).
- ☐ Remove the WHITE wire from hole 9 and insert it into hole 8.
- ☐ Remove the BLACK wire from hole 10 and insert it into hole 9.
- ☐ Remove the COAX wire from hole 11 and insert it into hole 10.
- ☐ Connector shell hole 11 is left empty.



### IMPORTANT

It is very important that the power harnesses are wired correctly for your type terminal. Applying power with a mis-wired harness can cause considerable damage to both the terminal and the Imaginator. Unless you are confident you wired the harnesses correctly, double check them against the proper diagram (10 or 11 pin model).

- ☐ Remove the terminal cover completely.
- ☐ Snap the 4 nylon card guides into the top 4 remaining holes of the CIRCUIT BOARD BRACKET



- ☐ The TERMINAL LOGIC board should already be set in the grooves toward the rear of the terminal. Move it there if it isn't.
- ☐ There are two supports molded into the base of the terminal that are meant to support the circuit board. However, on some terminals these supports do not line up with the circuit board. In this case secure a 6-32 X 1/2 screw with a 6-32 nut and a #6 lockwasher in each of the two bottom corner holes of the board. The lockwashers and nuts should be on the circuit side of the board.

### CAUTION

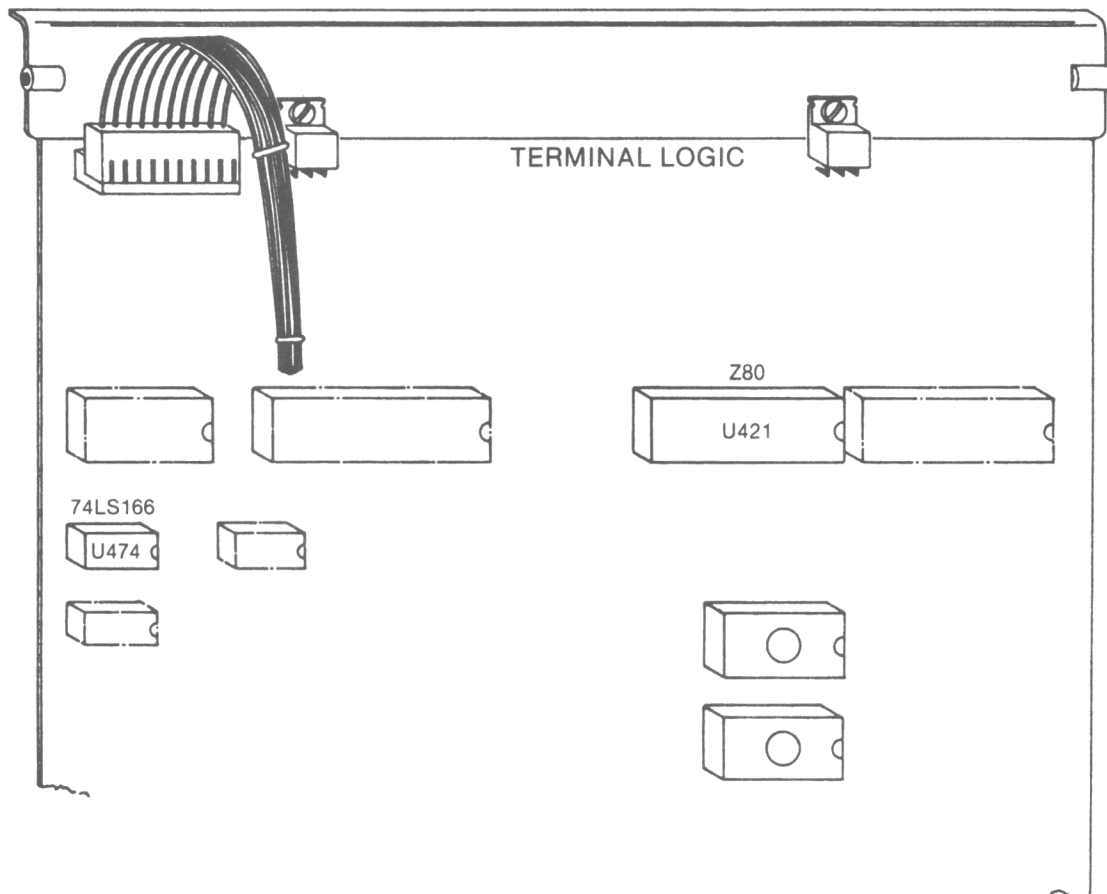
The metal-oxide-semiconductors (MOS) supplied with this kit are highly susceptible to destruction by static discharge. Place your free hand on the exposed metal traces of the circuit board before inserting a MOS IC in its socket. We recommend touching the power connectors J2 or J3. This will help eliminate the voltage differential between the IC and the circuit. Keep these IC's away from static collectors (e.g., plastic containers, styrofoam cups).

Integrated circuits are fragile and care must be used when handling them. The pins of an IC are often spread at an angle which makes it difficult to insert them into a socket. Place the pins on a flat surface and rock the IC a slight amount to straighten the pins. Every IC has some kind of notch or dot at one end. Orient the IC so that this marking will correspond to the marking on the IC socket and the marking on the circuit board. Place the IC on the socket and push straight down with even, gentle pressure over its entire length. Check to see that all of the pins went into the socket and that none accidentally folded under the IC. If you need to remove an IC from its socket, **do not** use your hands alone. The IC may suddenly dislodge and stab our finger. Use a tool.



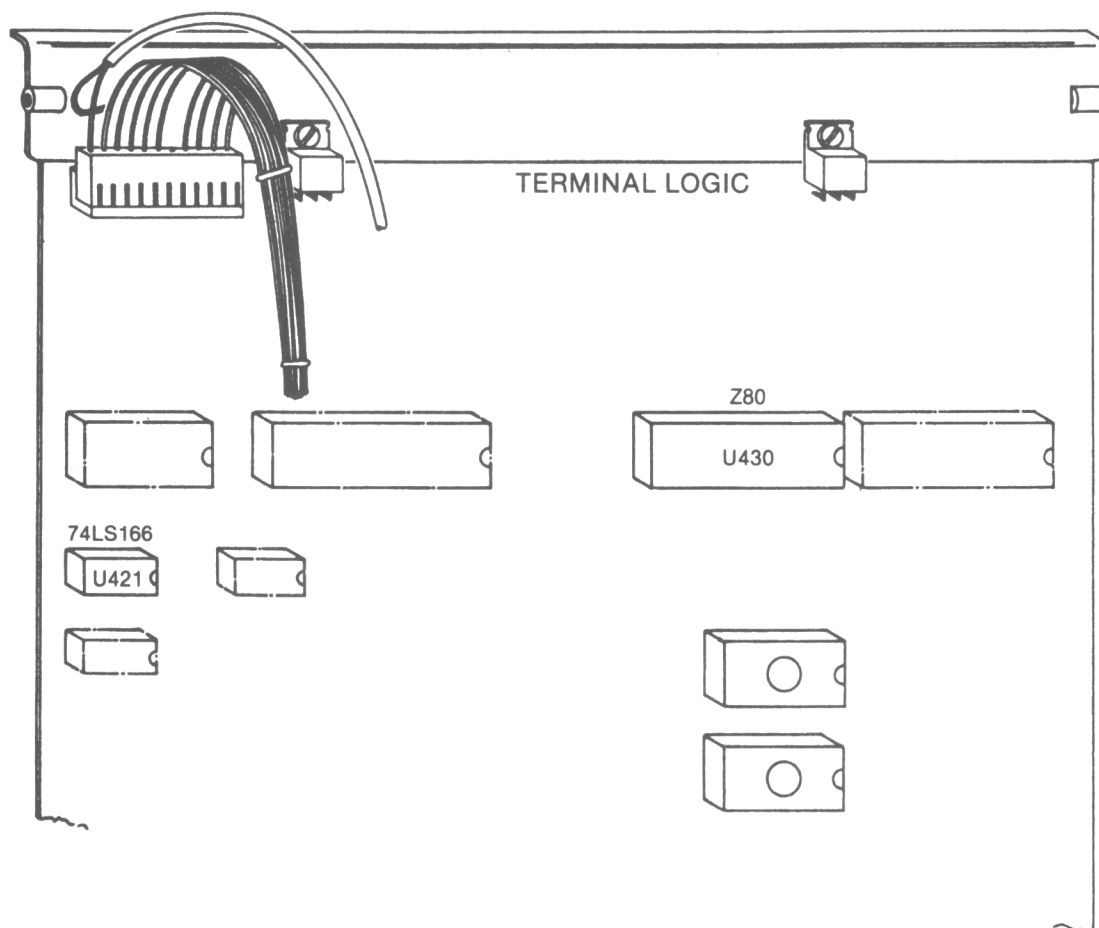
### PERFORM ONLY FOR 10 PIN MODELS

- ☐ **Make sure the terminal is turned off.** With an IC extractor or small, flat-blade screwdriver carefully remove U474 (74LS166) from the TERMINAL LOGIC board.
- ☐ Insert this IC into socket U2 on the Imaginator.
- ☐ **Read the next two steps before performing them.**
- ☐ Similarly, remove U421 (Z-80) from the TERMINAL LOGIC board. **Be careful.** This IC is a MOS device and is fragile. Place your free hand temporarily on the large aluminum heatsink on the TERMINAL LOGIC board before removing this device.
- ☐ Insert this IC into socket U7 on the Imaginator. Place your free hand on the circuit board traces as you did earlier before inserting this MOS device in its socket.
- ☐ Plug the indicated end of the 16 conductor ribbon cable assembly into socket U474 on the TERMINAL LOGIC board. Pin 1 of the cable's header must be aligned with pin 1 of the socket
- ☐ Plug the indicated end of the 40 conductor ribbon cable assembly into socket U421 on the TERMINAL LOGIC board. Pin 1 of the cable's header must be aligned with pin 1 of the socket.



### PERFORM ONLY FOR 11 PIN MODELS

- ☐ **Make sure the terminal is turned off.** With an IC extractor or small, flat-blade screwdriver carefully remove U421 (74LS166) from the TERMINAL LOGIC board.
- ☐ Insert this IC into socket U2 on the Imaginator
- ☐ **Read the next two steps before performing them.**
- ☐ Similarly, remove U430 (Z-80) from the TERMINAL LOGIC board. **Be careful.** this IC is a MOS device and is fragile. Place your free hand temporarily on the large aluminum heatsink on the TERMINAL LOGIC board before removing this device.
- ☐ Insert this IC into socket U7 on the Imaginator  
Place your free hand on the circuit board traces as you did earlier before inserting this MOS device in its socket.
- ☐ Plug the indicated end of the 16 conductor ribbon cable assembly into socket U421 on the TERMINAL LOGIC board. Pin 1 of the cable's header must be aligned with pin 1 of the socket.
- ☐ Plug the indicated end of the 40 conductor ribbon cable assembly into socket U430 on the TERMINAL LOGIC board. Pin 1 of the cable's header must be aligned with pin 1 of the socket.

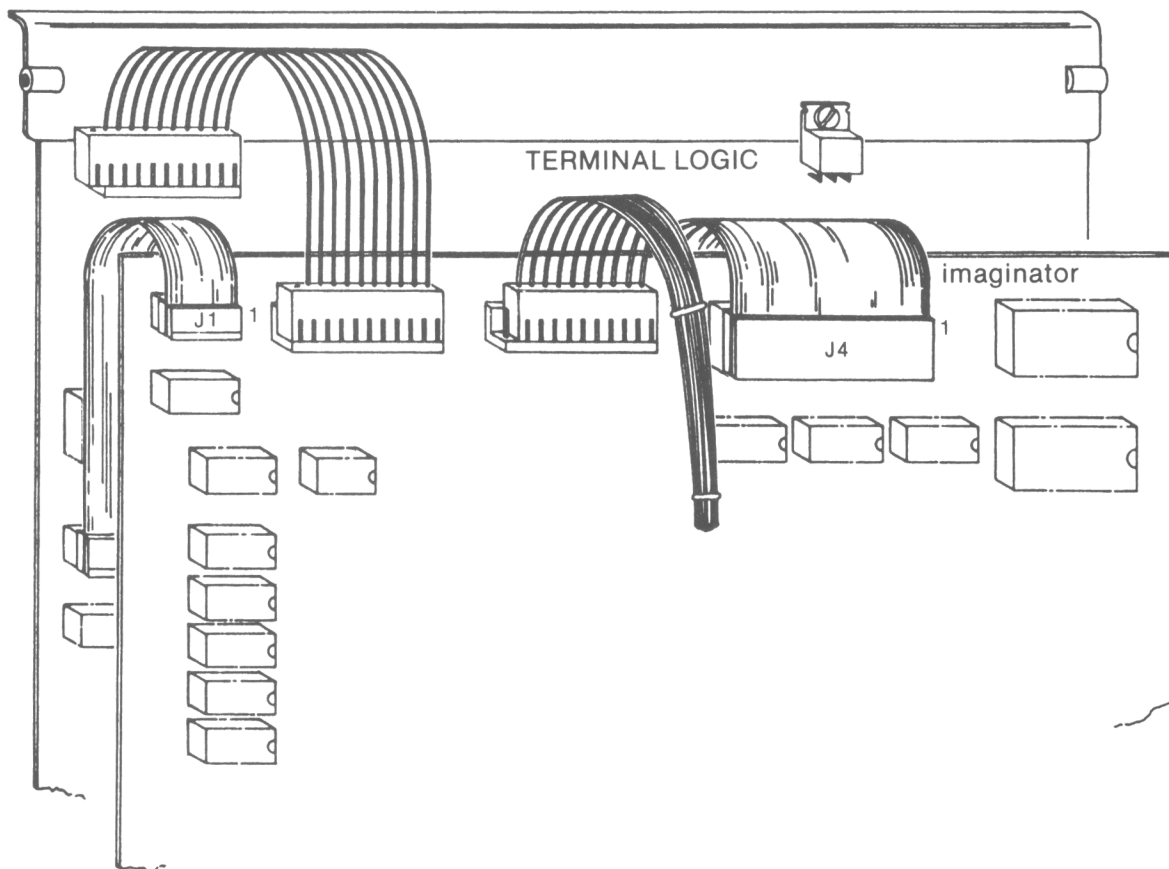


### PERFORM ON ALL MODELS

- ☐ Triple check the orientation of every IC. **An improperly oriented IC will not work and will probably be damaged when power is applied.** Also verify that every pin is indeed in the socket and not folded under the IC.
- ☐ While holding the ribbon cables up and out of the way, slide the Imaginator down the front groove of the CIRCUIT BOARD BRACKET
- ☐ Plug the free end of the 16 conductor ribbon cable assembly into socket J1 on the Imaginator. Pin 1 of the cable's header must be aligned with pin 1 of the socket.
- ☐ Plug the free end of the 40 conductor ribbon cable assembly into socket J4 on the Imaginator. Pin 1 of the cable's header must be aligned with pin 1 of the socket.

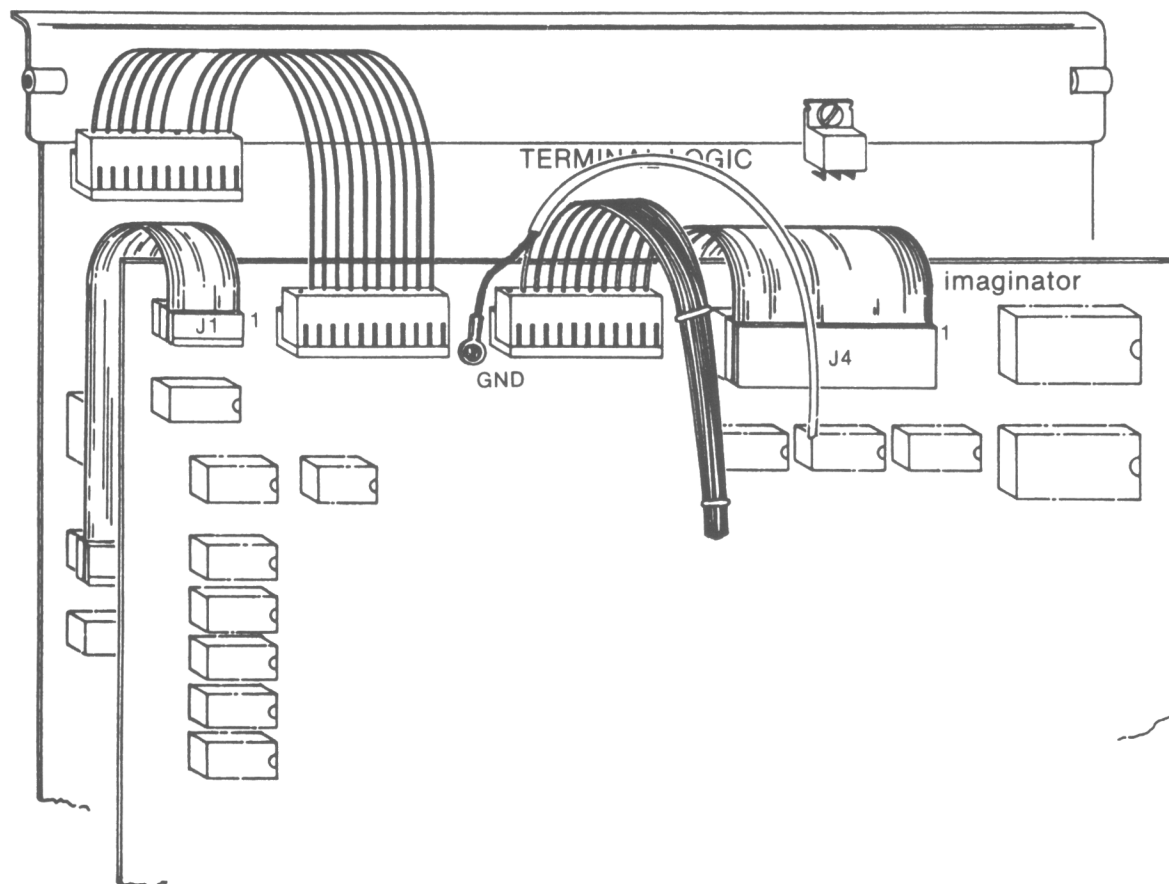
### PERFORM ONLY FOR 10 PIN MODELS

- ☐ Plug the power harness that was originally plugged onto the TERMINAL LOGIC board onto connector J3 on the Imaginator. The GREEN wire should coincide with pin 1 of the connector (pin 11 is free).
- ☐ Plug either end of the relay power harness onto connector J2 on the imaginator. The GREEN wire should coincide with pin 1.
- ☐ Plug the other end of the relay power harness onto connector P401 on the TERMINAL LOGIC board. The GREEN wire should coincide with pin 1, (hole 11 is free).



### PERFORM ONLY FOR 11 PIN MODELS

- ☐ Plug the power harness that was originally plugged onto the TERMINAL LOGIC board onto connector J3 on the Imaginator. The GREEN wire should coincide with pin 1 of the connector
- ☐ Secure the coax shield's terminal to the ground (GND) on the Imaginator with a 6-32 X 3/8 screw, 6-32 nut and #6 lockwasher. The nut and lockwasher should be on the circuit side of the board.
- ☐ Plug the Imaginator end of the relay power harness onto connector J2 on the Imaginator. The green wire should coincide with pin 1.
- ☐ Plug the other end of the relay power harness onto connector P401 on the TERMINAL LOGIC board. The green wire should coincide with pin 1.



## CHECKOUT

### PERFORM ON ALL MODELS

- ☐ Double check to see that everything is secure.
- ☐ Turn the terminal on.
- ☐ In about a minute the cursor should appear in the upper left hand corner of the screen.
- ☐ Turn the terminal off-line (depress the OFF-LINE key).
- ☐ Type your name on the keyboard. The characters should appear on the screen just as they did before adding the Imaginator

The following steps require you to type in graphic commands. Do not type a carriage return, a line feed, or anything else unless you are asked to. The graphics command processor (GCP) expects commands in specific formats and may become confused if presented with extraneous characters.

Once a command sequence is started, there is no good way to abort in the middle (a DELETE or BACKSPACE will not erase an incorrect command). Normally, one could either complete the incorrect sequence or give the terminal a hardware reset (right-SHIFT,RESET). However, in this section of the manual, we recommend a hardware reset and then a restart of this section beginning with the step that asked you to type your name.

A brief *description* accompanies each of the following commands but it is not necessary to understand them to proceed with this section. Each command is described in detail in the **User's Guide**.

(Note that you are asked to type a slash occasionally, don't let this confuse you, it's only purpose is to serve as a delimiter. Actually any character could be used except the numerals 0,1,2,3,4,5,6,7,8,9.)

- ☐ The terminal should be set up in Heath/Zenith mode not ANSI mode.
- ☐ Type **ESC x 1** Note that x is lower case.  
*Enable the 25th line.*
- ☐ Lock down the CAPS-LOCK key

- ☐ Type **ESC 1**  
*EnterGraphicsMode, ASCII.*
- ☐ Type **D 6 /**  
*DisplayToggle command, Graphics and Alphanumerics enabled.*
- ☐ Your name should still be the only display on the screen.
- ☐ Type **P 2 0 0 1 0 /**  
*PointAt (200,10) command.*
- ☐ Type **L 3 0 0 2 4 0**  
*LineTo (300,240) command.*
- ☐ A diagonal line should appear along with your name.
- ☐ Type **D 2 /**  
*DisplayToggle command, enable graphics only.*
- ☐ Only the diagonal line should appear
- ☐ Type **D 0 /**  
*DisplayToggle command, enable neither graphics nor alphanumerics.*
- ☐ The screen should be blank.
- ☐ Type **D 3 /**  
*DisplayToggle command, enable graphics and erase graphics.*
- ☐ Type **M 1 2 8 0 /**  
*MoveTo (128,0) command.*
- ☐ Type **A 3 7 4 2 4 6**  
*AreaTo (374,246) command*
- ☐ A large filled rectangle should appear

This rectangle represents a square with the dimensions of 247 horizontal points and 247 vertical points. However, the rectangle displayed may not appear to have equal length sides. If correction is required, proceed with the following adjustments. Refer to the **Adjustment** section of your terminal's **Operators Manual** for details.

### WARNING

**When power is applied to the terminal, do not touch the flyback transformer, the high voltage lead, or the anode socket. An electrical shock hazard exists in these areas.**

- ☐ Using a flat blade screwdriver adjust the VERT SIZE control on the VIDEO CIRCUIT board to produce a square. Be careful not to let the end of the screwdriver touch any other component or lead.
- ☐ At this time you may also wish to adjust the FOCUS and the BRIGHTNESS controls on the VIDEO CIRCUIT board to suit your personal conditions.
- ☐ Turn the terminal off.
- ☐ Put the terminal's cover back in place.
- ☐ Proceed to the **User's Guide**.

## **WE WOULD LIKE YOUR COMMENTS ON THIS MANUAL**

Did you find any errors in this manual? Where?

Was it complete, should some areas be covered in greater detail?

Was it the right level? Too simple? Too difficult?

Was it clearly written?

Please rate this document with respect to similar ones?

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