SUPERBOARD II KIT

ASSEMBLY MANUAL

M/A-COM OSI
April, 1982

NOTE

The Superboard II is a sophistocated microcomputer, a very delicate piece of electonic hardware. Assembly of this kit should only be attempted by individuals experienced with electronic assembly and test techniques.

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1333 S. Chillicothe Rd.
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Printed in the United States of America

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OVERVIEW

Your OSI Superboard, when completed, is a powerful, versatile 8K computer. The video display is an easy to read 24 character by 24 line format which features both upper and lower case letters directly from the keyboard. In addition, there are numerous non alpha-numeric graphics characters which, together with the standard text characters, make up a set of 255 characters. The Superboard connects directly to a video monitor (or standard TV set by way of an RF modulator) and to a cassette player. With a substitution of connections at the rear edge Molex socket, the Superboard can be used with a serial printer or a modem as well as with the cassette player. The addition of a 610 I/O board will give you memory expansion capability up to 32K and the possibility of adding one or two minifloppy disk drives.

Before beginning the assembly, you should read through this entire assembly manual in order to get in mind the total picture of the project. Do not rush the the assembly. Care and frequent checking of your work will pay off in the long run. Assembly will take about 20-25 hours.

MATERIAL REQUIREMENTS

For Assembly

Good quality soldering iron
(25 watt with 1/16" plated tip)

Rosin core solder
(supplied with kit)

Needle nose pliers

Side cutters (diagonal cutters)

Screwdriver

Solder Sucker (or solder braid)

Csotch tape

AC/DC VOM multimeter

Logic probe (useful for testing but not required)

For Use

5 Volt DC, 3 Amp power supply
regulation - better than 4%
ripple - less than 4%
The addition of a 610 will require an additional power supply - total 6 amps.

Video monitor (or B&W TV with RF modulator*)

Portable cassette recorder (used on AC)

Small speaker (useful with DAC but not required)

*ATV Research Microverter recommended

OSI LIMITED 30-DAY WARRANTY

The OSI warranty is a Limited Warranty as defined by the U.S. Consumer Product Warranty and Federal Trade Commission Act. This warranty entitles you to certain legal rights although the details vary from state to state.

Covered Parts: OSI will replace factory defective parts for a period of 30 days from date of purchase. Replacement parts are warranted to be free from defects for the balance of the original warranty period. Replacement parts are obtained by calling (216) 562-2020 and asking for the Superboard Kit Department. (8-5 EST Monday-Friday)

Not Covered: The warranty specifically does not cover assembly errors, damage caused by negligence or abuse. Use of unauthorized parts, modifications or corrosive solder voids this warranty completely. Warranty does not cover inconveniences, loss of use, assembly or set up time, unauthorized service.

NOTE: OSI cannot accept collect calls.

Customer Information: OSI will not service kits which have not been completed. Malfunctions involving non-OSI peripherals (monitors, tape recorders, etc.) are the customer's responsibility.

Returns: The customer must obtain a Return Authorization (RA) number before returning any item to OSI. Please call (216) 562-2020 and ask for Superboard Kit Department. Shipping damage is not covered by this warranty.

Repair Fee: A standard repair fee will be charged on all Superboard Kits returned to OSI. The standard fee is $50. OSI reserves the right to repair or Replace at our discretion. The customer will pay the shipping to OSI and OSI will pay the return shipping

Software: Software is specifically not warranted.

ASSEMBLY INTRODUCTION

Before you start to mount the parts on the circuit board, it will be helpful for you to become familiar with what functions the various sections of the board will perform. Position the board in front of you with the "Ohio Scientific Model 600 CPU" label side up and with the notch in the upper right corner. In this position, the long edge of the board will extend away from you. This is the orientation which is shown in Figure I-1. For the purpose of insuring that the board is oriented correctly for each step of assembly, the edge farthest from you has been labeled N for North. As you can see from Figure I-1, the keyboard section of the ciruit board is closest to you while the Input/Output (I/O) section is at the upper left. The RAM chips will be located at the upper right with the RAM chip select circuit components just below. Just above the keyboard on the right is the circuitry for decoding the signals from the keyboard. To the left above the keyboard section are the ROM chips which contain the programs necessary for your computer to function as it does. Above the ROM chips is the circuitry for selecting ROM addresses. Finally, the heart and soul of your Superboard, the 6502 microprocessor, is located in the center above the keyboard.

Figure I-2 is a detailed diagram of the superboard component layout. The rectangles in the top two-thirds of the diagram are the individual IC chips. The codes on these chips (U8, U9, U10, ... etc.) will be used in the manual to refer to particular chips. These same codes are used in the complete Superboard schematics* found at the end of this manual. You will note that, with some exceptions, the numbers start low at the south-east portion of the board and increase as you move west and north. The positions of the resistors, capacitors, and diodes are marked with a shape which corresponds roughly to the physical form of the circuit element. The letters R, C, and D specify resistor, capacitor, or diode. The numbering system is the same as that for the IC chips.

As you complete each step, check off the appropriate box in the sequence of steps.	**

* See Appendix
**Important points and warnings will be outlined with a box for emphasis.

Your Superboard II Kit Contains

Bag A	Capacitors	56 Pieces
Bag B	Chips, Diodes and Transistors	31
Bag C	Resistors and Pots	58
Bag D	Misc. Hardware, Sockets and Solder	108
Bag E	Keyboard Parts	110
Bag F	Chips	27
Bag G	Miscellaneous	3
Bag H	Chips	37
		430 Total

Superboard II Bare circuit board

Superboard II Kit Assembly Manual

Cassette tapes (two, one test and one blank)

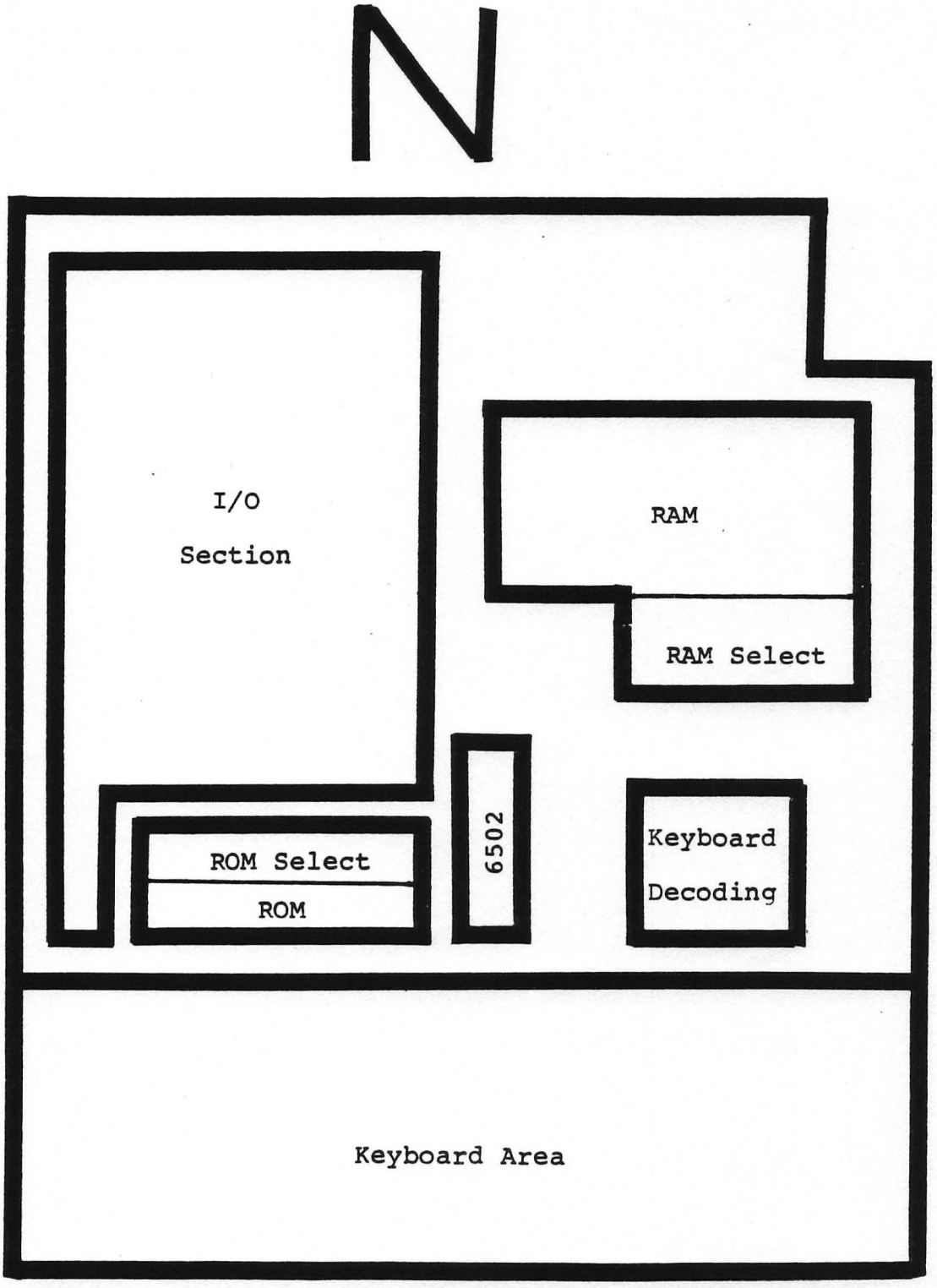

N
I/O
Section
RAM
RAM Select
6502
ROM Select
ROM
Keyboard
Decoding
Keyboard Area

Figure I-1

SUPERBOARD KIT BOARD LAYOUT DIAGRAM

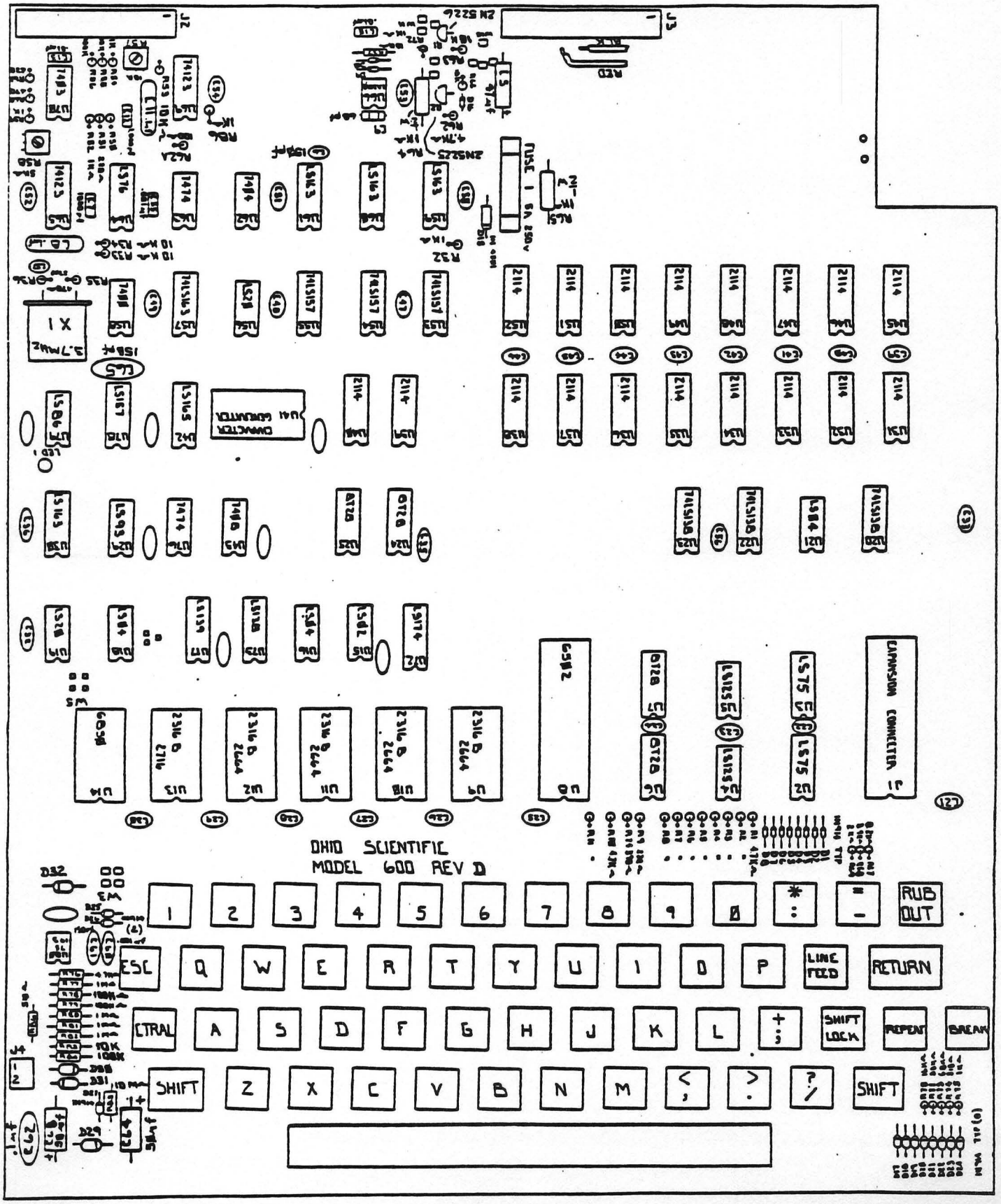


Figure I-2

STAGE I: Low-Profile Parts Installation

The first stage in assembling the Superboard kit consists of soldering the IC sockets and other low-profile parts (diodes, resistors, etc.) to the board. Most of the soldering involved in the project will be done during this stage. You will also do some preliminary testing.

There are many diagrams to assist you in properly locating components on the board. However, be sure to double check the position and orientation of each part before soldering.

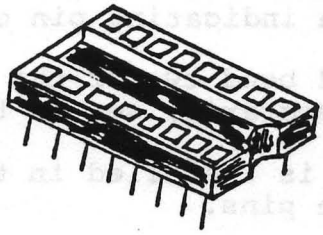
Stage I assembly is divided into five parts as described on the following pages.

STAGE I, Part One: Socket Installation

Parts List (These parts will be found in Bag D and/or in plastic tubes marked "D".)

check:	Part Number	Quantity	Description
( )	SC-14FI	16	14 pin IC socket
( )	SC-16FI	25	16 pin IC socket
( )	SC-18FI	18	18 pin IC socket
( )	SC-24FI	7	24 pin IC socket
( )	SC-40FI	2	40 pin IC socket

Note: It is a good idea to find and check each part on the list at this time. This will save time and help to avoid mistakes when the various parts are called for in the assembly steps.

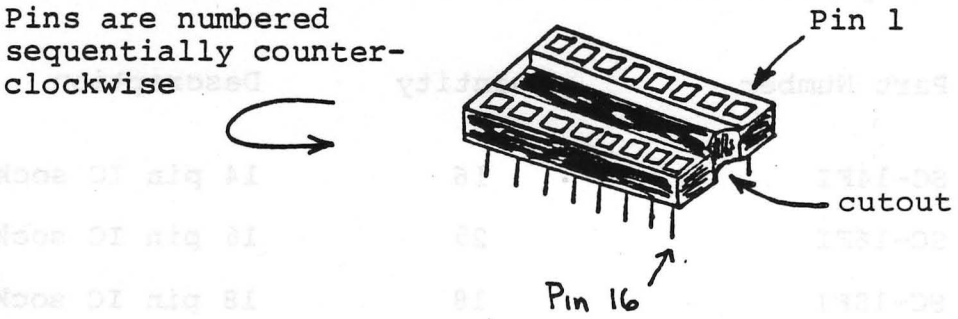


16 pin IC socket

(the 24 pin and 40 pin sockets have rectangular openings between the rows of pins)

Socket Installation Notes

The IC sockets have small semicircular cutouts at one end that are used to orient them properly on the board:



With one exception (noted in assembly STEP 2), the sockets will be properly oriented when the cutout faces south relative to the north edge of the board.

Within each section of the board the largest sockets should be installed and soldered first. These should be followed by the next largest size and so on until all the indicated sockets have been installed.

The installation of a socket requires three steps:

1) put the socket in the board checking the orientation of the cutout (or notch indicating pin one).

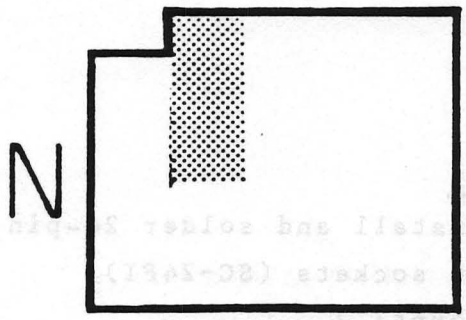
2) turn the board over and bend two of the pins on opposite corners to temporarily secure the socket.

3) verify that the socket is installed in the correct location and solder the pins.

When several sockets the same size are to be installed, the above three steps can be carried out simultaneously for all of the sockets in a given area.

STEP 1

( ) A. Install and solder
18-pin IC sockets (SC-18FI)
count: 16

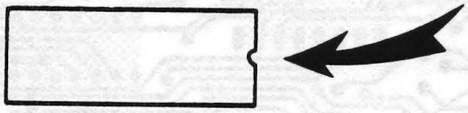


(detail location)

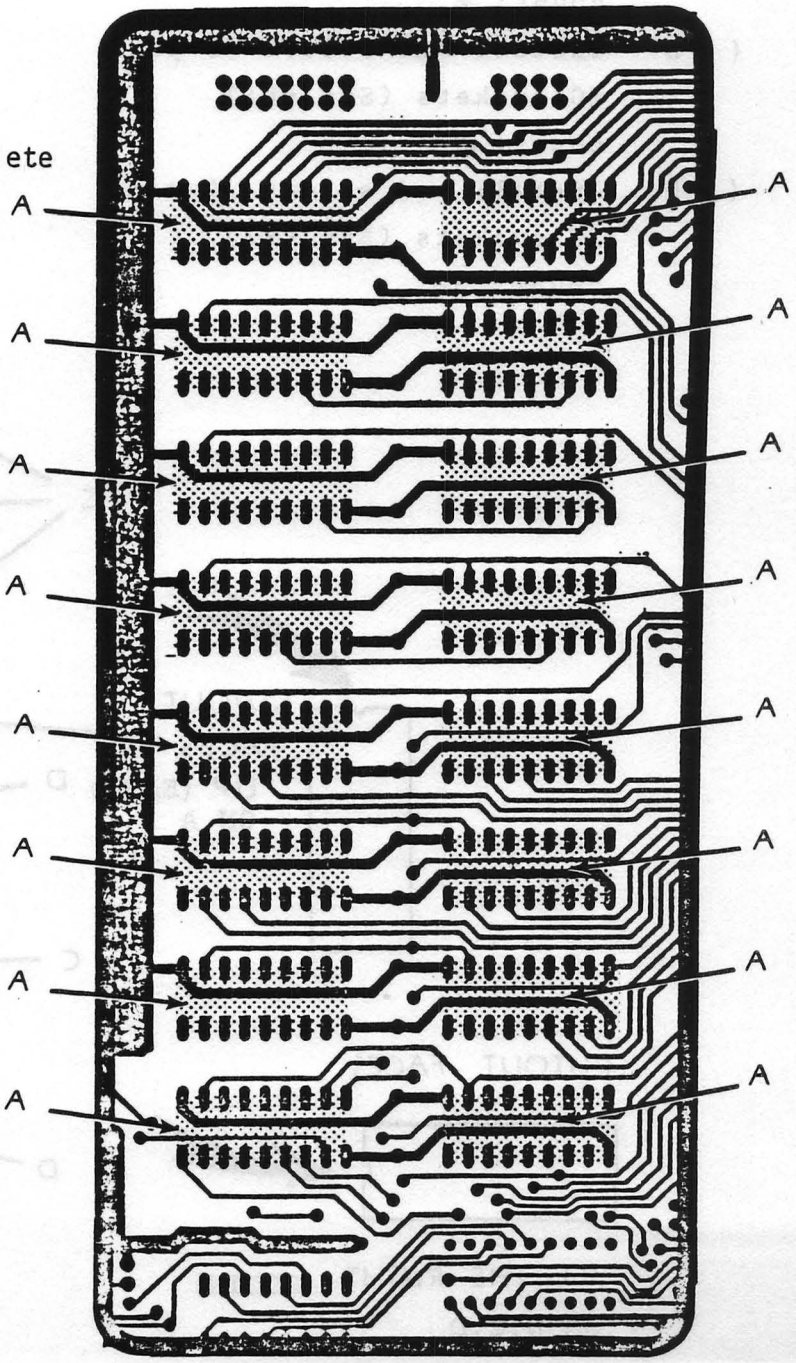
Note: For best results, use the solder included with your kit.

Note: Check the appropriate box in the columns to the left as you complete each step to keep track of your progress.

CUTOUT FACES



TO THE RIGHT (SOUTH)



(detail)

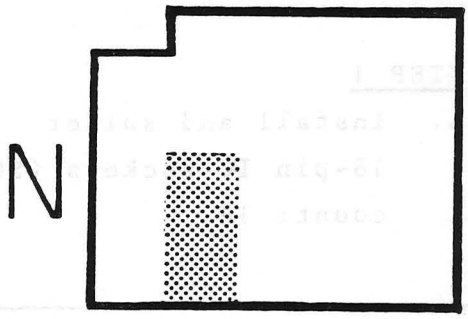
STEP 2

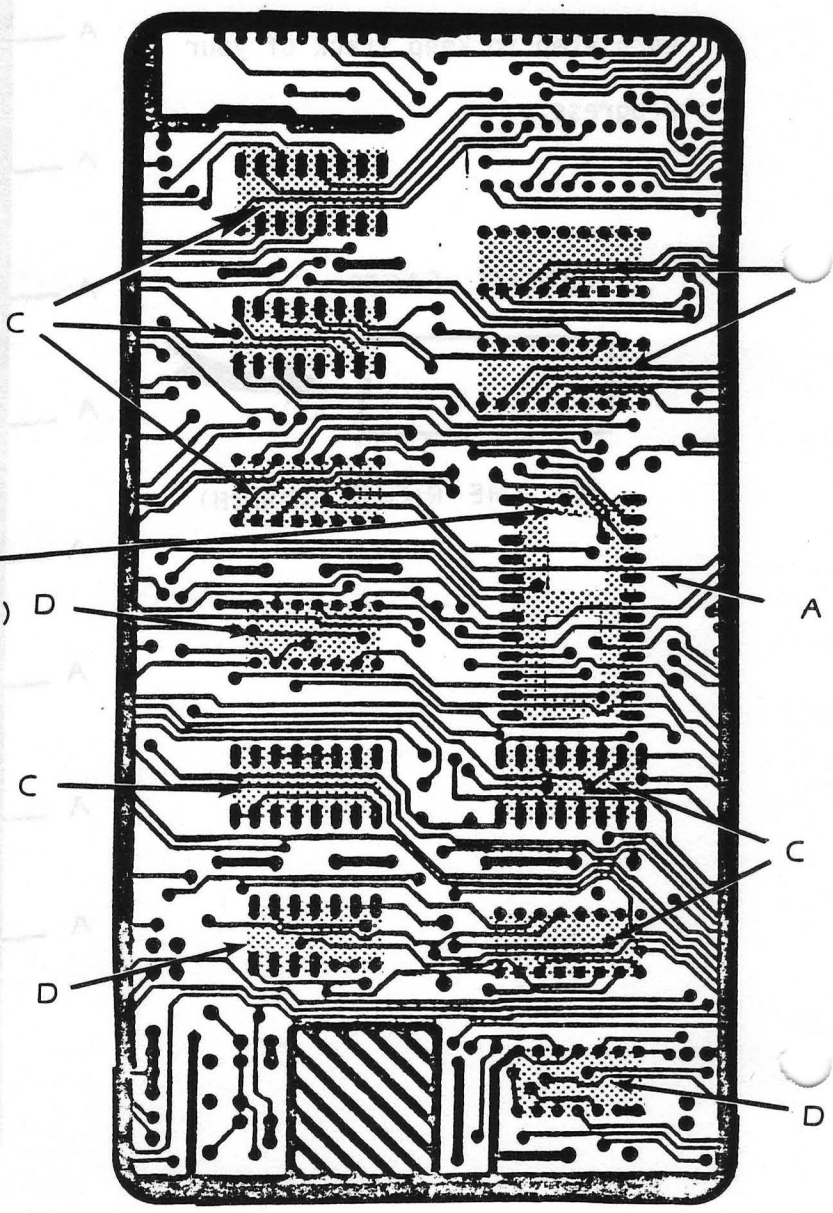
( ) A. Install and solder 24-pin IC sockets (SC-24FI) count: 1

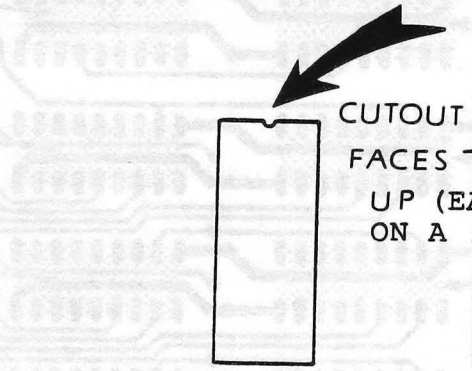
( ) B. Install and solder 18-pin IC sockets (SC-18FI) count: 2

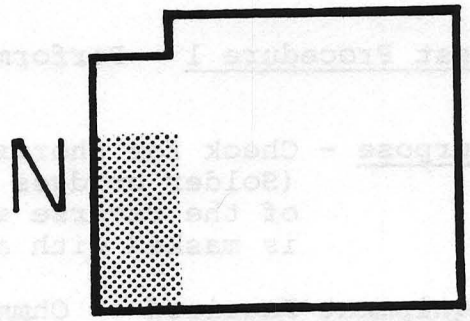
( ) C. Install and solder 16-pin IC sockets (SC-16FI) count: 6

( ) D. Install and solder 14-pin IC sockets (SC-14FI) count: 3





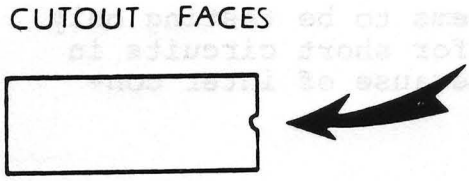


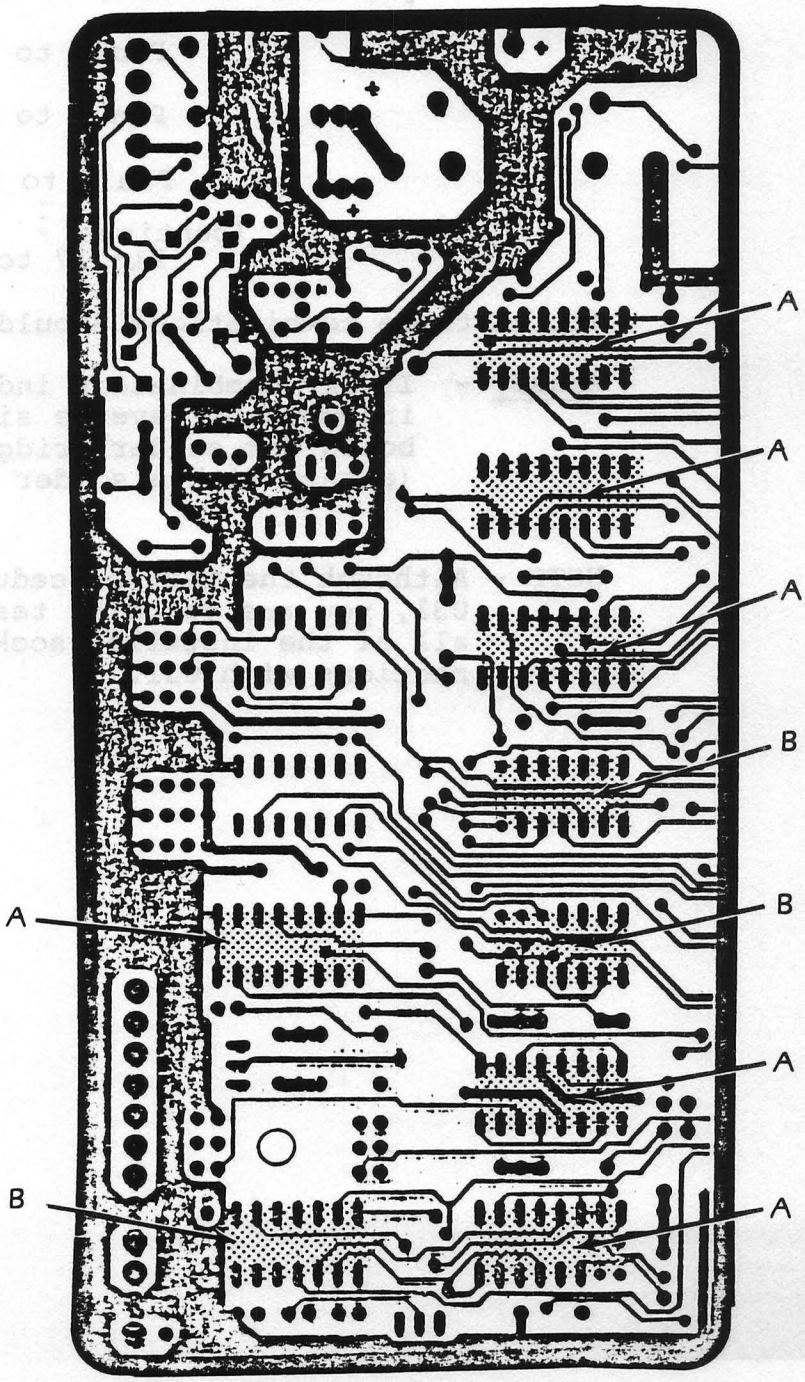


STEP 3

( ) A. Install and solder
16-pin IC sockets (SC-16FI)
count: 6

( ) B. Install and solder
14-pin IC sockets (SC-14FI)
count: 3





( ) Test Procedure 1 - Perform after Step 3

Purpose - Check for shorts resulting from solder bridges. (Solder bridges are unlikely to occur since most of the reverse side of the printed circuit board is masked with a green plastic film.)

Equipment Required - Ohmmeter with probes.

Procedure - Locate socket U31 (upper right hand corner in Step 1). Use an Ohmmeter to check the following pin combinations:

Pin 1 to Pins 2, 3, 4 thru Pin 18

Pin 2 to Pins 3, 4 thru Pin 18

Pin 3 to Pins 4 thru Pin 18

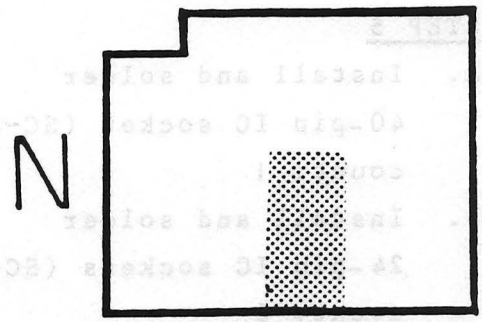
(continue) ⋮ ⋮

Pin 17 to Pin 18

All of these combinations should indicate an open circuit.

Remedy - If any combination indicates a completed circuit, inspect the reverse side of the printed circuit board for solder bridges and remove excess solder (either with a solder sucker or desoldering braid).

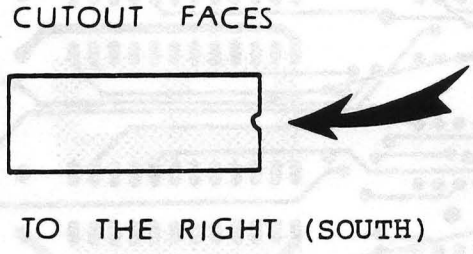
NOTE - Although the test procedure seems to be testing only U31, you are actually testing for short circuits in all of the installed sockets because of inter connections with U31.

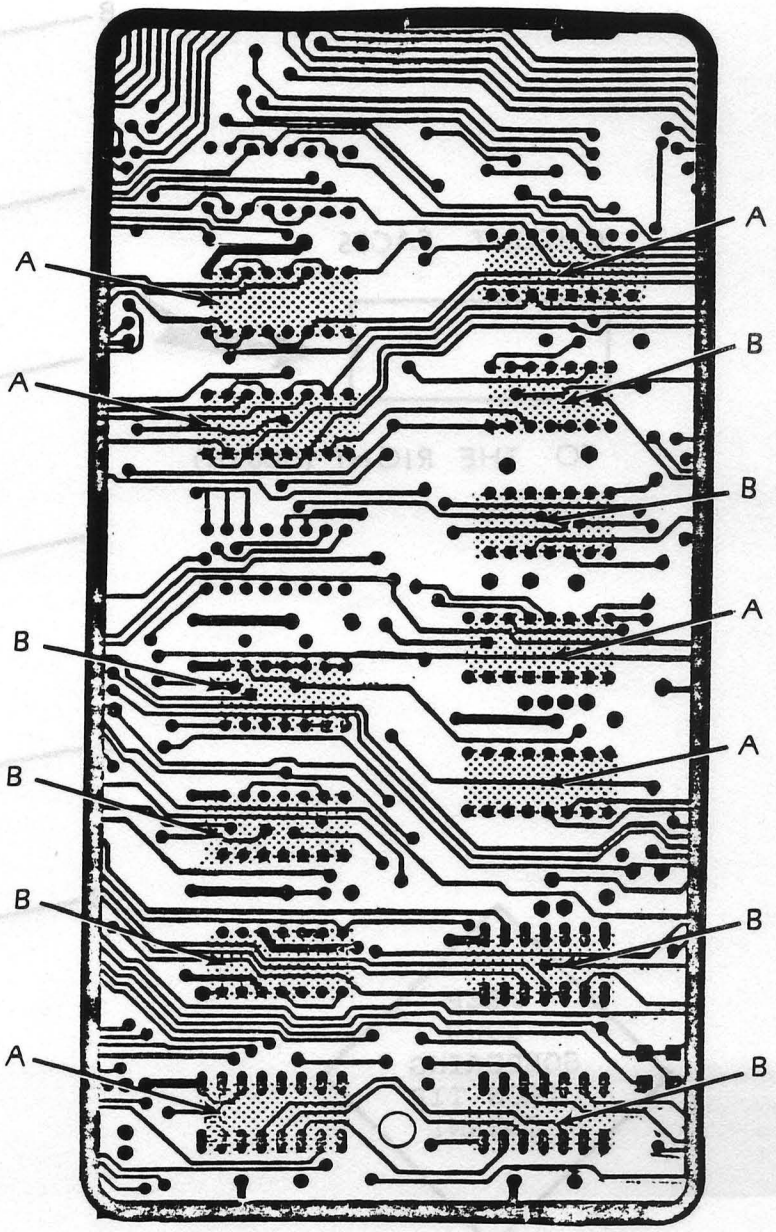


STEP 4

( ) A. Install and solder
16-pin IC sockets (SC-16FI).
count:6

( ) B. Install and solder
14-pin IC sockets (SC-14FI)
count: 7

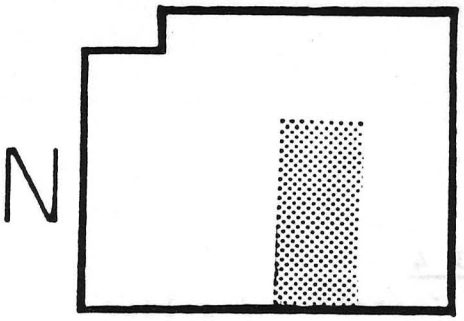


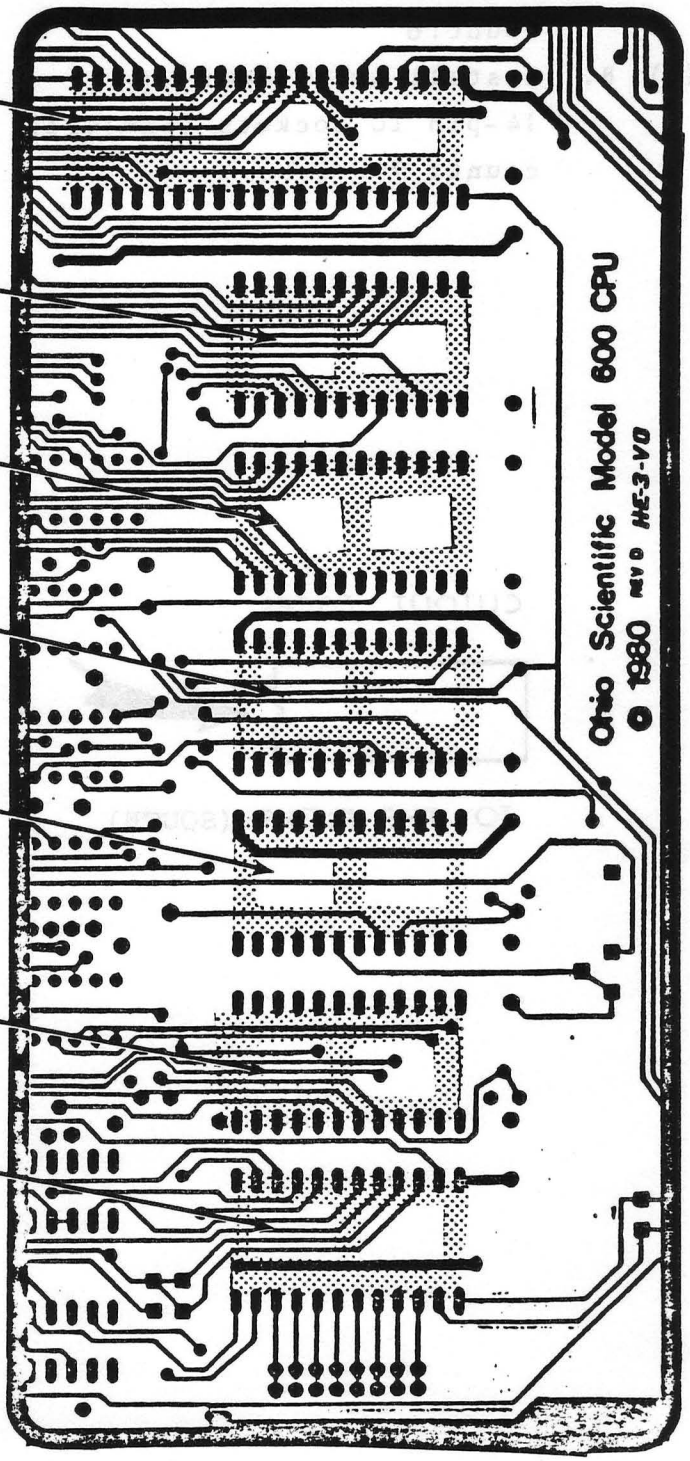


STEP 5

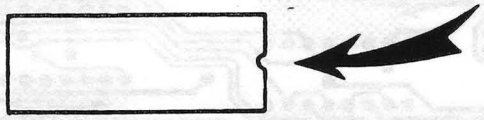
( ) A. Install and solder
40-pin IC socket (SC-40FI)
count: 1

( ) B. Install and solder
24-pin IC sockets (SC-24FI)
count: 6





CUTOUT FACES



TO THE RIGHT (SOUTH)

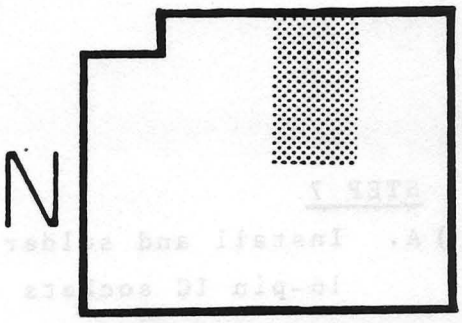
KEEP YOUR SOLDERING IRON TIP CLEAN!

STEP 6

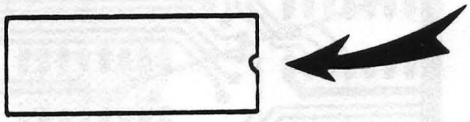
( ) A. Install and solder
40-pin IC socket (SC-40FI)
count: 1

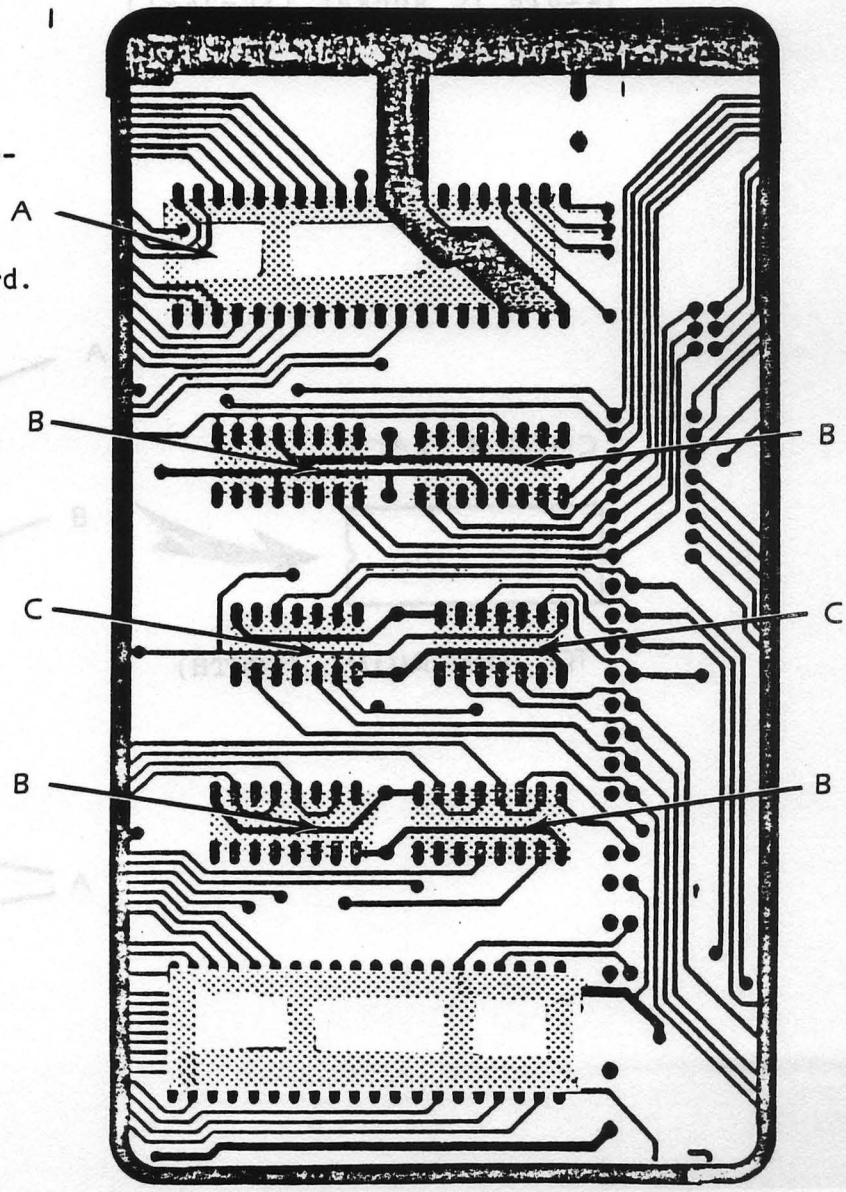
( ) B. Install and solder *
16-pin IC sockets (SC-16FI)
count: 4

( ) C. Install and solder
14-pin IC sockets (SC-14FI)
count: 2



*Note: These sockets are only populated when a 610 I/O Expander Board is attached to the Superboard.

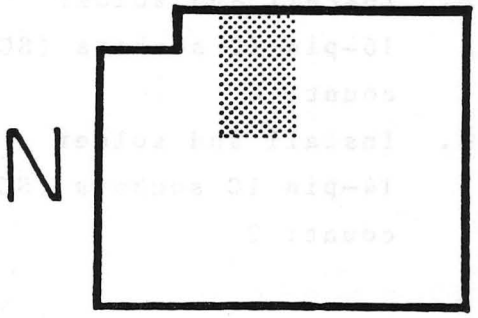


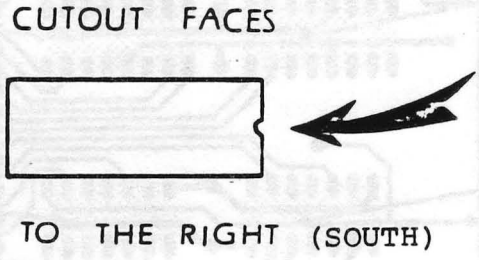


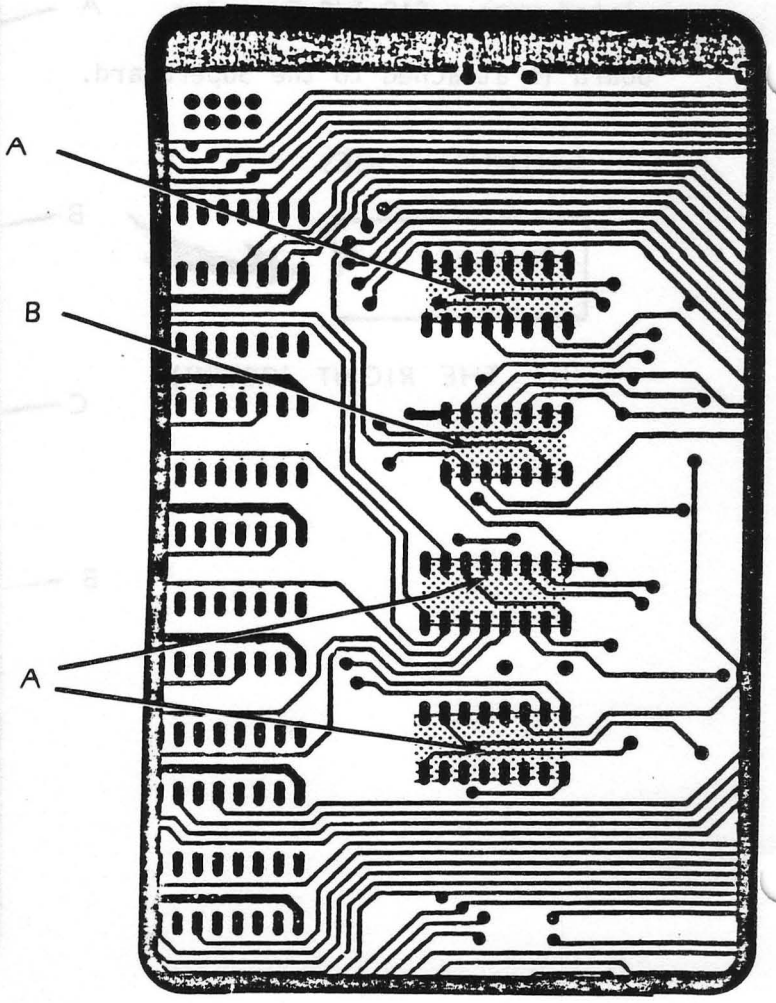
STEP 7

( ) A. Install and solder
16-pin IC sockets (SC-16FI)
count: 3

( ) B. Install and solder
14-pin IC socket (SC-14FI)
count: 1







( ) Test Procedure 2 - Perform after STEP 7

Purpose - Check for shorts resulting from solder bridges.

Equipment Required - Ohmmeter with probes.

Procedure - Locate socket U9 (the uppermost 24 pin socket in STEP 5). Use an ohmmeter to check the following pin combinations:

Pin 1 to Pins 2, 3, 4, ---, 24

Pin 2 to Pins 3, 4, ---, 24

Pin 3 to Pins 4, 5, ---, 24

(continue) . . .

Pin 23 to Pin 24

All of these combinations except Pin 18 to Pin 21, Pin 18 to Pin 24 and Pin 21 to Pin 24 should indicate an open circuit. The connections among Pins 18, 21 and 24 should all indicate completed circuits (these are all connected to +5V).

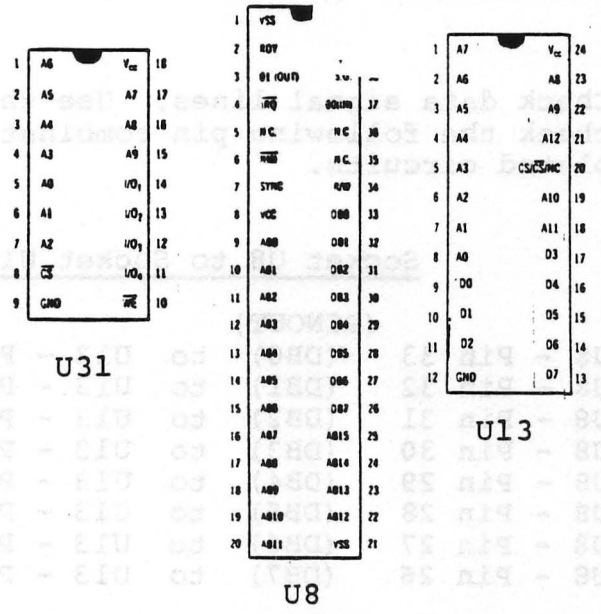
Remedy - If any combination (other than those among Pins 18, 21 and 24) indicates a completed circuit, inspect the reverse side of the printed circuit board for solder bridges and remove excess solder with a solder sucker or desoldering braid.

( )Test Procedure 3 - Perform after STEP 7

Purpose - Check for continuity of address and data signal lines.

Equipment Required - Ohmmeter with probes.

Procedure - (1) Locate sockets U31 (upper right hand corner of STEP 1), U8 (40 pin socket in STEP 5) and U13 (second from bottom 24 pin socket in STEP 5).



U8, U13, and U31 socket diagrams with pinouts* indicated

(2) Check address lines. Use the ohmmeter to check the following pin combinations for circuits.

Socket U31 - Socket U8: circuit completed	(PINOUT*)
U31 - Pin 5 and U8 - Pin 9	(A0)
U31 - Pin 6 and U8 - Pin 10	(A1)
U31 - Pin 7 and U8 - Pin 11	(A2)
U31 - Pin 4 and U8 - Pin 12	(A3)
U31 - Pin 3 and U8 - Pin 13	(A4)
U31 - Pin 2 and U8 - Pin 14	(A5)
U31 - Pin 1 and U8 - Pin 15	(A6)
U31 - Pin 17 and U8 - Pin 16	(A7)
U31 - Pin 16 and U8 - Pin 17	(A8)
U31 - Pin 15 and U8 - Pin 18	(A9)

*PINOUT refers to notation on schematics and PINOUT charts at end of manual.

(3) Check data signal lines. Use the ohmmeter to check the following pin combinations for completed circuits.

Socket U8 to Socket U13 Complete Circuit

	(PINOUT)			(PINOUT*)
U8 - Pin 33	(DB0)	to	U13 - Pin 9	(D0)
U8 - Pin 32	(DB1)	to	U13 - Pin 10	(D1)
U8 - Pin 31	(DB2)	to	U13 - Pin 11	(D2)
U8 - Pin 30	(DB3)	to	U13 - Pin 13	(D3)
U8 - Pin 29	(DB4)	to	U13 - Pin 14	(D4)
U8 - Pin 28	(DB5)	to	U13 - Pin 15	(D5)
U8 - Pin 27	(DB6)	to	U13 - Pin 16	(D6)
U8 - Pin 26	(DB7)	to	U13 - Pin 17	(D7)

*PINOUT refers to notation on schematics and PINOUT charts at end of manual.

STAGE I, Part Two: Diode Installation

Parts List: (Found in Bag B)

	Part Number	Quantity	Description
check:			
( )	Q-1N914	26	Diode
( )	Q-1N4001	1	Diode Rectifier

typical diode; polarity is indicated by black band at one end

Note: As you locate each part check the appropriate box.

Diode Installation Notes

The next few steps involve the insertion of the small diodes on the Superboard. There are 26 Q-1N914 diodes in the kit. They are orange with a silver stripe around the middle and a black stripe at one end. The black stripe enables the builder to orient the diode properly. The leads on all the diodes (except one) should be bent to a 90^0 angle so that the center section is 3/8" wide. The last diode is installed in a "Standup" or vertical position.

The procedure for installing one diode is:

1) Bend the leads to the correct length.

2) Insert the diode into the board, checking for the correct orientation.

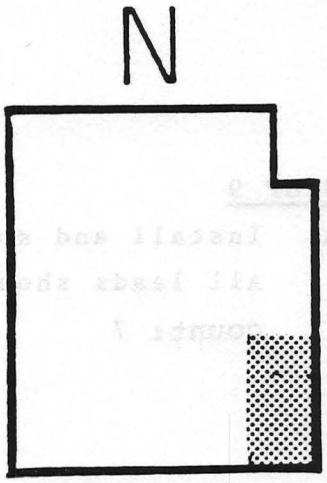
3) Turn the board over and solder the diode into place. Do not apply any more heat than necessary.

4) Cut the extra wire from the leads on the non-component side of the board.

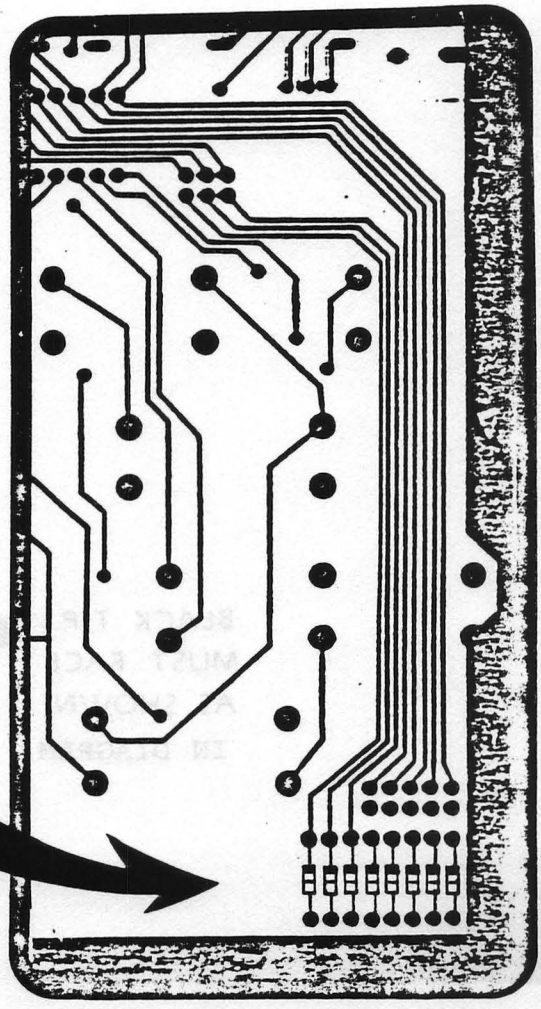
NOTE: Groups of diodes may be soldered instead of one at a time.

STEP 8

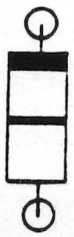
( ) A. Install and solder diodes (Q-1N914)
count: 8
The leads on the diodes should be bent to 3/8"



KEEP YOUR SOLDERING IRON TIP CLEAN!



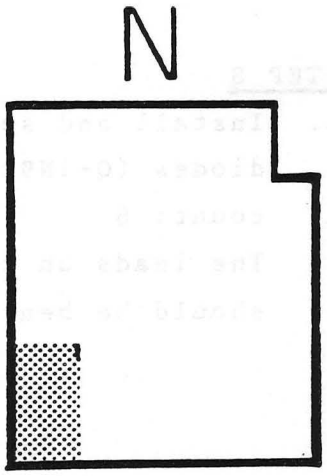
BLACK TIP: MUST FACE AS SHOWN IN DIAGRAM

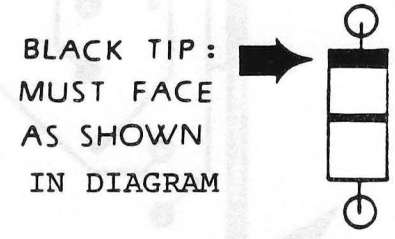


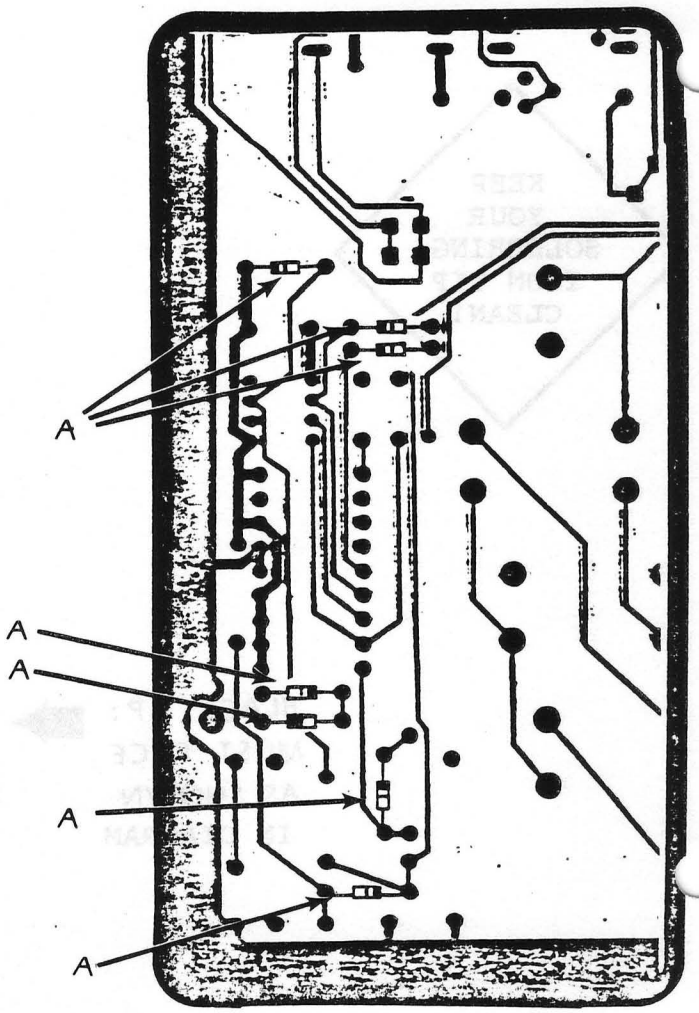
A

STEP 9

( ) A. Install and solder diodes (Q-1N914)
All leads should be bent to 3/8"
count: 7

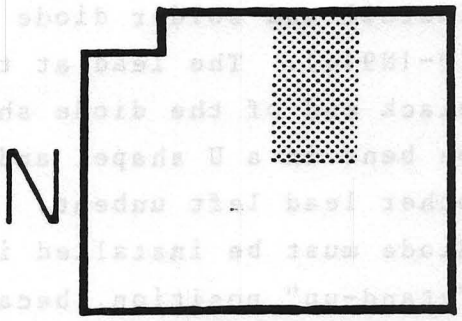


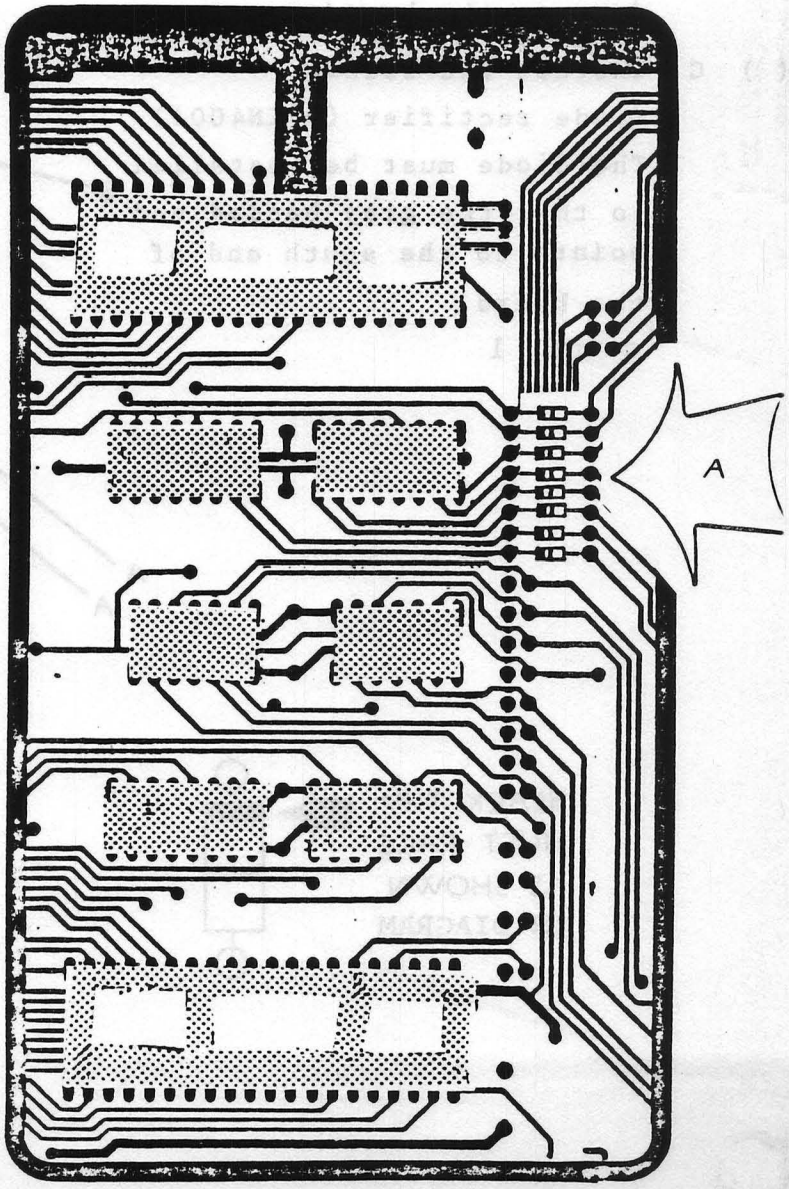




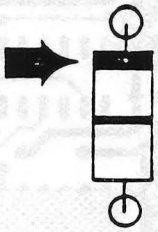
STEP 10

( ) A. Install and solder diodes (Q-1N914)
count: 8
Bend the leads on the diodes to 3/8"





BLACK TIP:
MUST FACE
AS SHOWN
IN DIAGRAM



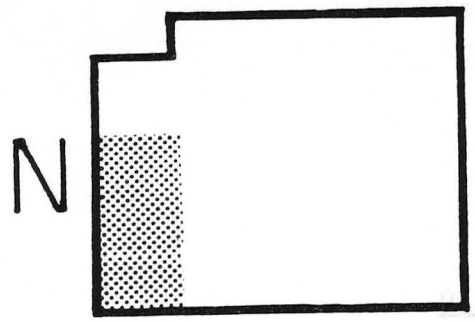
KEEP
YOUR
SOLDERING
IRON TIP
CLEAN!

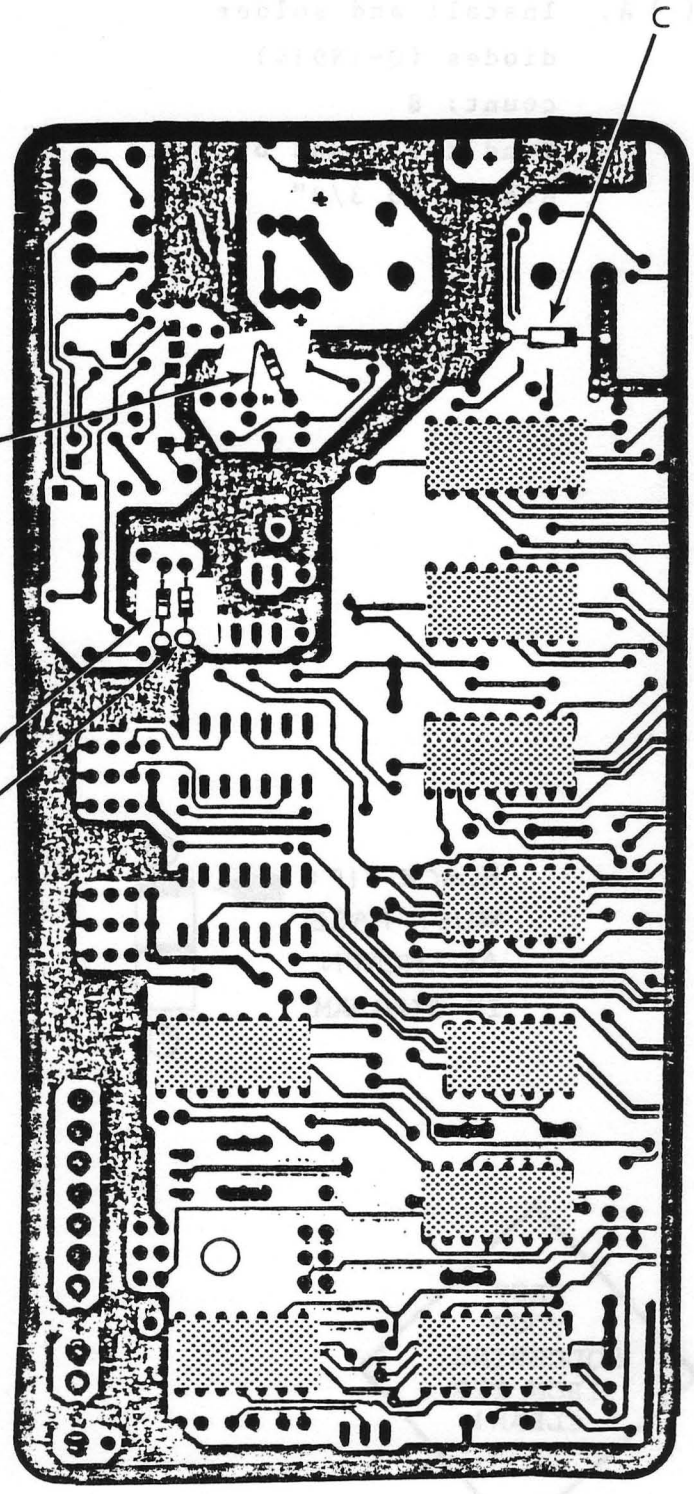
STEP 11

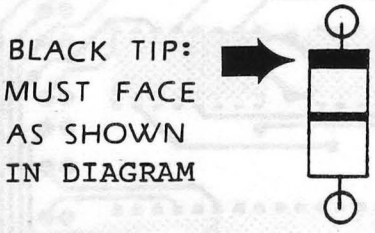
( ) A. Install and solder diodes (Q-1N914). Bend the leads for 3/8" hole spacing. count: 2

( ) B. Install and solder diode (Q-1N914). The lead at the black end of the diode should be bent in a U shape, and the other lead left unbent. This diode must be installed in a "stand-up" position, because the holes are too close together for the diode to lie down on the board. count: 1

( ) C. Install and solder diode rectifier (Q-IN4001) The diode must be installed so that the gray banded end points to the south end of the board. count: 1



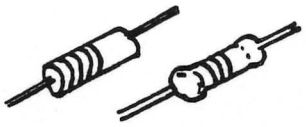




STAGE I, Part Three: Resistor Installation

Parts List: (Found in Bag C)

check:	Part Number	Quantity	Description
( )	R1-101	1	100 Ohm (brown-black-brown-gold)
( )	R1-102	7	1K Ohm (brown-black-red-gold)
( )	R1-103	8	10K Ohm (brown-black-orange-gold)
( )	R1-104	4	100K Ohm (brown-black-yellow-gold)
( )	R1-105	4	1M Ohm (brown-black-green-gold)
( )	R1-106	1	10M Ohm (brown-black-blue-gold)
( )	R1-153	1	15K Ohm (brown-green-orange-gold)
( )	R1-163	1	16K Ohm (brown-blue-orange-gold)
( )	R1-202	1	2K Ohm (red-black-red-gold)
( )	R1-221	3	220 Ohm (red-red-brown-gold)
( )	R1-333	1	33K Ohm (orange-orange-orange-gold)
( )	R1-391	1	390 Ohm (orange-white-brown-gold)
( )	R1-392	1	3.9K Ohm (orange-white-red-gold)
( )	R1-471	4	470 Ohm (yellow-violet-brown-gold)
( )	R1-472	12	4.7K Ohm (yellow-violet-red-gold)
( )	R1-511	2	510 Ohm (green-brown-brown-gold)
( )	R1-683	1	68K Ohm (blue-gray-orange-gold)
( )	R1-822	1	8.2K Ohm (gray-red-red-gold)
( )	R2-102	2	1K Ohm (brown-black-red-silver)



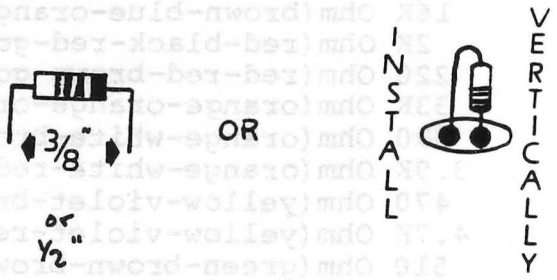
typical resistors

Note: At times gold and silver (toleramce) parts may be substituted in your kit, this will not affect the operation of your computer. If you have trouble reading the colors on some resistors use your VOM to test the values.

Note: As you locate each part check the appropiate box.

Resistor Installation Notes

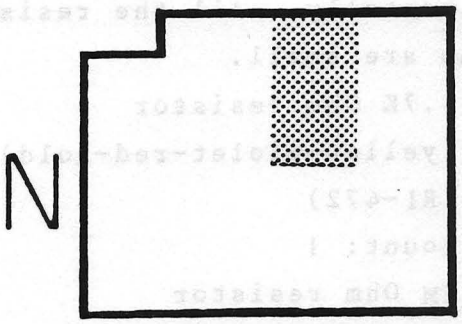
The resistors are mounted on the board in one of two ways. Some are mounted horizontally (and lie flat). The leads on these are each bent 90^0 so that the center section is 3/8" or 1/2". The remaining resistors are mounted into holes that are 1/8" apart and so must be mounted "standing up". One lead is left unbent and the other is bent into a U-shape. The procedure for installing a resistor is the same as for installing a diode (except that the orientation of a resistor is unimportant).



Note: As a convention it is a good idea to insert all resistors the same way, for instance, insert all resistors with the gold band down.

STEP 12

Install and solder the following resistors. Each resistor is mounted vertically. All the resistors in this group are small.



( ) A. 4.7K Ohm resistor
(yellow-violet-red-gold)
(R1-472)
count: 10

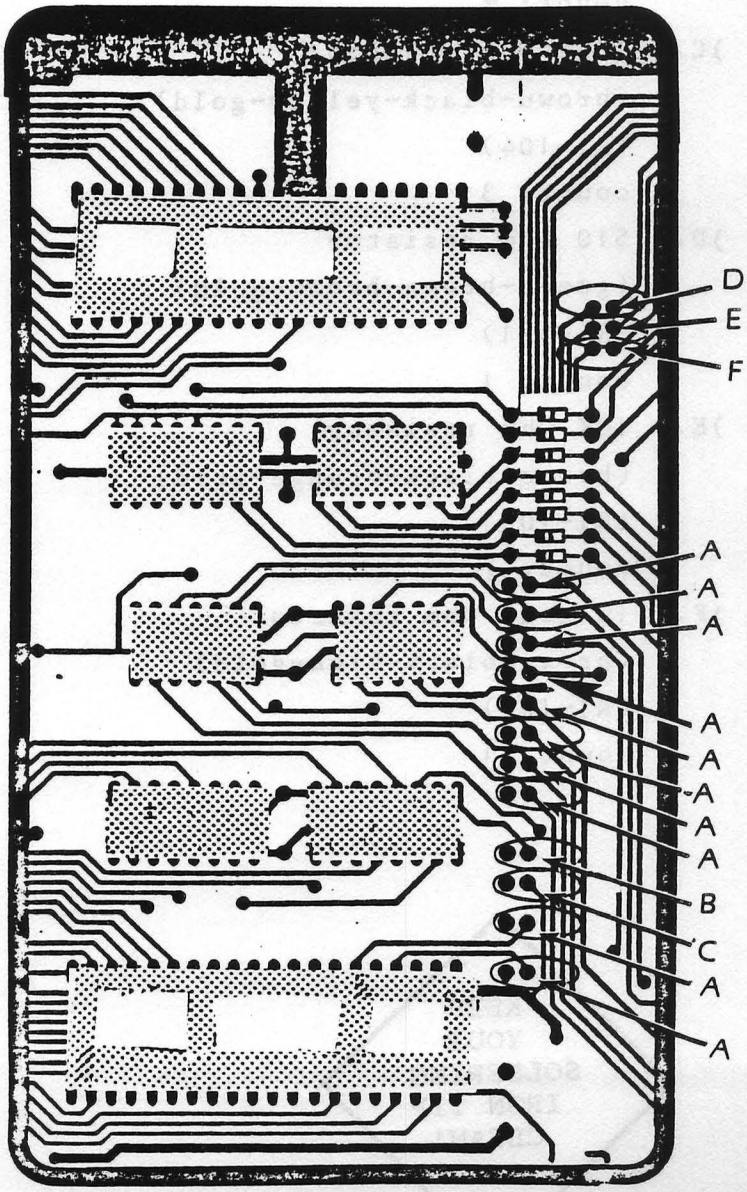
( ) B. 220 Ohm resistor
(red-red-brown-gold)
(R1-221)
count: 1

( ) C. 390 Ohm resistor
(orange-white-brown-gold)
(R1-391)
count: 1

( ) D. 8.2K Ohm resistor
(gray-red-red-gold)
(R1-822)
count: 1

( ) E. 3.9K Ohm resistor
(orange-white-red-gold)
(R1-392)
count: 1

( ) F. 2K Ohm resistor
(red-black-red-gold)
(R1-202)
count: 1



STEP 13

Install and solder the following resistors. Each resistor in this group is mounted horizontally. All the resistors in this group are small.

( ) A. 4.7K Ohm resistor
(yellow-violet-red-gold)
(R1-472)
count: 1

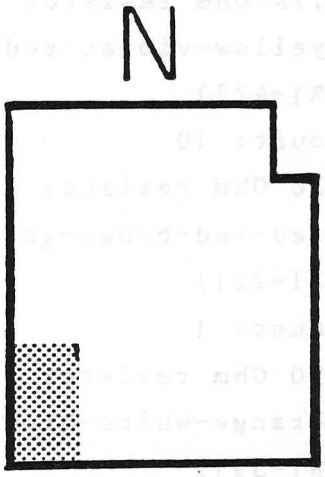
( ) B. 1M Ohm resistor
(brown-black-green-gold)
(R1-105)
count: 4

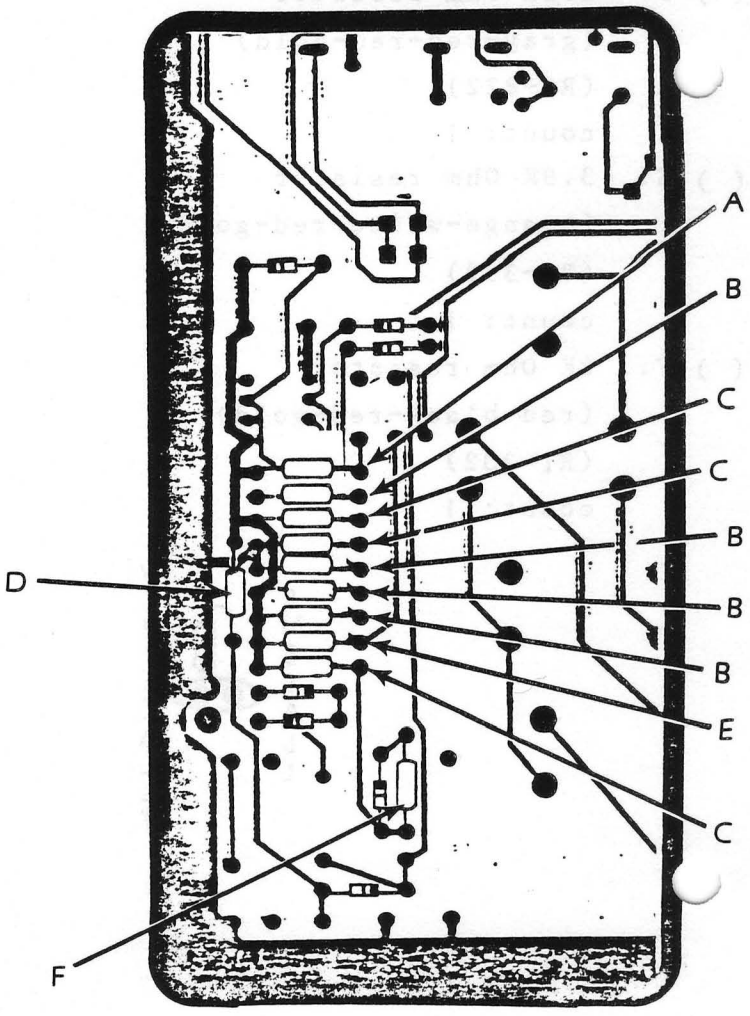
( ) C. 100K Ohm resistor
(brown-black-yellow-gold)
(R1-104)
count: 3

( ) D. 510 Ohm resistor
(green-brown-brown-gold)
(R1-511)
count: 1

( ) E. 10K Ohm resistor
(brown-black-orange-gold)
(R1-103)
count: 1

( ) F. 10 Meg. Ohm resistor
(brown-black-blue-gold)
(R1-106)
count: 1

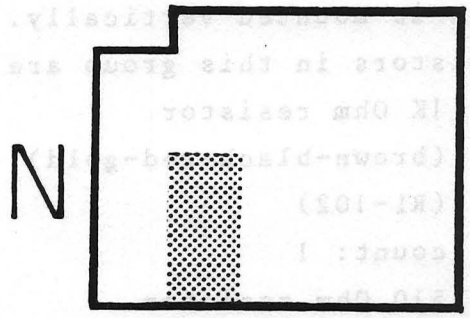




KEEP YOUR SOLDERING IRON TIP CLEAN!

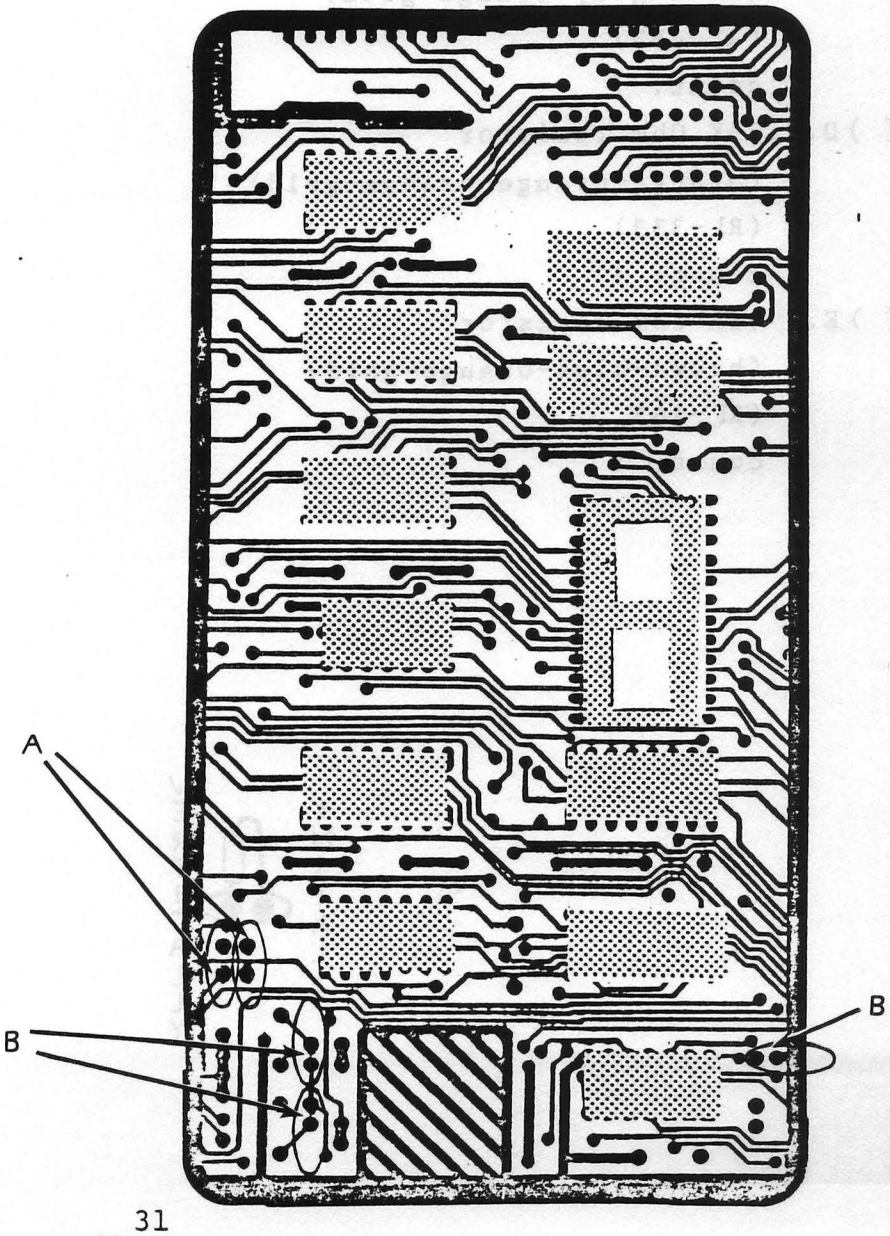
STEP 14

Install and solder the following resistors. Each is mounted vertically. All the resistors in this group are small.



( ) A. 10K Ohm resistor
(brown-black-orange-gold)
(R1-103)
count: 2

( ) B. 470 Ohm resitor
(yellow-violet-brown-gold)
(R1-471)
count: 3



STEP 15

Install and solder the following resistors. Each is mounted vertically. All the resistors in this group are small.

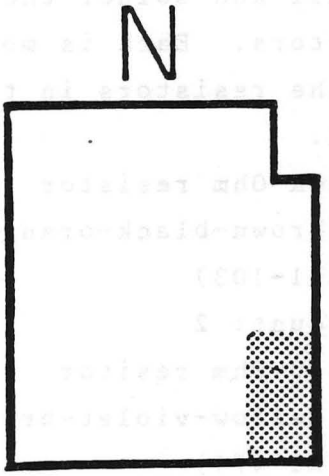
( )A. 1K Ohm resistor
(brown-black-red-gold)
(R1-102)
count: 1

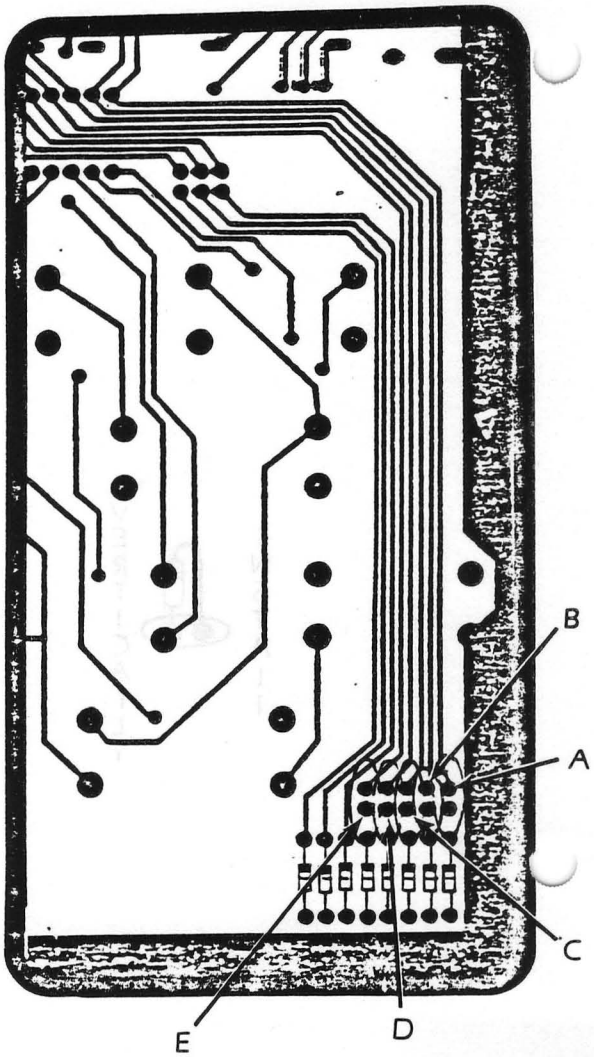
( )B. 510 Ohm resistor
(green-brown-brown-gold)
(R1-511)
count: 1

( )C. 68K Ohm resistor
(blue-gray-orange-gold)
(R1-683)
count: 1

( )D. 33K Ohm resistor
(orange-orange-orange-gold)
(R1-333)
count: 1

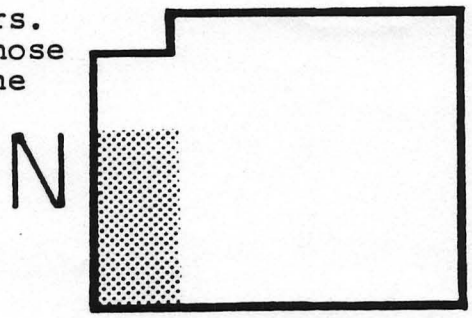
( )E. 16K Ohm resistor
(brown-blue-orange-gold)
(R1-163
count: 1





STEP 16

Install and solder the following resistors. The two resistors in part G and one of those in part B are mounted horizontally and the rest are mounted vertically. The two in part G are the larger 1/2 watt resistors and the rest are the smaller 1/4 watt resistors.



( ) A. 1K Ohm resistors
(brown-black-red-gold)
(R1-102)
count: 6

( ) B. 10K Ohm resistors
(brown-black-orange-gold)
(R1-103)
count: 5

( ) C. 100K Ohm resistor
(brown-black-yellow-gold)
(R1-104)
count: 1

( ) D. 220 Ohm resistors
(red-red-brown-gold)
(R1-221)
count: 2

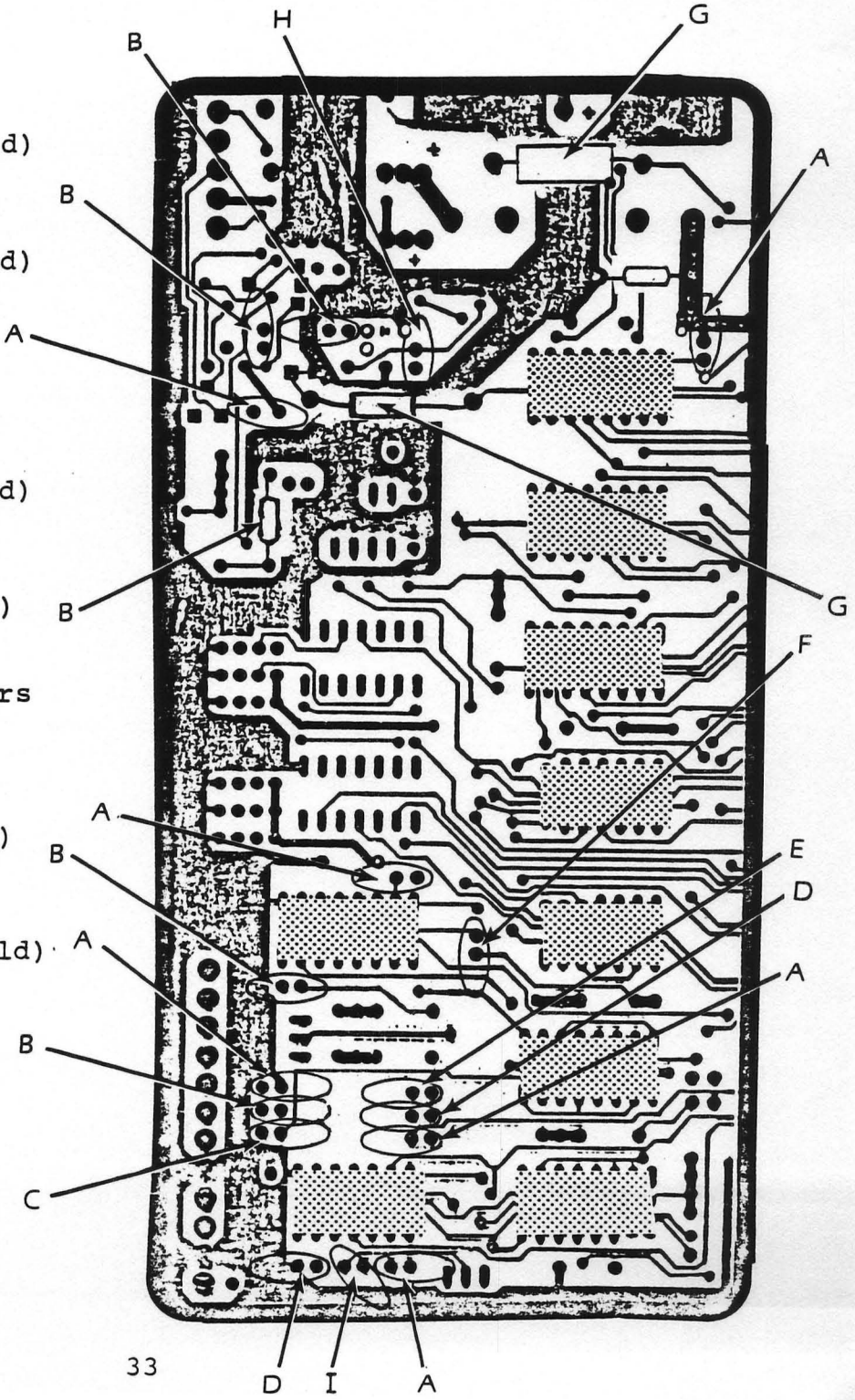
( ) E. 15 K Ohm resistor
(brown-green-orange-gold)
(R1-153)
count: 1

( ) F. 100 Ohm resistor
(brown-black-brown-gold)
(R1-101)
count: 1

( ) G. 1K Ohm 1/2 watt resistors
(brown-black-red-gold)
(R2-102) Bend to 1"
count: 2

( ) H. 4.7K Ohm resistor
(yellow-violet-red-gold)
(R1-472)
count: 1

( ) I. 470 Ohm resistor
(yellow-violet-brown-gold)
(R1-471)
count: 1



KEEP YOUR SOLDERING IRON TIP CLEAN!

RUB OUT
RETURN
REPEAT
BREAK
LINE FEED
SHIFT LOCK
SHIFT

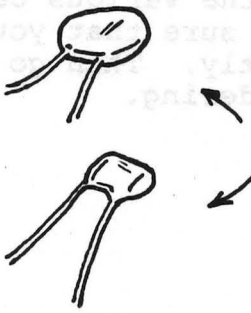
SHIFT
CTRL
ESC

STAGE I, Part Four: Capacitor Installation

Parts List (Bag A)

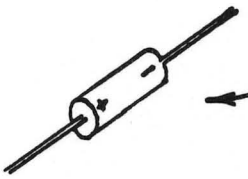
check:	Part Number	Quantity	Description
( )	C-102	4	.001 µf capacitor
( )	C-103	2	.01 µf capacitor
( )	C-104	3	.1 µf capacitor
( )	C-151	3	150 pf capacitor
( )	C-270	1	27 pf capacitor
( )	C-506	3	50 µf electrolytic capacitor (may be 47 µf)
( )	C-680	1	68 pf capacitor*
( )	CB-10410	39	.1 µf bypass capacitor

Note: As you locate each part check the appropriate box.



typical ceramic capacitors

(Note: see next page for help with identification)



electrolytic capacitor; polarity is indicated, usually with "+" signs at one end or with arrows pointing to the "-" end.

* - this may have the appearance of either a ceramic or an electrolytic capacitor; see step 19, E.

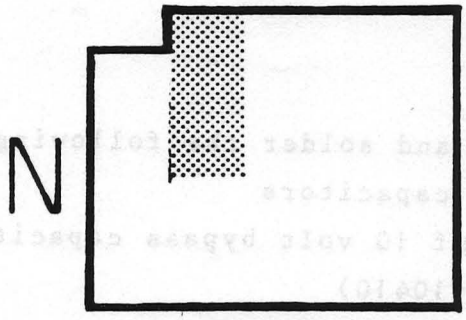
Capacitor Installation Notes

There are two types of capacitors used on the Superboard. Ceramic capacitors are shaped like a small disk, square or "blob" with two leads. Their installation is similar to that for resistors. However, often the ceramic coating material extends down the leads. This insulating material must be removed so that a good solder connection can be made. This can be done with a needlenose pliers. Be careful not to damage the body of the capacitor.

Electrolytic capacitors are cylindrical in shape, significantly larger than the resistors and diodes on the Superboard. These capacitors are polarized and must be installed with the orientation indicated in the diagrams.

Labelling of capacitors can be confusing to the inexperienced. Frequently the units (microfarads, etc.) are not indicated on ceramic capacitors. As a general rule, if the number is less than one, then the units are microfarads (μF); if the number is greater than 10, the units are picofarads (PF). Also, the numerical value may be preceded or followed by a numerical-letter code that has meaning only to the component's manufacturer. In a few cases, the part-number (indicated in the assembly steps) may appear instead of the numerical value of the capacitor.

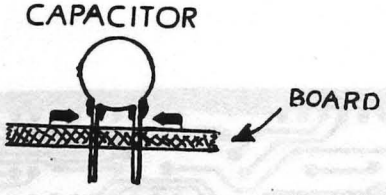
Recommendation: Do a "dry run" of STEPS 17 through 24; i.e., position all of the various capacitors on the board and be sure that you have identified them correctly. Then go back to STEP 17 and begin soldering.



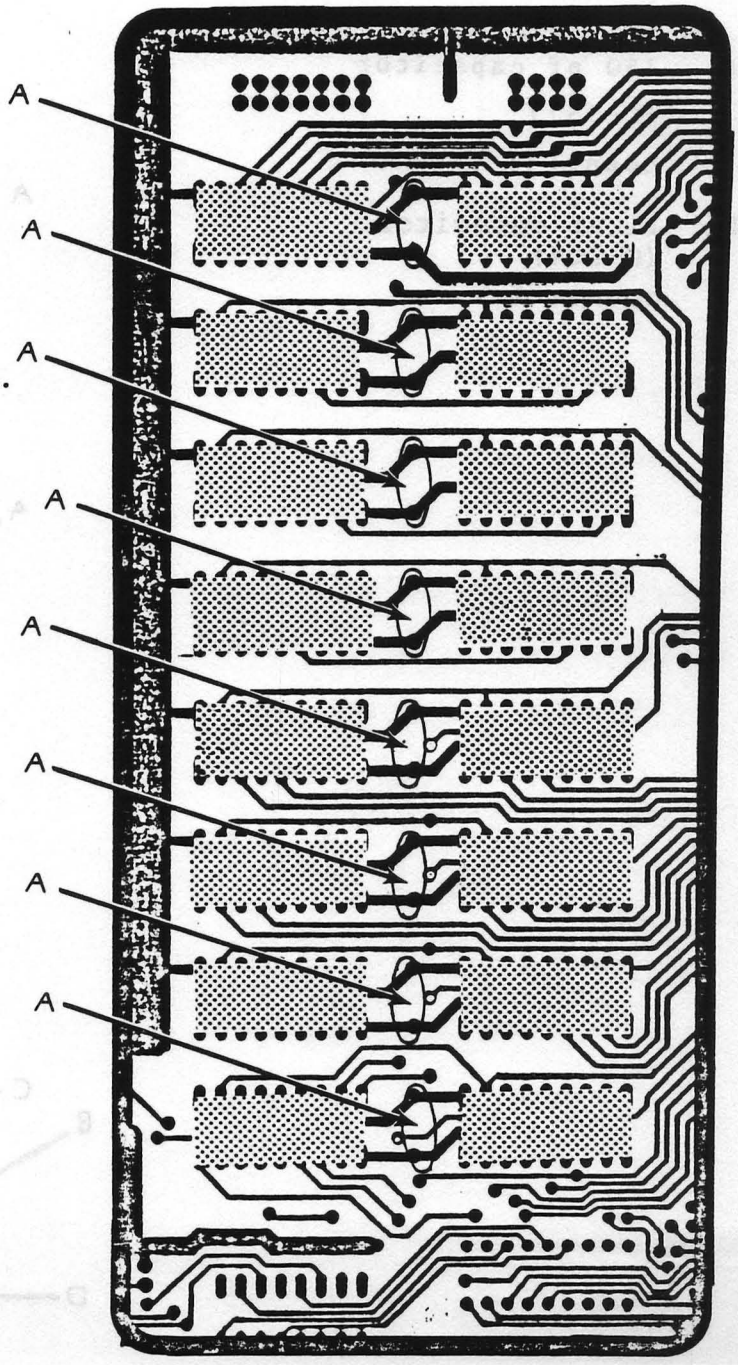
STEP 17

Install and solder the following ceramic capacitors.

( )A. .1 µf 10 volt bypass capacitor
(CB-10410)
count: 8



REMOVE INSULATION so that it does not extend down into the insertion hole.



KEEP YOUR SOLDERING IRON TIP CLEAN!

STEP 18

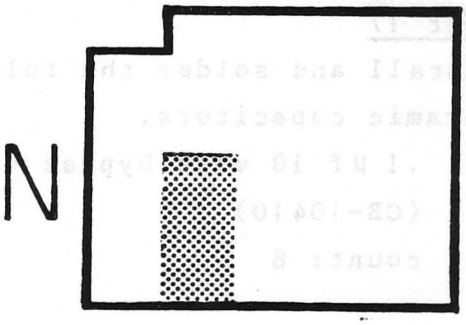
Install and solder the following ceramic capacitors

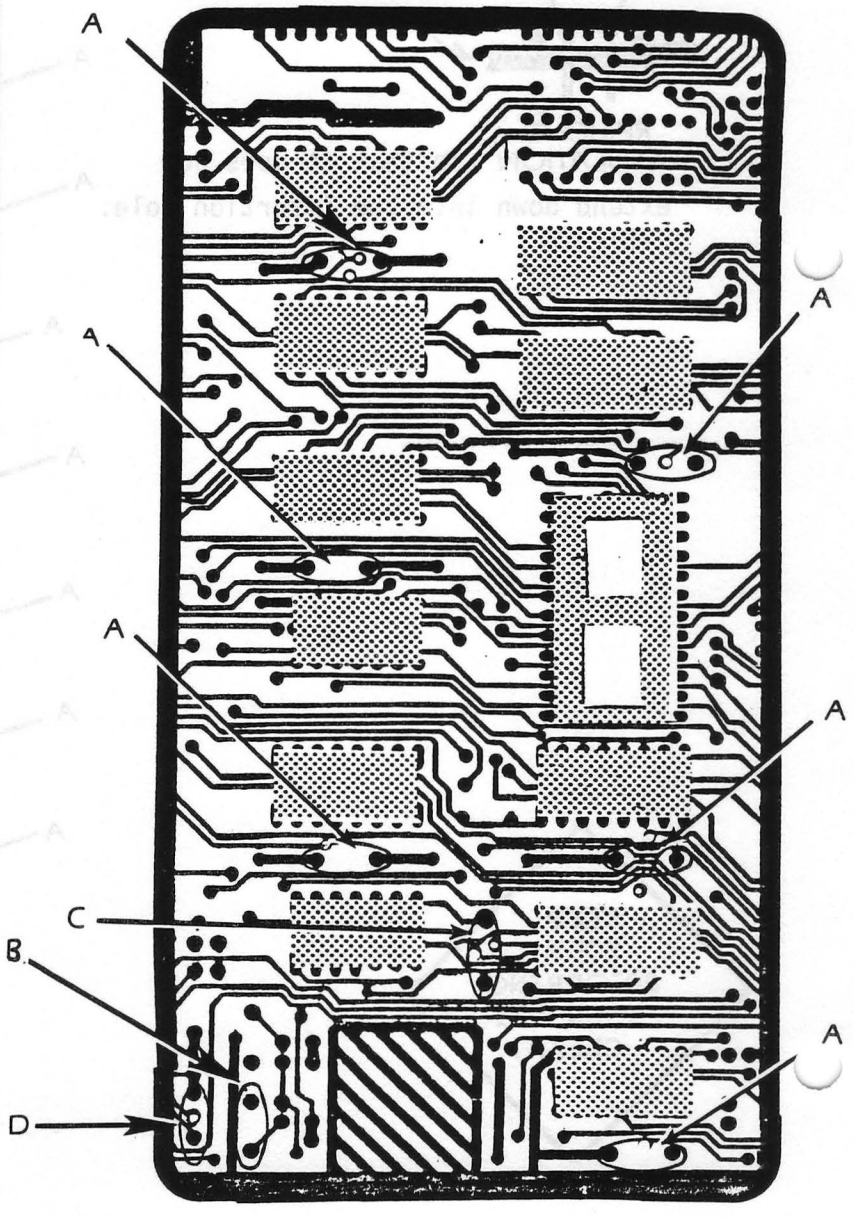
( )A. .1 µf 10 volt bypass capacitors
(CB-10410)
count: 6

( )B. 27 pf capacitor
(C-270)
count: 1

( )C. 150 pf capacitor
(C-151)
count: 1

( )D. .1 µf capacitor
(C-104)
count: 1





STEP 19 Install and solder the following capacitors

( ) A. .1 µf 10 volt bypass capacitors (CB-10410)

count: 5

( ) B. .001 µf capacitors (C-102)

count: 3

( ) C. .01 µf capacitors (C-103)

count: 2

( ) D. 150 pf capacitor (C-151)

count: 1

( ) E. 68 pf capacitor (C-680) This capacitor may have a disk or tubular shape. If it is tubular, it should be oriented so that the end with the black ring is east.

count: 1

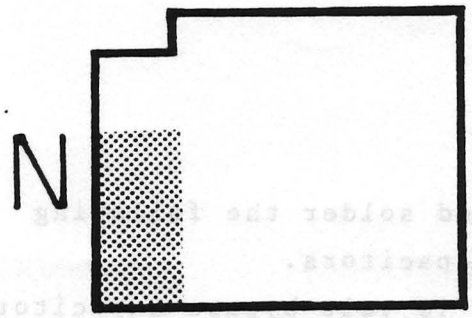
( ) F. .1 µf capacitor (C-104)

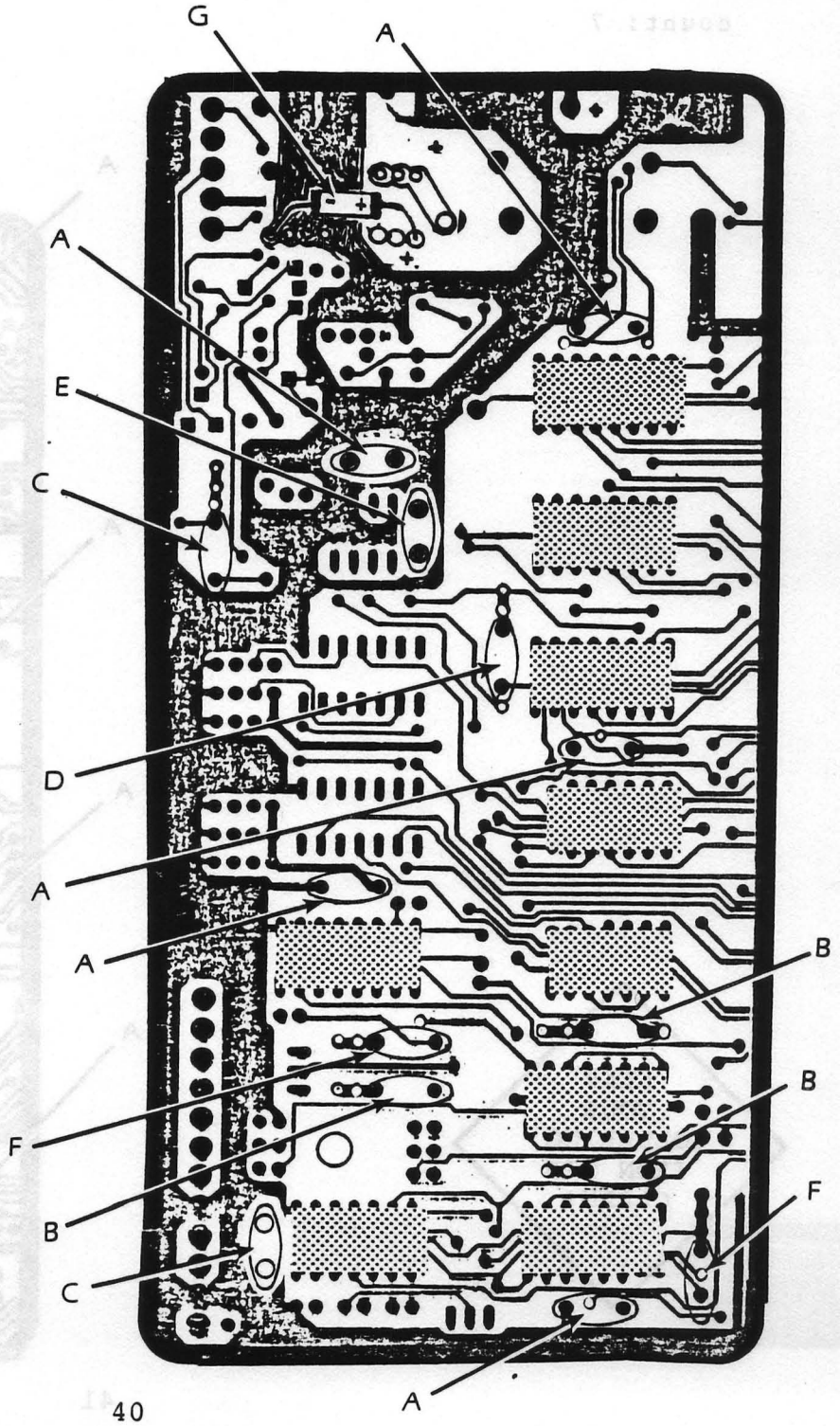
count: 1

( ) G. 47 µf electrolytic capacitor. (In some kits this is a 50 µf electrolytic capacitor.) (C-506)

count: 1

WARNING: Electrolytic capacitors must be installed with the proper orientation, in this case, the plus is south.

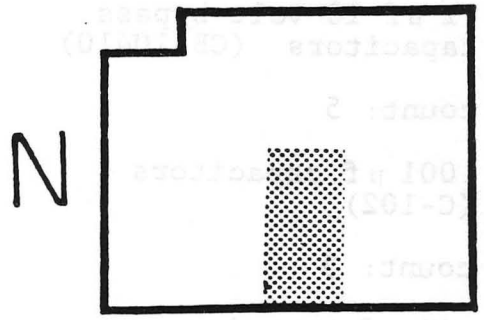


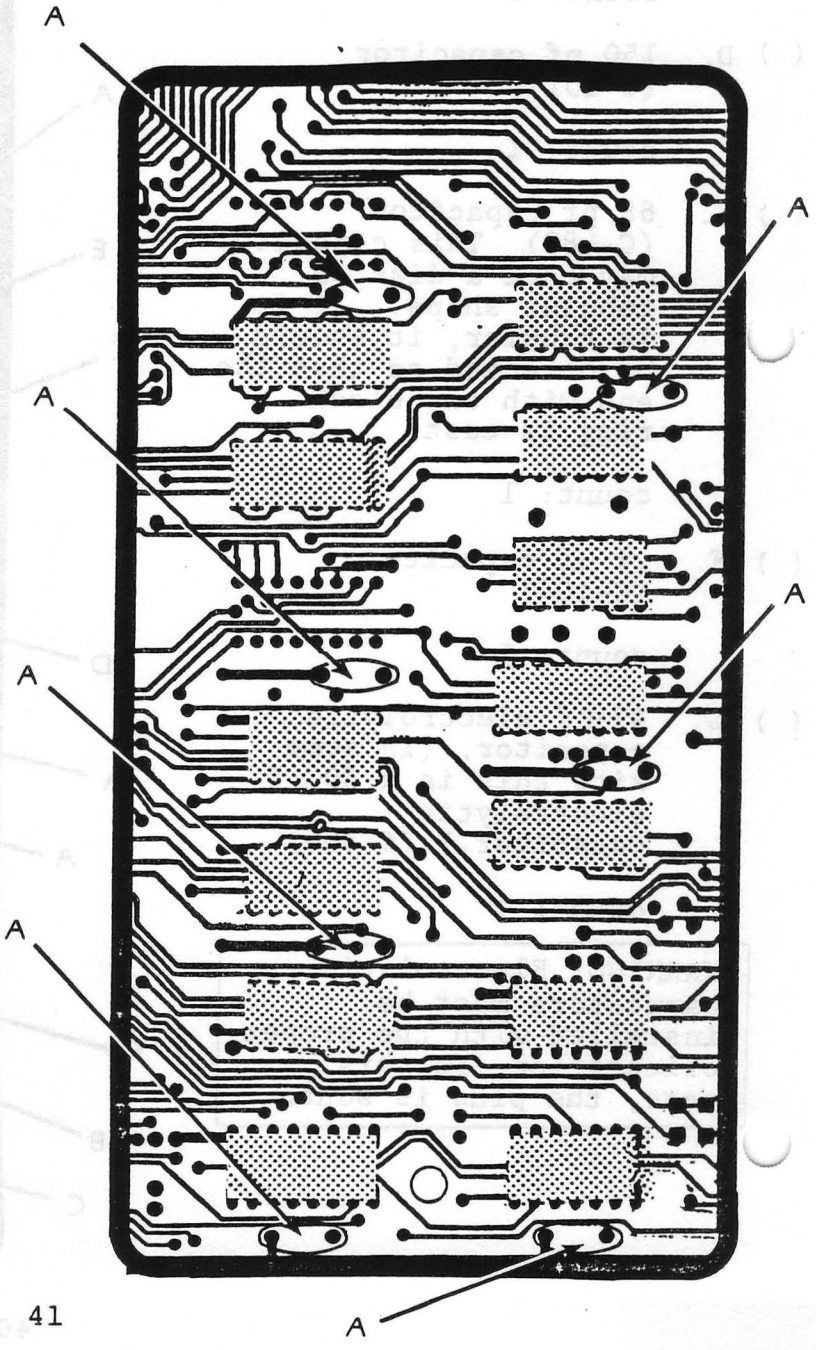


STEP 20

Install and solder the following ceramic capacitors.

( )A. .1 µf 10 volt bypass capacitors (CB-10410)
count: 7



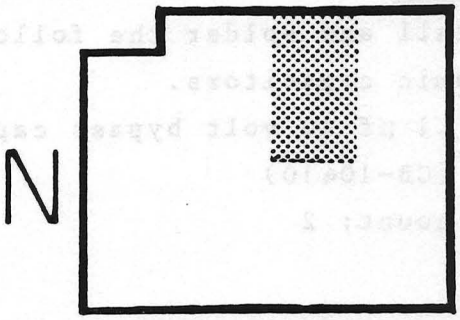


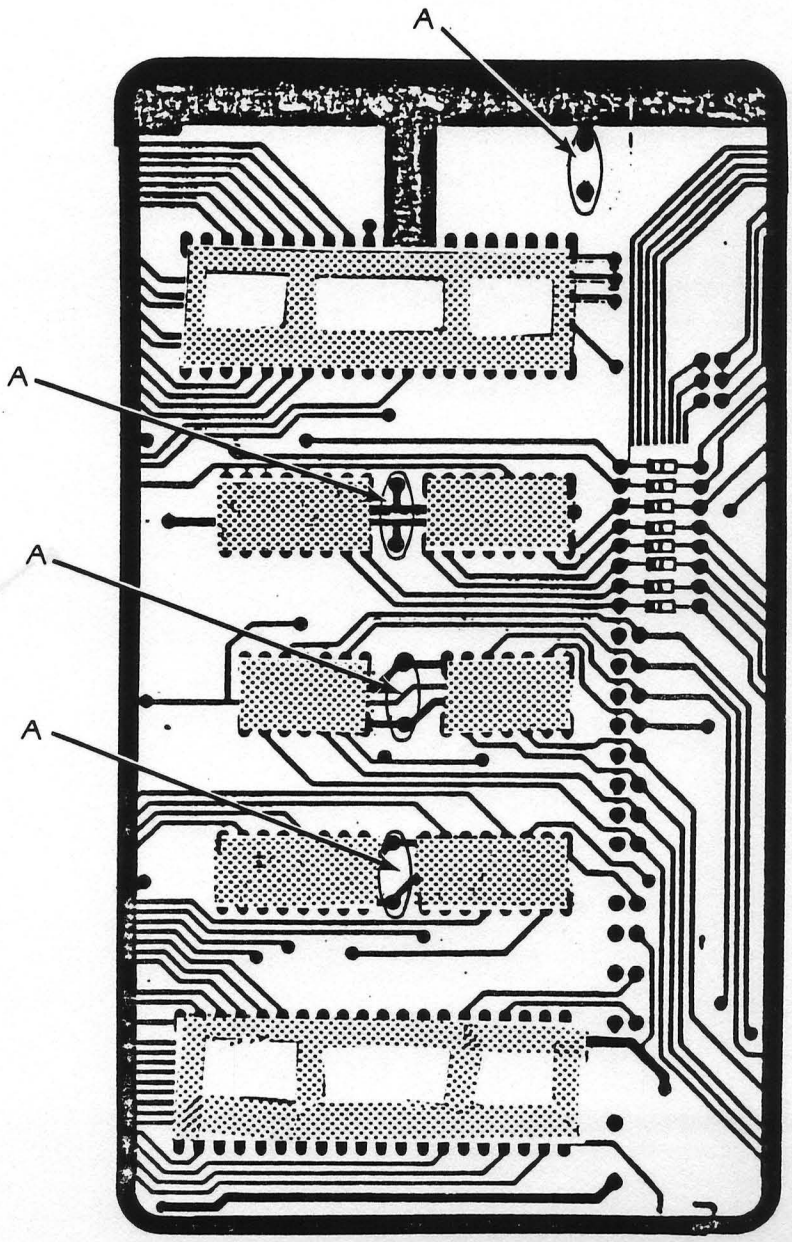
KEEP YOUR SOLDERING IRON TIP CLEAN!

STEP 21

Install and solder the following ceramic capacitors

( ) A. .1 µf 10 volt bypass capacitors (CB-10410)
count: 4

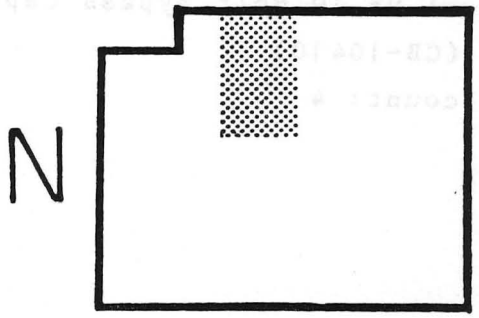


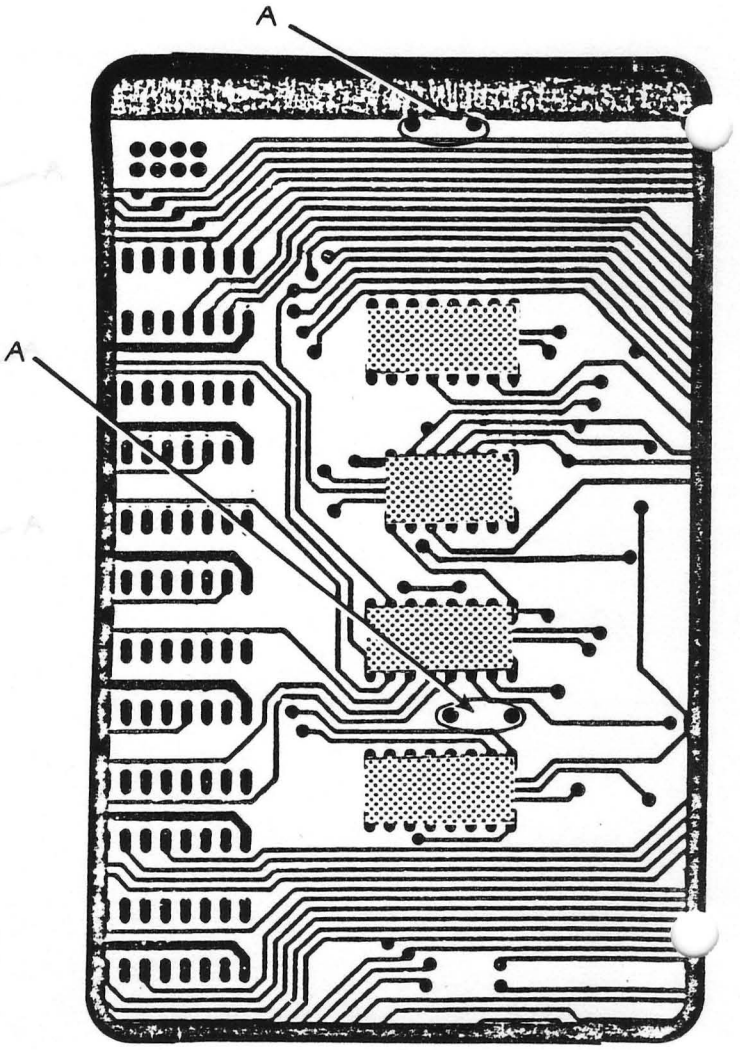


STEP 22

Install and solder the following ceramic capacitors.

( )A. .1 µf 10 volt bypass capacitors (CB-10410)
count: 2

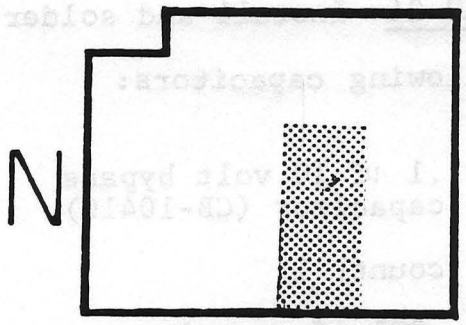


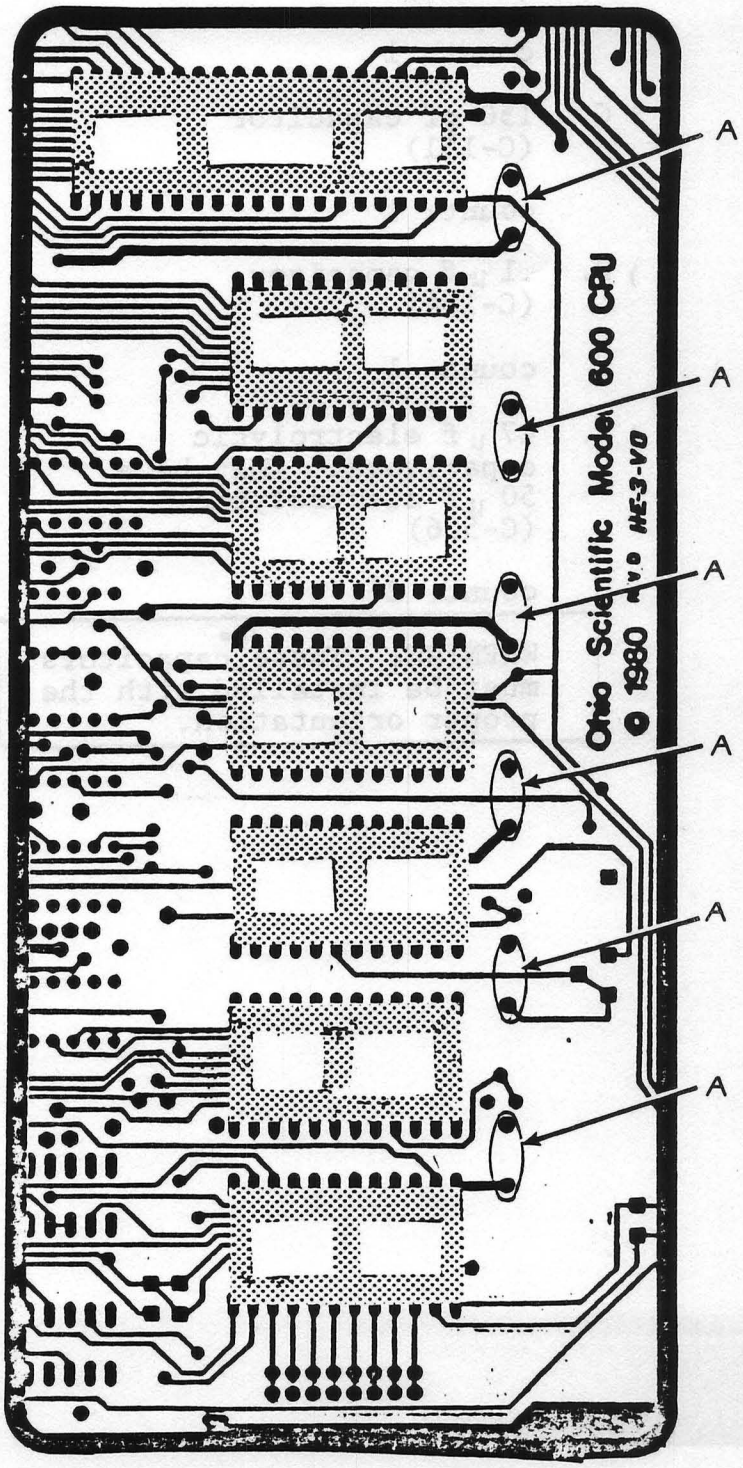


STEP 23

Install and solder the following ceramic capacitors

( )A. .1 µf 10 volt bypass capacitors (CB-10410)
count: 6





KEEP YOUR SOLDERING IRON TIP CLEAN!

STEP 24 Install and solder the following capacitors:

( ) A. .1 µf 10 volt bypass capacitor (CB-10410)

count: 1

( ) B. .001 µ f capacitor (C-102)

count: 1

( ) C. 150 pf capacitor (C-151)

count: 1

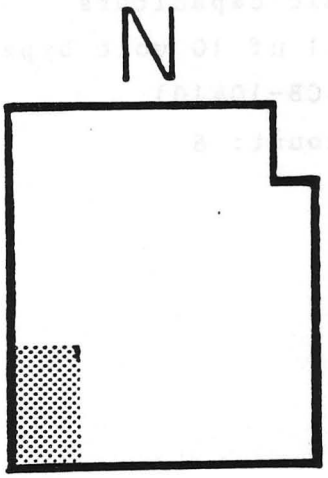
( ) D. .1 µ f capacitor (C-104)

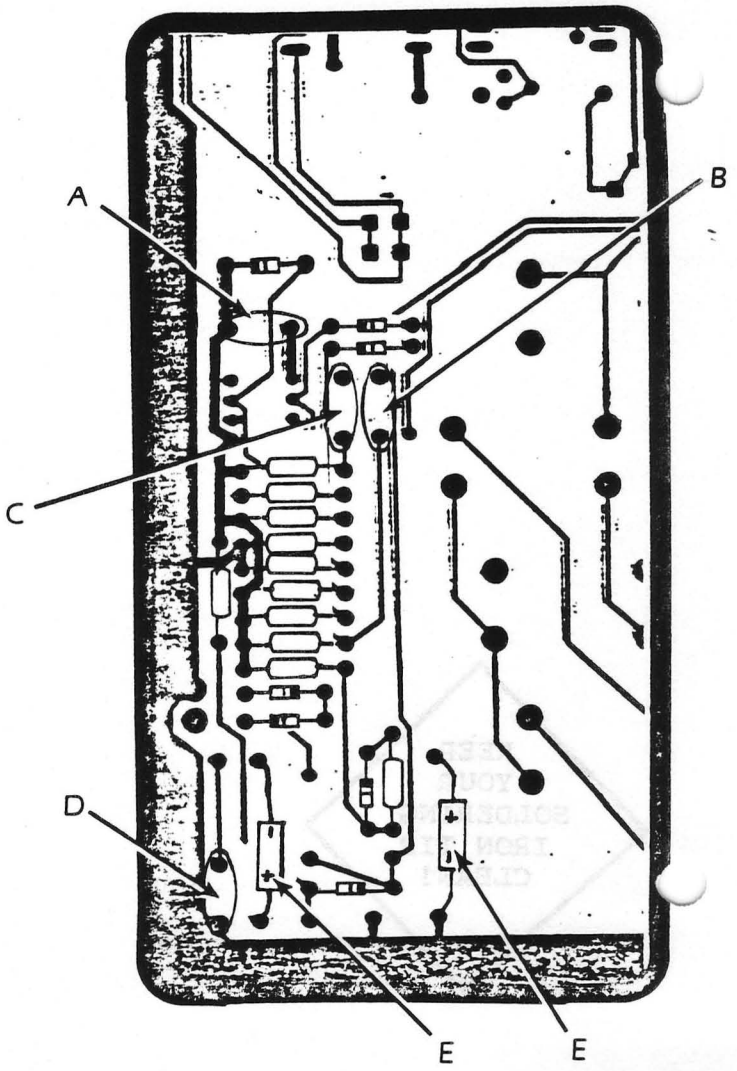
count: 1

( ) E. 47 µ f electrolytic capacitors. (May be a 50 µ f electrolytic) (C-506)

count: 2

> WARNING: These two capacitors must be installed with the proper orientation.





STAGE I, Part Five: Miscellaneous Components Installation.

At this point, all IC sockets, diodes, resistors, and capacitors have been soldered to your Superboard. You are now ready for the final phase of STAGE I assembly.

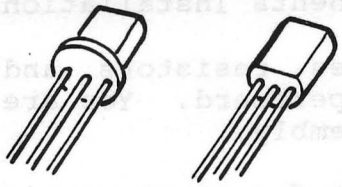
Many of the components in these next few steps require a certain orientation. Read the instructions carefully, and double check the position of each part before soldering.

Parts List (Bags B, C, and D)

Check	Part Number	Quantity	Description	
( )	Q-2N5225	1	Transistor	Bag B
( )	Q-2N5226	1	Transistor	
( )	IC-3130	1	8-pin chip (TTL)	
( )	IC-393	1	8-pin chip (TTL)	
( )	RP-103	1	10K trimmer potentiometer	Bag C
( )	RP-502	1	5K trimmer potentiometer	
( )	HW-FH2	2	Fuse holder clips	Bag D
( )	HW-N632	6	Nuts (6-32)	
( )	HW-RBI	6	Rubber feet	
( )	HW-S632.50	6	Screws (1/2" X 6-32)	
( )	HW-WM6	6	Flat washers (#6)	
( )	HW-WMI6	6	Lock washers (#6)	
( )	L-LED1	1	Light emitting diode	
( )	SC-12FM	2	12-pin female Molex	
( )	SC-2FM	1	2-pin female Molex	
( )	Y-WA-SBCF	1	power connector subassembly (female)	
( )	Y-WA-SBCM	1	Power connector subassembly (male)	
( )	Shorting plug	1	Shorting plug subassembly	
( )	X-395	1	Crystal (may be installed)	

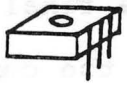
(See the next page for help in identifying these parts.)

Note: As you locate each part check the appropriate box.

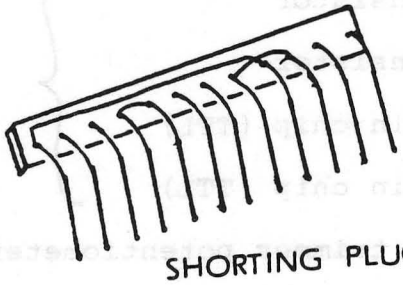


TRANSISTORS

POTENTIOMETER (pot)

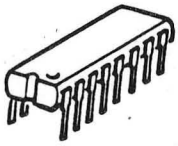


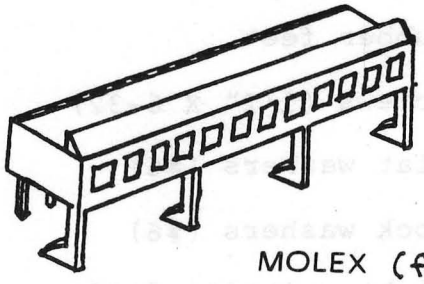
LED (red)



SHORTING PLUG

IC ("chip") (TTL)

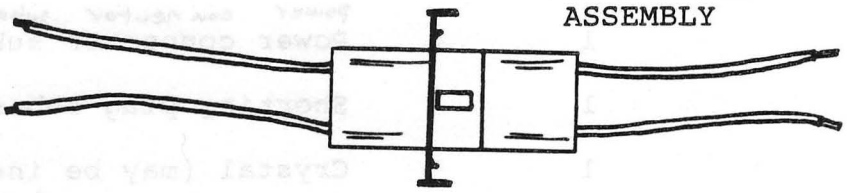




MOLEX (female)

POWER CABLE ASSEMBLY

(Y-WA-SBCF
Y-WA-SBCM
together)



Stage I, part five, Parts Identification

STEP 25

Install and solder the following components:

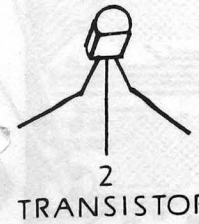
( )A. 8 pin IC (IC-3130)
This chip must be installed so that the semicircular cutout is at the south end.
After you turn the board over, bend the leads on opposite corners to hold the IC in place during soldering.
count: 1

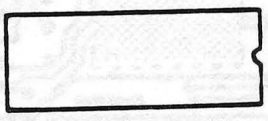
( )B. 10 K potentiometer. (RP-103)
This unit should be installed with pin 3 towards the west side of the board.
count: 1

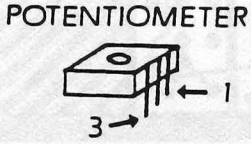
( )C. 5 K potentiometer. (RP-502)
This unit should be installed with 3 towards the north side.
count: 1

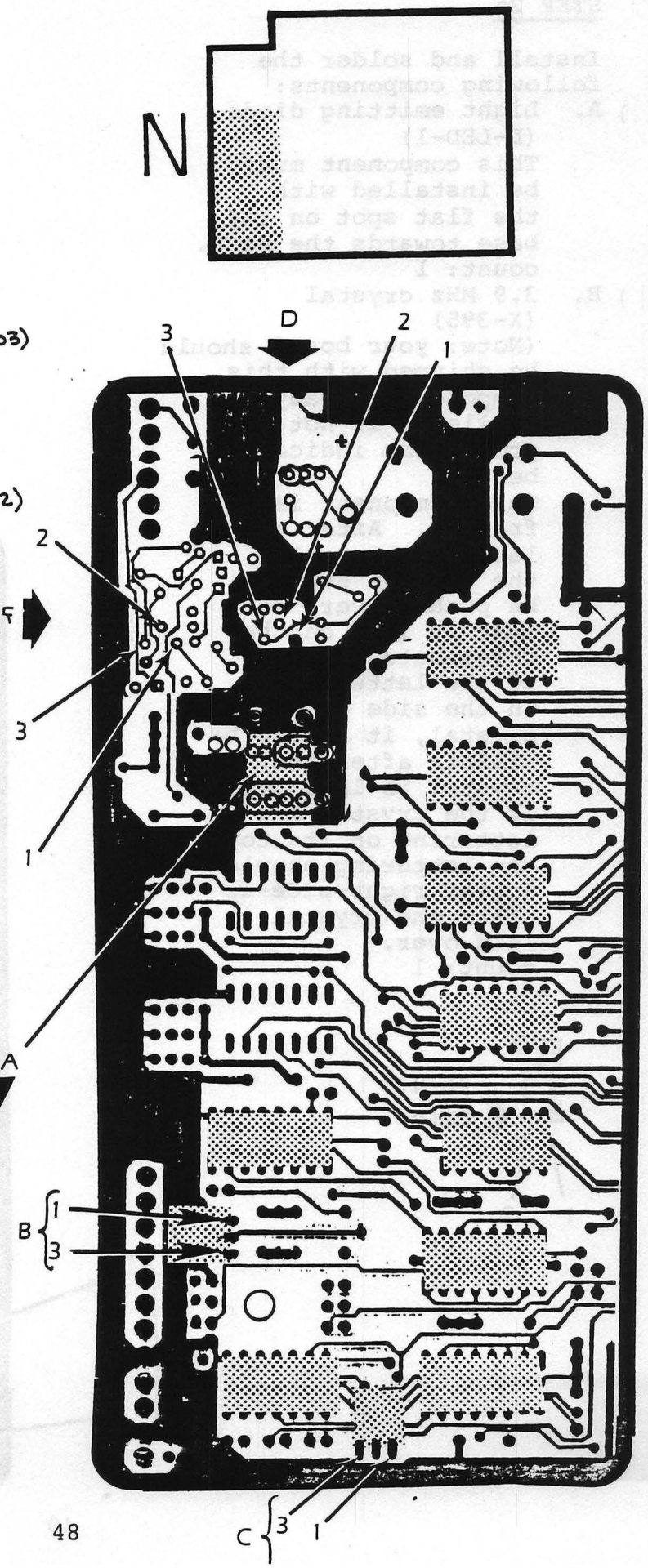
( )D. transistor NPN (Q-2N5225)
Note the pin orientation. This transistor is installed with the flat side towards the east. Transistors are heat sensitive! Use care.
count: 1

( )E. transistor PNP (Q-2N5226)
This transistor is also installed with the flat side toward the east.
count: 1







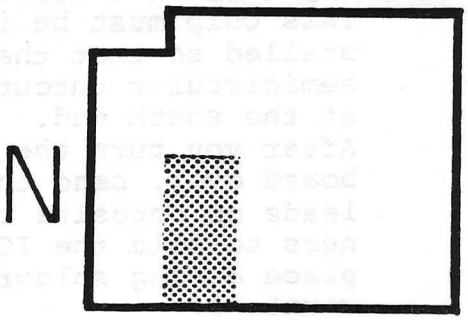


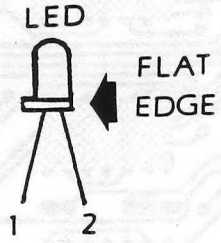
STEP 26

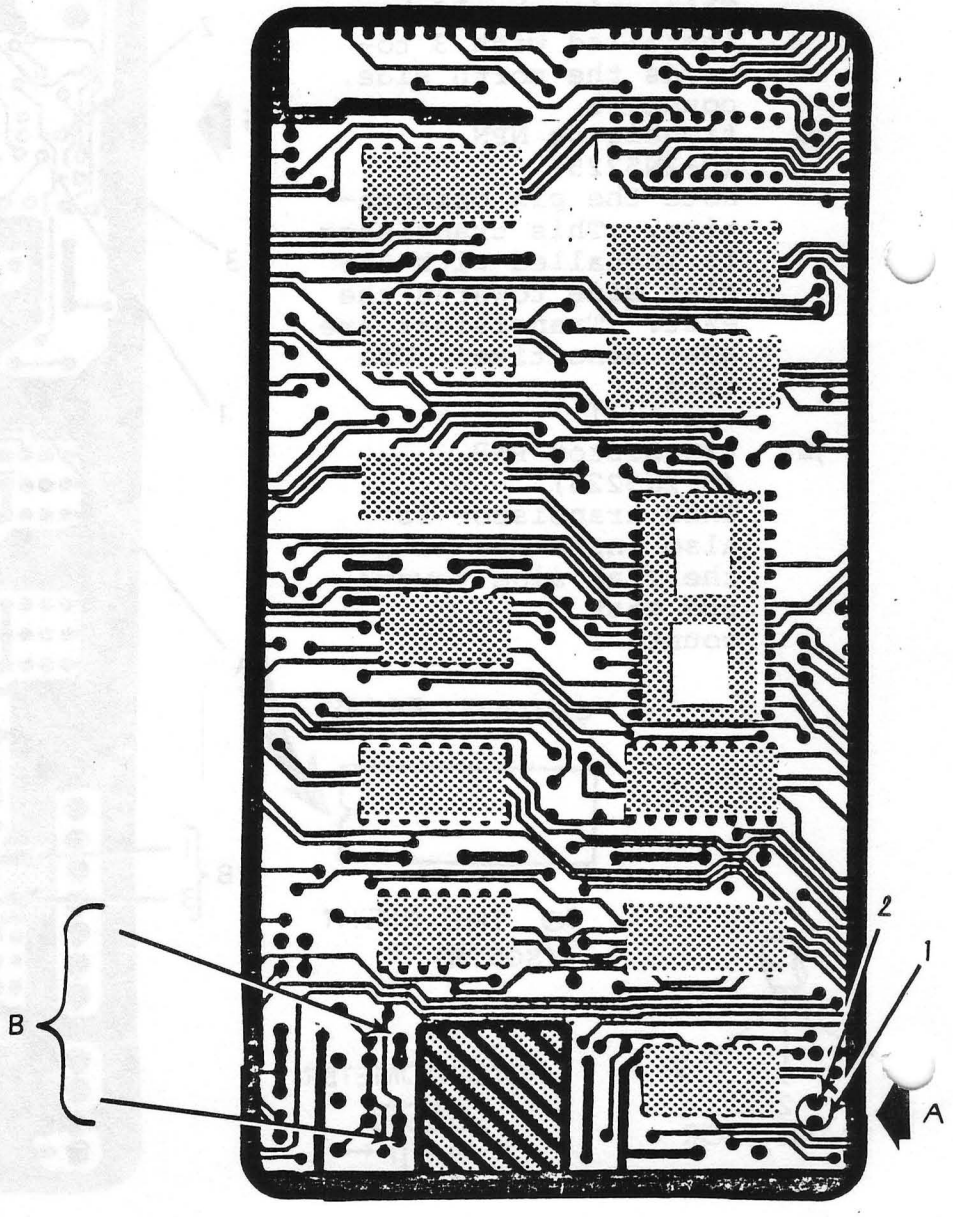
Install and solder the following components:

( ) A. Light emitting diode (L-LED-1)
This component must be installed with the flat spot on the base towards the east.
count: 1

( ) B. 3.9 MHz crystal (X-395)
(Note: your board should be shipped with this component already installed. If not, proceed as indicated below.)
This component is fragile. After the leads are inserted, the crystal should be pushed over, so that it lays on the cross-hatched area. If the lettering is on the side of the crystal, it should be visible after the crystal is laid over. If the crystal has lettering on its top, the lettering should appear right-side-up after the crystal is laid over.
count: 1



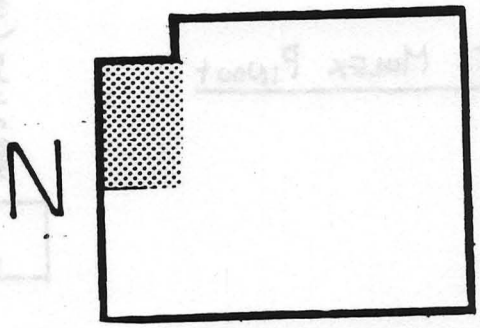




STEP 27

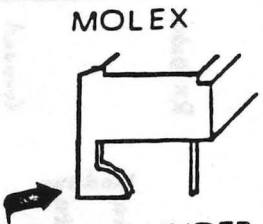
Install and solder the following components:

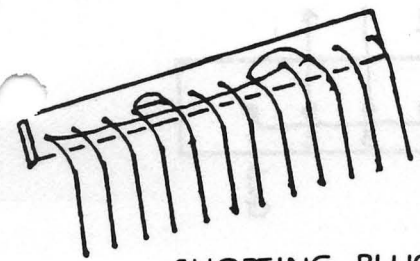
( )A. 12 pin female molex (SC-12FM)
The molex clips over the edge of the super-board.
count: 1

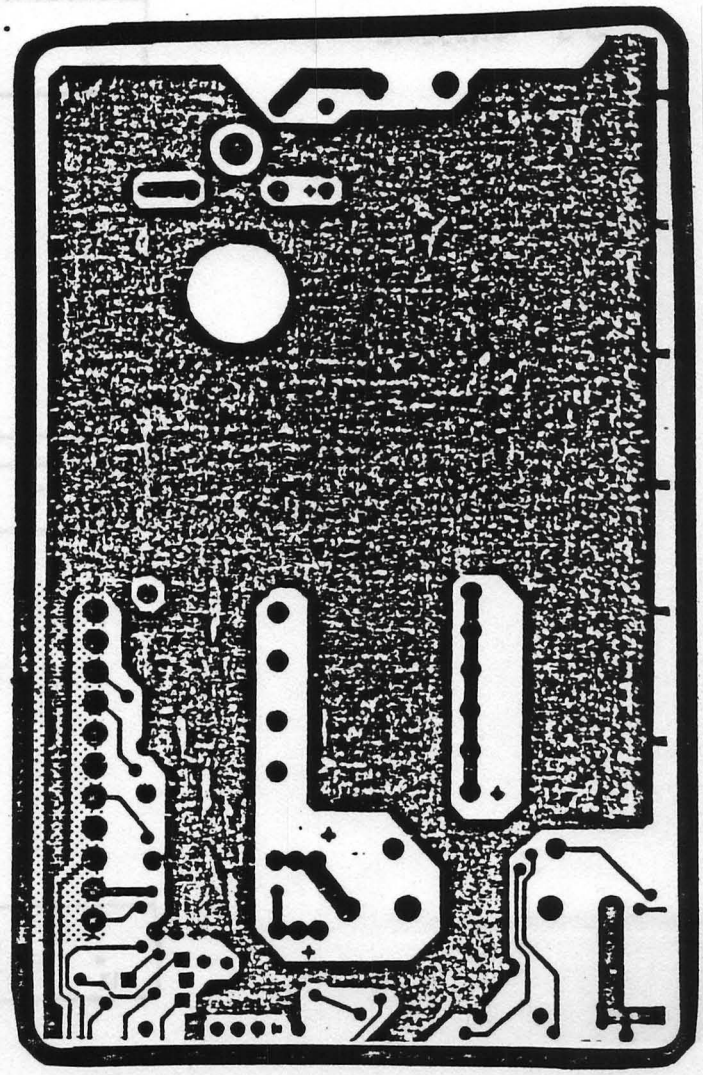


Note: If you plan to put the kit in a case, the molex must be installed "vertically" so that it doesn't overhang the rear of the board. First bend the pins down on the molex. Then, cover the ground path adjacent to the 12 holes in the board for the molex with tape. Then position the molex in the holes so that the molex sockets are up and the four plastic clips point toward the center of the board (south). Solder in place.

( )B. Insert shorting plug assembly into molex. Plug must point up so that jumper wires are visible on top. However, if you have installed the molex in the alternate manner described in the note above, it will be positioned properly if the plug with the jumper wires facing toward the north.

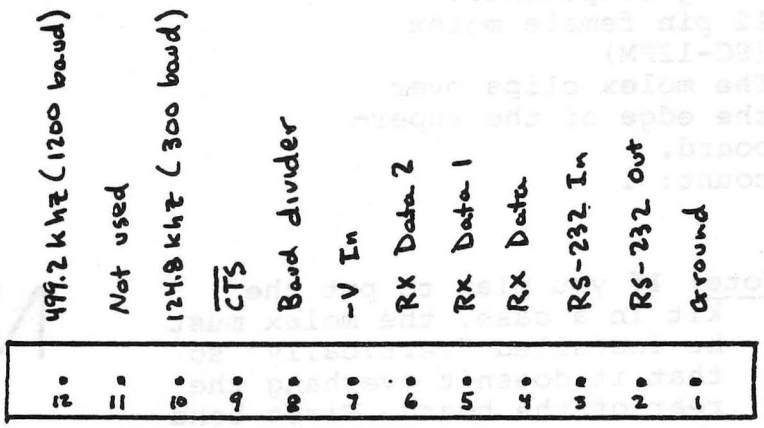




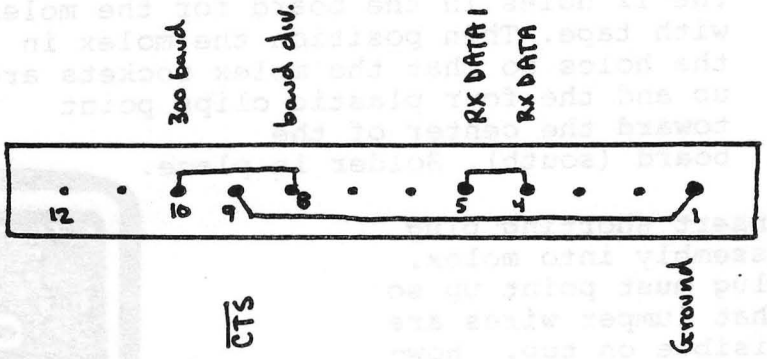


J3 Molex - Shorting Plug Details

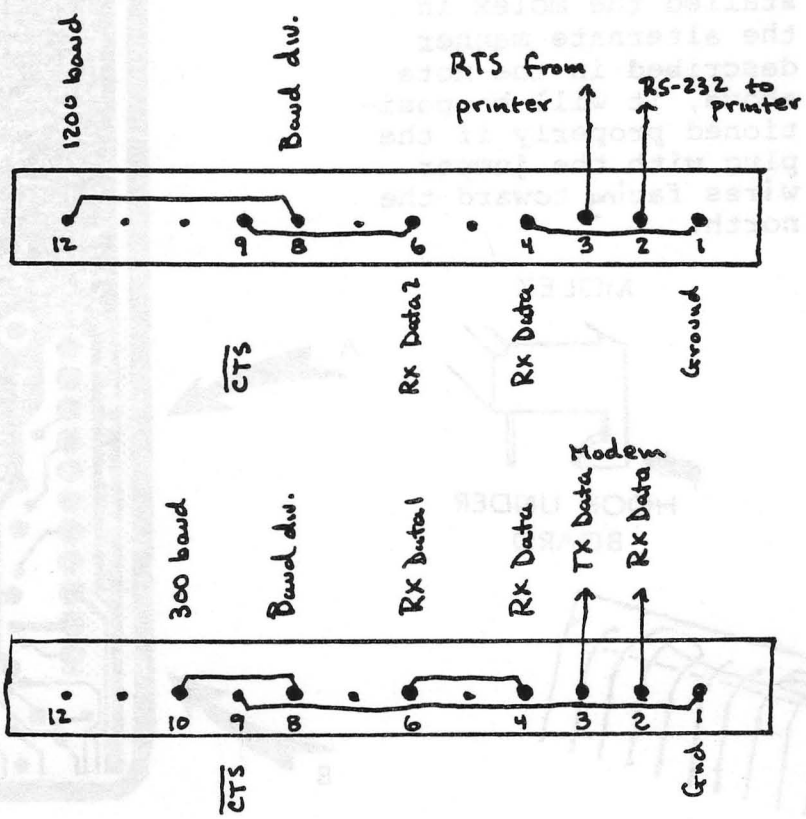
J3 Molex Pinout



J3 Cassette Operation



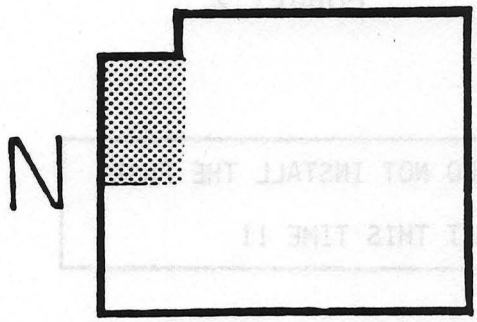
J3 Printer Operation

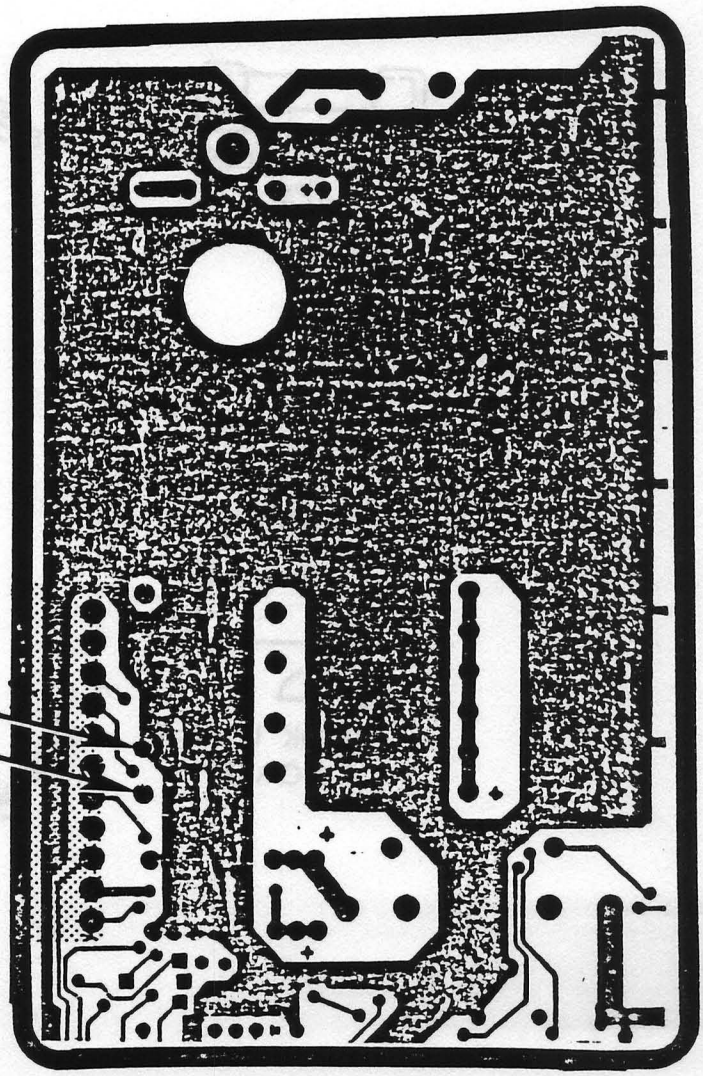


STEP 28

Install and solder the following components:

( ) A. Power connector subassembly (Y-WA-SBCM). The black wire is soldered to the ground. The red lead is the power lead.



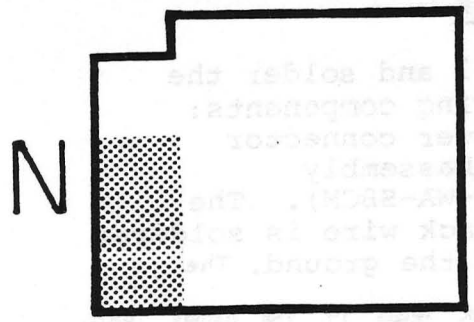


STEP 29

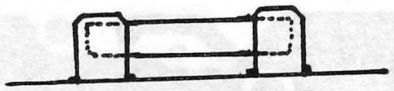
Install and solder the following components:

( ) A. 12 pin female molex (SC-12FM). The molex clips over the edge of the super-board.
count: 1

( ) B. Fuse holder clips (HW-FH2)
count: 2

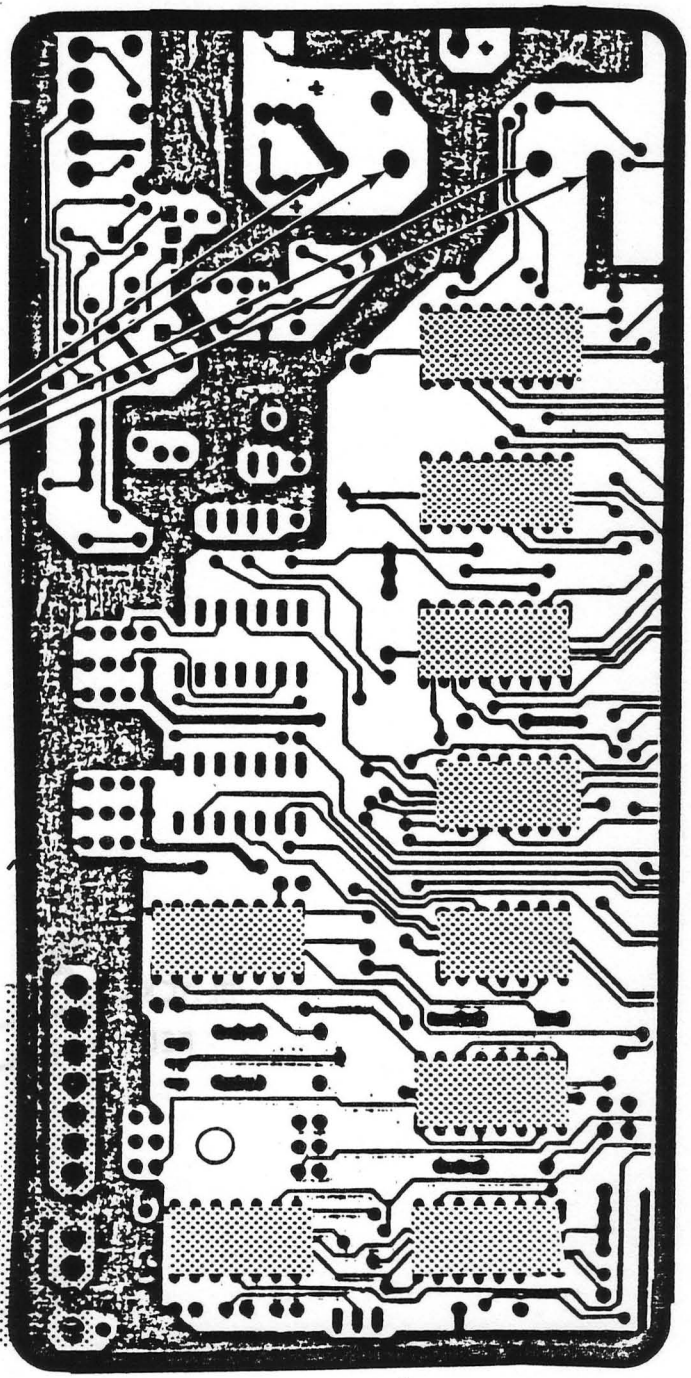


- DO NOT INSTALL THE FUSE AT THIS TIME !!

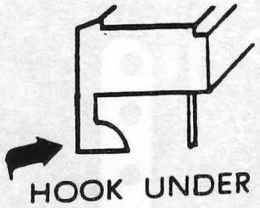


FUSE HOLDER CLIPS

B



MOLEX



HOOK UNDER BOARD

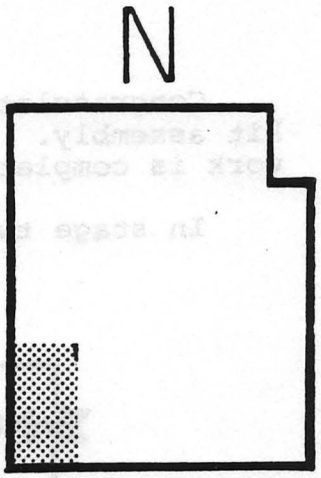
A

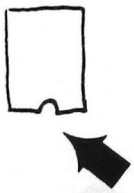
STEP 30

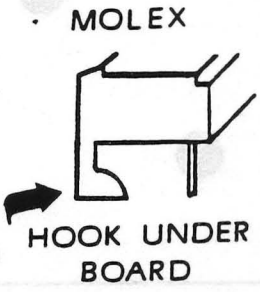
Install and solder the following components:

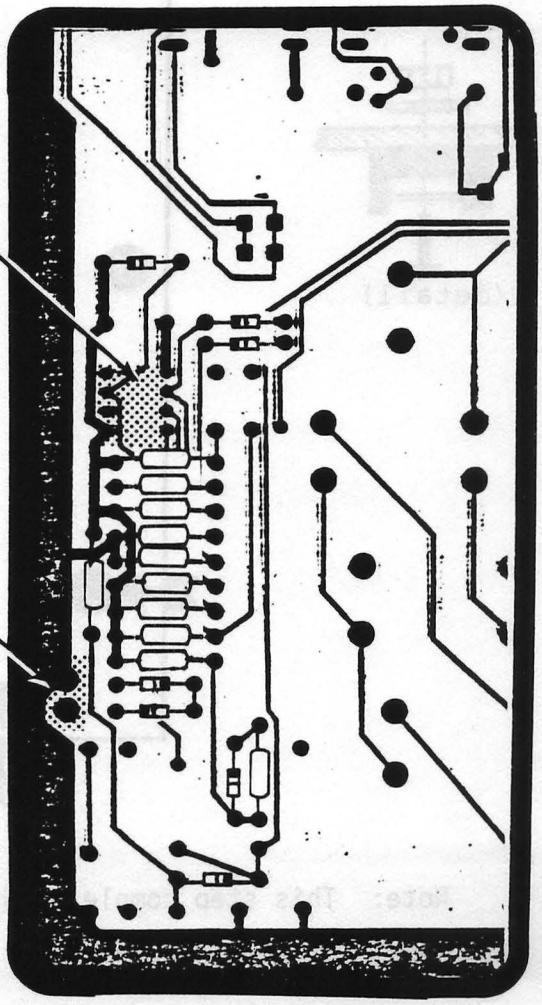
( )A. 8 pin chip (IC-393) This chip must be installed so that the semicircular cutout (or circular depression) faces south. count: 1

( )B. 2 pin female molex (SC-2FM). The molex clips over the side of the superboard, count: 1









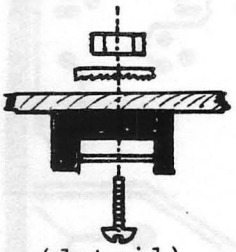
STEP 31

Install the following components:

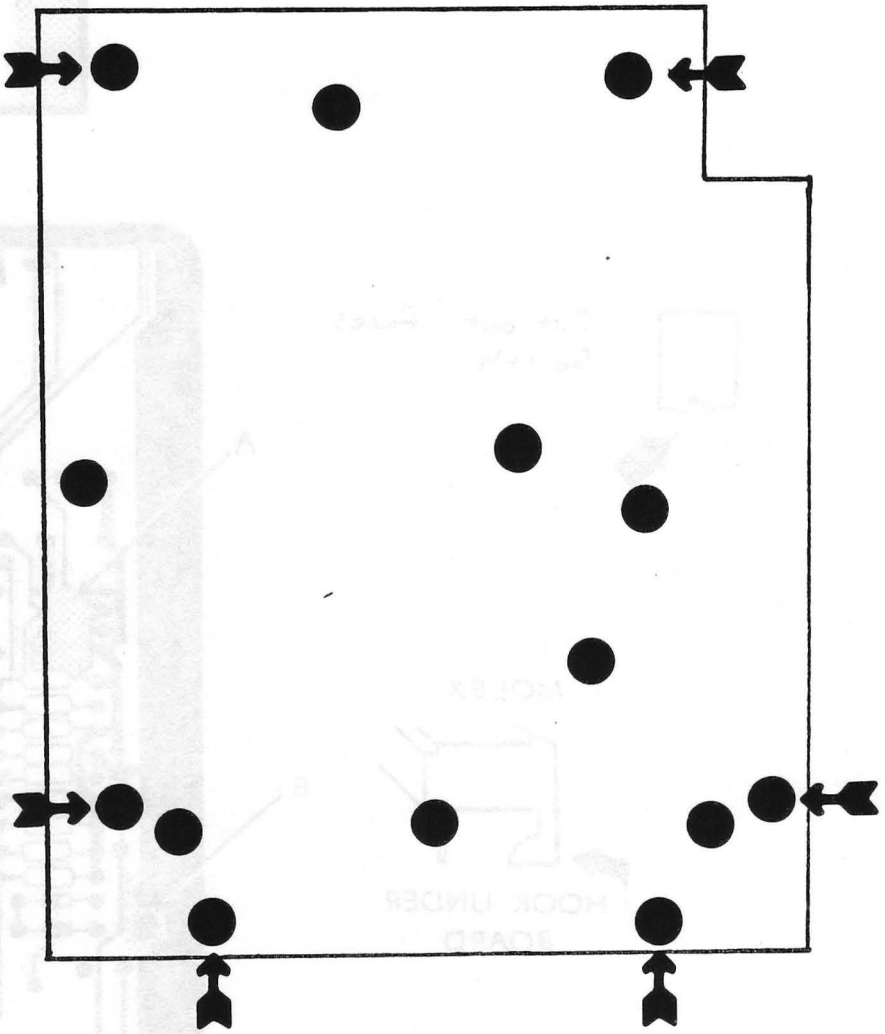
( ) A. Install the six rubber feet. All the large holes in the board are shown below and the ones to use for the feet are indicated by arrows. Use a nut, bolt and two washers for each foot, with the lock washer and nut on the top of the board.

Congratulations! You have completed the first stage of your kit assembly. At this point most (but not all!) of the soldering work is complete.

In stage two you will assemble and align the keyboard.



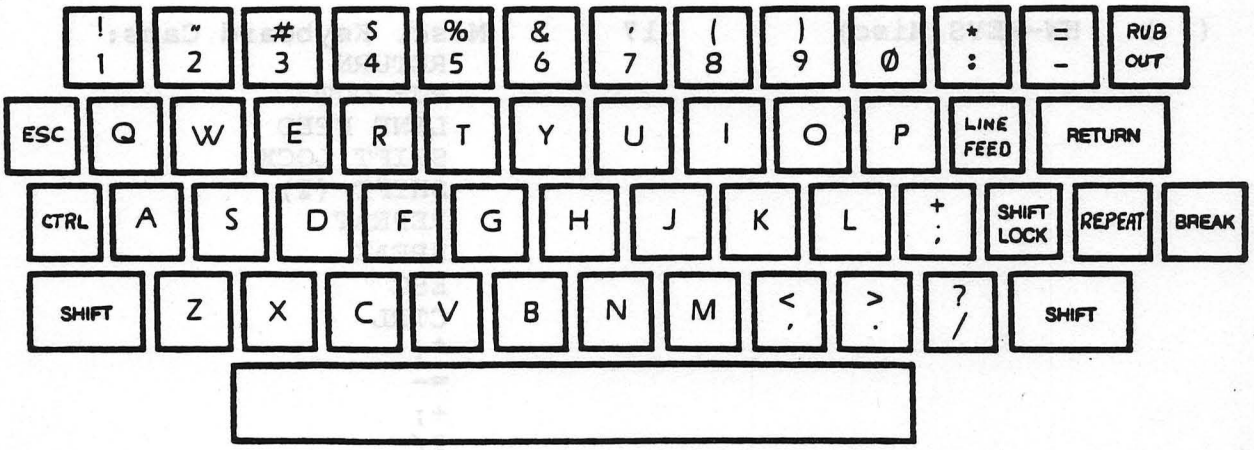
(detail)



Note: This step completes Stage I.

STAGE II -- Keyboard Assembly

The keyboard of the Superboard is pictured below



The keyboard is constructed by mounting 53 key switches and key caps in the region of the printed circuit board illustrated on the next page. Each of the switches mounts in one of the 53 pairs of vertical holes located in this region.

All but one of the switches (52) are simple spring action switches which automatically open when they are released. One switch, the switch used by the SHIFT LOCK key (row 3) latches. When this key is pressed, it remains depressed until it is released by pressing it again.

During keyboard assembly, you will want to refer to the diagram above for correct key placement.

Stage II Part 1

Parts List Bag E

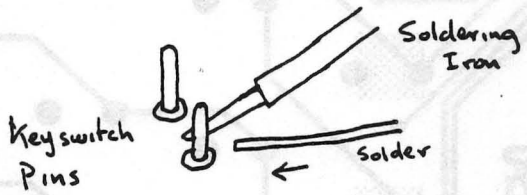
check:	Part Number	Quantity	Description
( )	HW-KEYS 1-0	10	Numerical Keyboard Caps
( )	HW-KEYS A-Z	26	Letter Keyboard Caps
( )	HW-KEYS(Misc)	17	Misc. Keyboard Caps: RETURN RUB OUT LINE FEED SHIFT LOCK SHIFT (2) REPEAT BREAK ESC CTRL *: =- +; ?/ <, >. Spacebar
( )	HW-KEYS SWITCH	52	Keyboard Switches
( )	HW-KEYS SW ALT.	1	Locking Keyboard Switch
( )	Spacebar Hardware	8	Hardware for Mounting Spacebar: Left bracket Right bracket Spacebar mount Spacebar metal bar Screws (2) Nuts (2)
	Total	114	

Note: As you locate each part, check the appropriate box.

STEP 32: Install the key caps on the key switches. The key caps must be installed so that the pins on the bottom of the the key switches are positioned vertically relative to the key character.

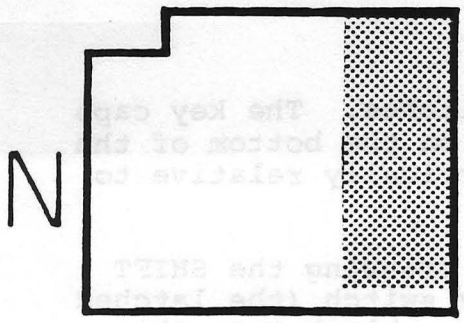
( ) A) Assemble the SHIFT LOCK key by pressing the SHIFT LOCK key cap on the latched key switch (the latched key switch is the only one with a black top; the others have white tops).

( ) B) Assemble the remaining keys for the top four rows of the keyboard by installing the key caps on the spring action key switches. One key switch will remain for use with the space bar.



SPECIAL SOLDERING INSTRUCTIONS

DO NOT APPLY SOLDER DOWN ONTO THE PINS OF THE KEY SWITCHES. APPLY THE SOLDER FROM ONE SIDE WHILE HOLDING THE SOLDERING IRON ON THE OTHER SIDE OF THE PIN.



SOLDER INSTRUCTIONS --

DO NOT APPLY SOLDER DOWN ONTO THE PINS OF THE KEY SWITCHES. APPLY THE SOLDER FROM ONE SIDE WHILE HOLDING THE SOLDERING IRON ON THE OTHER SIDE OF THE PIN.

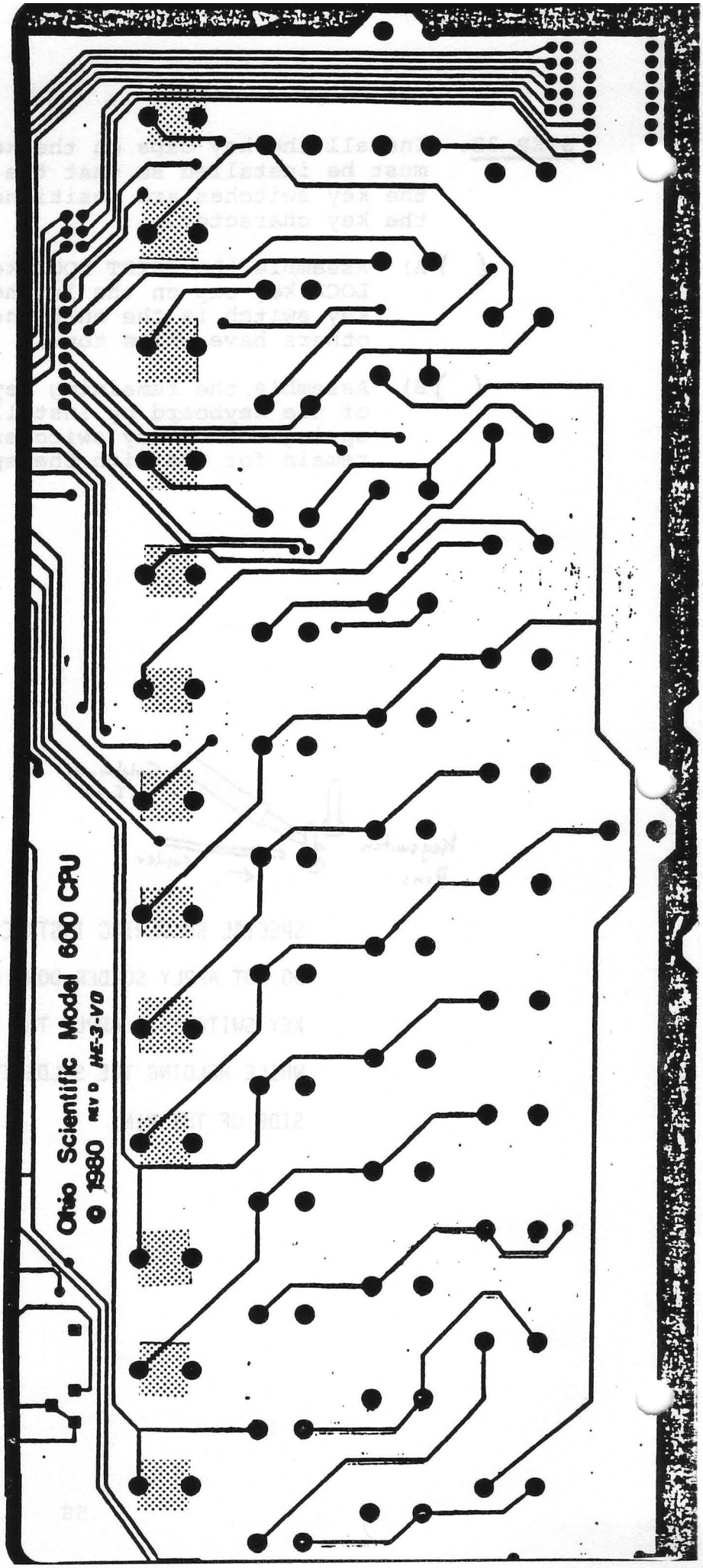
STEP 33: TOP ROW OF KEYBOARD

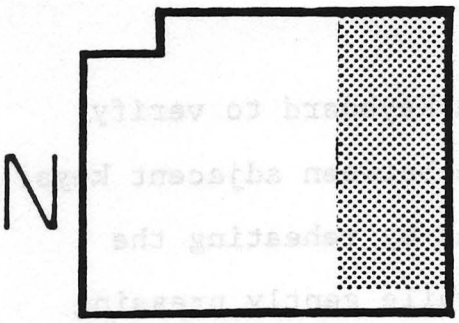
( )A Insert the keys for the top row of the keyboard in the 13 pairs of vertical contacts in the top row of the keyboard area of the printed circuit board.

( )B Check to be sure that there is clearance between each pair of keys and then put a strip of masking tape over the keys to hold this alignment. Cover the keys with a piece of stiff cardboard to hold them in place as you turn the board over on the workspace.

( )C Solder the top pin of each switch in the top row. Apply a small amount of downward pressure as you solder to insure that the switches remain fully seated in the board.

( )D Turn the board over and check that each key is correctly aligned and fully seated in the board. Make any necessary adjustments and then solder the bottom pin of each key.





STEP 34: (REPEAT FOR ROWS 2, 3 AND 4 OF KEYBOARD)

( )A) Insert the keys for the next row of the keyboard in the next row of contact in the keyboard area of the printed citcuit board.

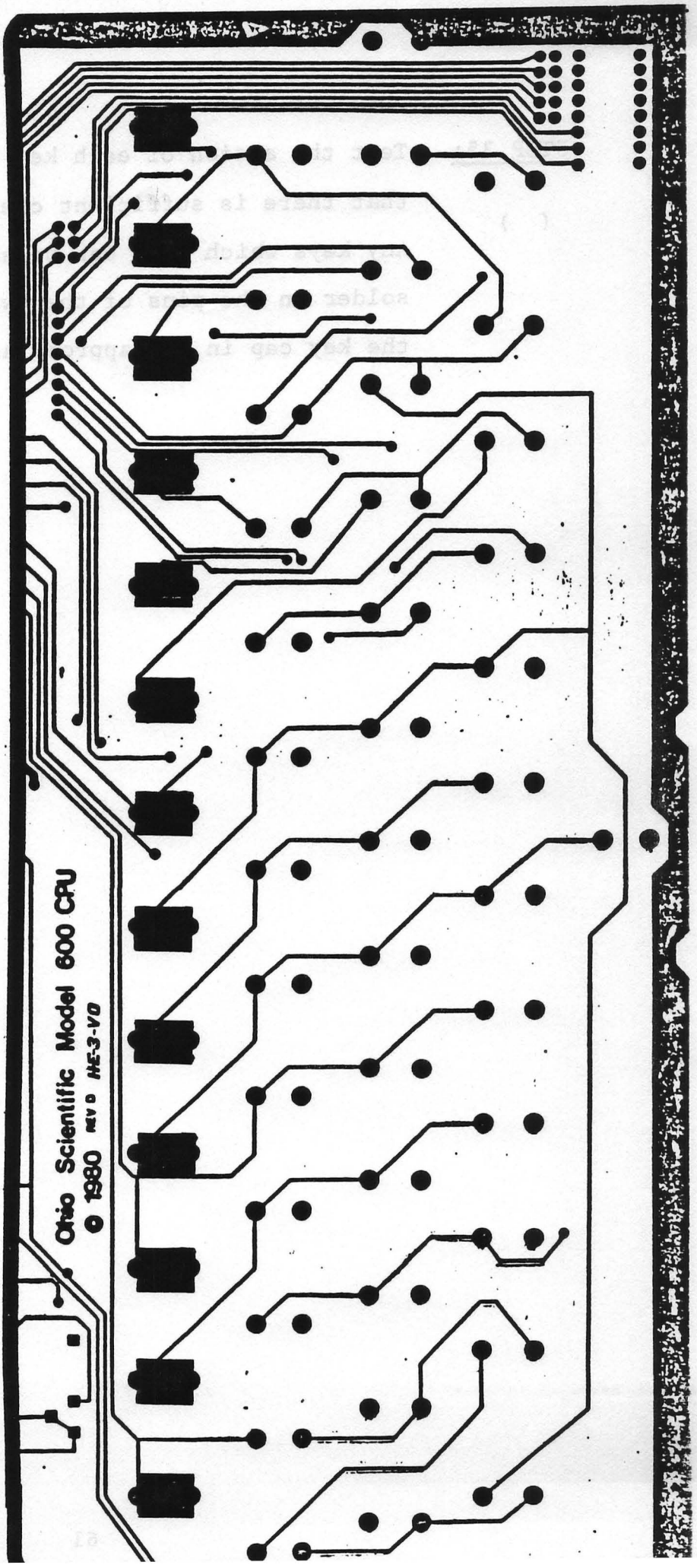
( )B) Slide a 1¼" x 11" strip of thin cardboard (such as found on the back of tablets of paper) between the new row of keys immediately above to aid in aligning the keys.

( )C) Check to be sure that there is clearance between each pair of keys and then put a strip of masking tape over the keys to hold this alignment. Cover the keys with a piece of stiff cardboard to hold them in place as you turn the board over on the workspace.

( )D) Solder the top pin of each switch in the new row of keys. Apply a small amount of downward pressure as you solder to insure that the switches remain fully seated in the board.

( )E) Turn the board over and check that each key is correctly aligned and fully seated in the board. Make any necessary adjustments and then solder the bottom pin of each key.

( )F) Remove the strip of cardboard between the rows.



STEP 35: Test the action of each key on the keyboard to verify that there is sufficient clearance between adjacent keys.

( ) Any keys which bind can be adjusted by reheating the solder on the pins of the switch while gently pressing the key cap in the appropriate direction.

STEP 36: THE SPACE BAR

The following 10 parts are required to assemble and install the space bar on the Superboard keyboard.

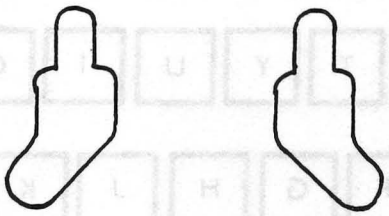
( ) -- one regular spring action key switch

(This part is identical to the regular key switches used in rows 1 through 4 of the keyboard)

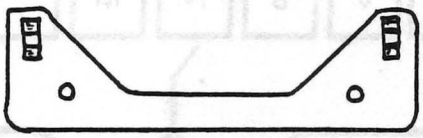
( ) -- one space bar key cap

This key cap is a plastic bar 5 3/4 inches long.

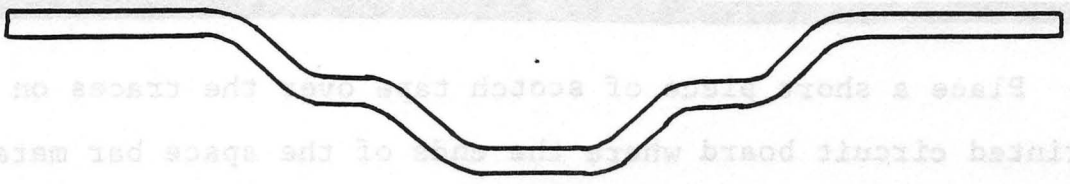
( ) -- two support brackets for the space bar (plastic)



( ) -- one space bar mount (plastic)



( ) -- one space bar metal bar

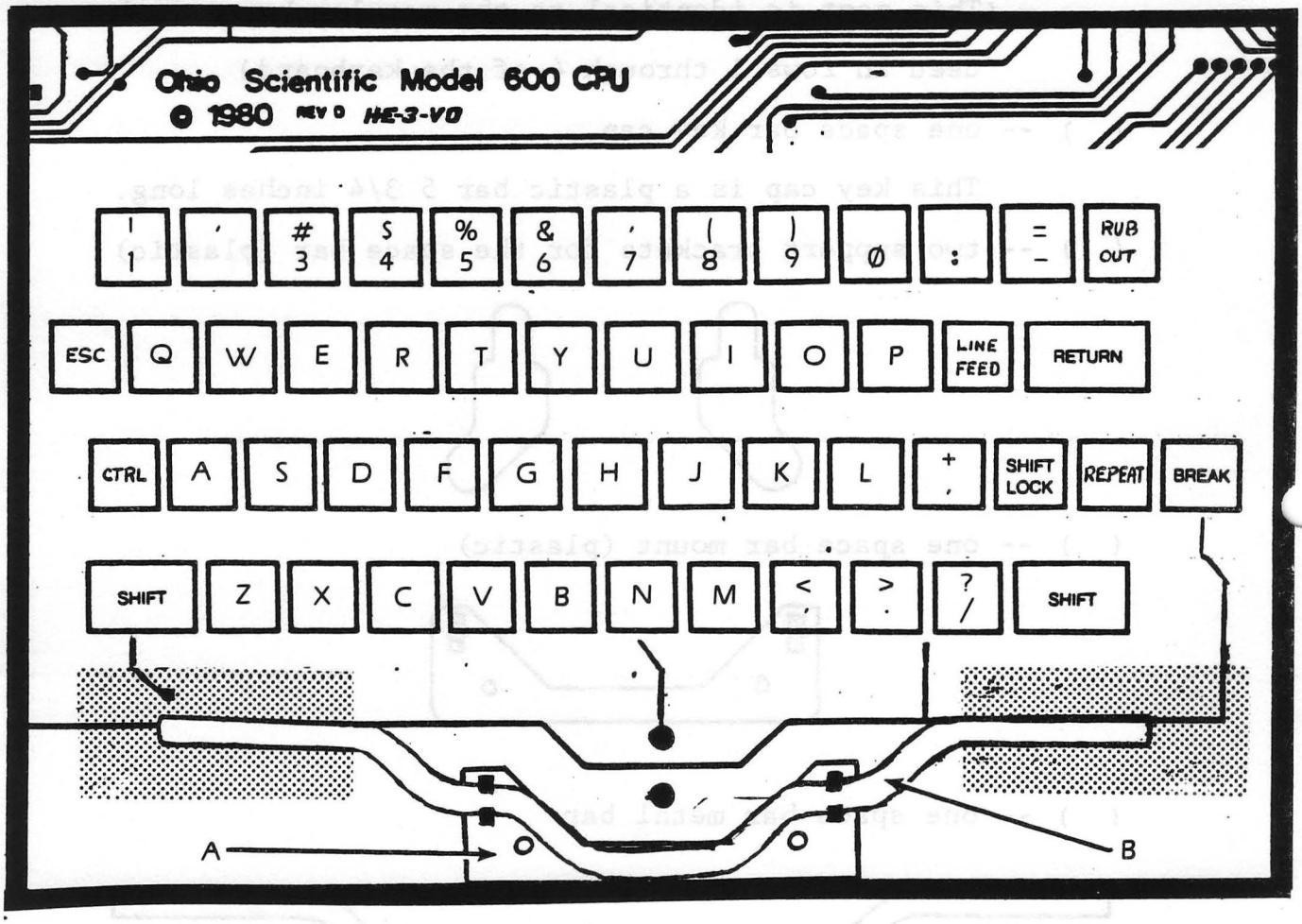


( ) -- two small nuts and bolts (4 pieces)

Step 36 (continued)

( ) A) Use the two small nuts and bolts to attach the space bar mount to the front edge of the printed circuit board as shown below. Do not fully tighten these screws yet.

( ) B) Snap the space bar metal bar into the space bar mount as shown below.



( ) C) Place a short piece of scotch tape over the traces on the printed circuit board where the ends of the space bar metal bar strike the board. The pieces of tape should extend about 1/2 inch beyond the ends of the space bar metal bar as illustrated by the shaded regions in the above figure.

Step 36 (continued)

( ) D) Insert the regular spring action key switch into the center hole on the underside of the space bar key cap.

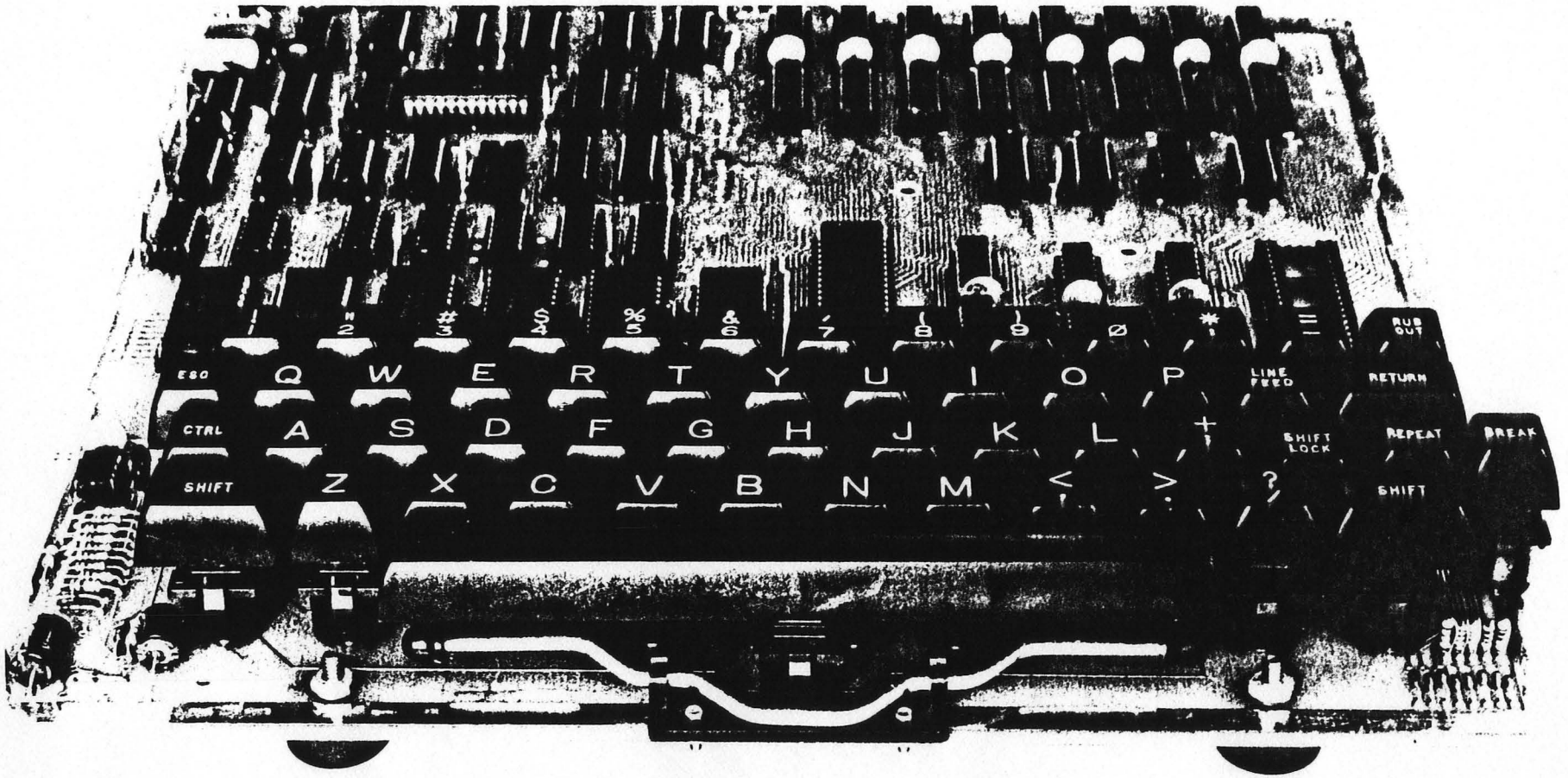
( ) E) Insert one support bracket into each of the end holes on the underside of the space bar key cap. The holes on the lower end of each support bracket should face inward toward the center of the space bar and the ends of the support brackets should angle toward the bottom row of the keyboard. The support brackets should be fully seated (up to the shoulder) in the key cap.

( ) F) Position the space bar assembly so that the pins on the key switch align with the holes on the printed circuit board and the holes on the inside of the support brackets align with the ends of the space bar metal bar. Insert the pins on the key switch into the holes on the printed circuit board and gently spread the ends of the support brackets and insert the ends of the space bar metal bar.

( ) G) Insert the cardboard strip between the space bar and lower row of keys to insure clearance. Turn the board over and solder both pins of the switch for the space bar.

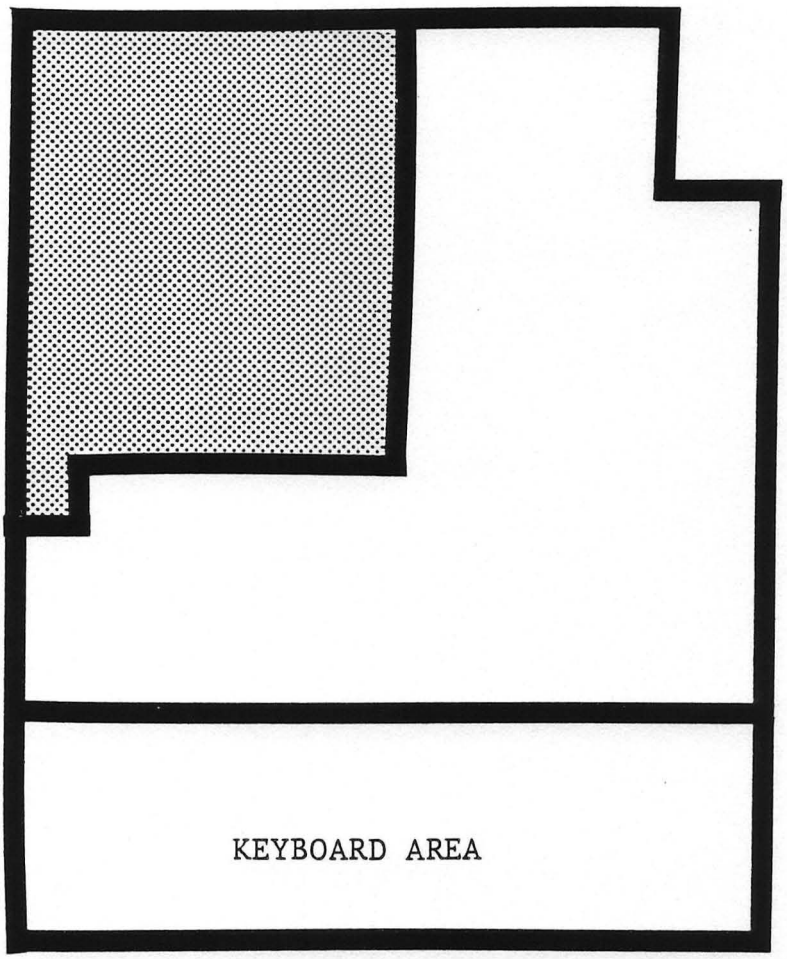
( ) H) Test the action of the space bar. If it binds, it may be necessary to reheat the solder on the pins of the switch and slightly adjust the alignment. When the alignment looks good, tighten the two nuts and bolts securing the space bar mount to the board.

This completes Stage II. All soldering work is complete. You are now ready to insert IC chips and test the video portion of your computer.


ESC
CTRL
SHIFT
Q W E R T Y U I O P
A S D F G H J K L
Z X C V B N M
LINE FEED
SHIFT LOCK
RUB OUT
RETURN
REPEAT
SHIFT
BREAK

STAGE III: Assembly and Testing of Video Portion

The video portion of the Superboard is located in the shaded region of the following diagram. During this stage of construction, IC chips are inserted in the sockets in this region and the video output is tested and adjusted.



Stage III Part 1

PARTS LIST (found in bags and/or tubes marked F and G)

PART NUMBER	QUANTITY	DESCRIPTION	
( ) IC-2114	2	RAM	Bag F
( ) IC-7400	1	TTL	
( ) IC-7403	1	TTL	
( ) IC-7408	1	TTL	
( ) IC-74123	2	TTL	
( ) IC-7474	2	TTL	
( ) IC-74LS04	1	TTL	
( ) IC-74LS157	4	TTL	
( ) IC-74LS163	5	TTL	
( ) IC-74LS165	1	TTL	
( ) IC-74LS20	2	TTL	
( ) IC-74LS76	1	TTL	
( ) IC-74LS86	1	TTL	
( ) IC-74LS93	1	TTL	
( ) IC-8T28	2	BUFFER	
( ) IC-CARGEN	1	CHAR. GEN. 38129	Bag G
( ) Y-WA-3SB	1	3-cable Video/Cassette wiring harness assembly	
( ) F-005	1	Fuse	

Note: As you locate each part, check the appropriate box.

CAUTION: OBSERVE THE FOLLOWING GUIDELINES WHEN INSERTING IC CHIPS IN THE SOCKETS MOUNTED ON THE SUPERBOARD

1) Pin one is marked on IC chips in one of two ways. On some chips a small dot is placed at one end, off center and near pin one. A notch at one end of the chip (on the center line of the chip) is often used to indicate the end containing pin one. Some manufacturers use both a dot and a notch to mark pin one. Look out for misleading mold marks.

2) Pin one of each IC chip should be inserted in the end of the socket with the semicircular cutout. With the exception of IC-CARGEN all IC chips mount with pin one pointed toward the keyboard. Pin one on IC-CARGEN points toward the side of the board with the notched corner.

3) Before inserting an IC chip in its socket check to make sure that the legs are perpendicular to the body of the chip. If necessary gently press the legs against a flat surface to bend them perpendicular to the body of the chip.

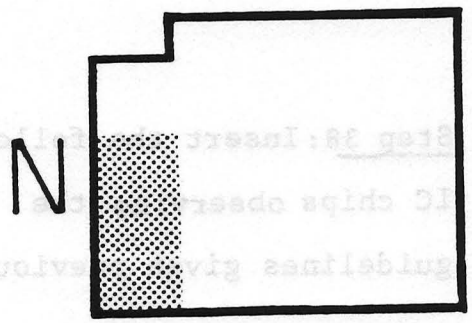
4) Begin inserting an IC chip by partially inserting the pins at one end and then carefully press the entire chip into place after verifying that the remaining pins are properly aligned.

5) Removing an IC chip requires extreme care to avoid bending or breaking the pins. Loosen one end of the chip and then insert a small screwdriver or narrow knife blade under the chip and slowly pry up first one end and then the other without tilting the chip very much in either direction.

Note: It is advisable to support the center of the Superboard while inserting IC chips to prevent the board from "bending". A magazine or thickness of newspaper will work well.

CAUTION: IC's should never be installed or removed when the power to the board is on!

After installation, check each IC for bent pins - - pins that bend under during installation and fail to make contact.



Step 37: Insert the following IC chips observing the guidelines given previously.

( ) A. IC-7403

( ) B. IC-74123
count 2

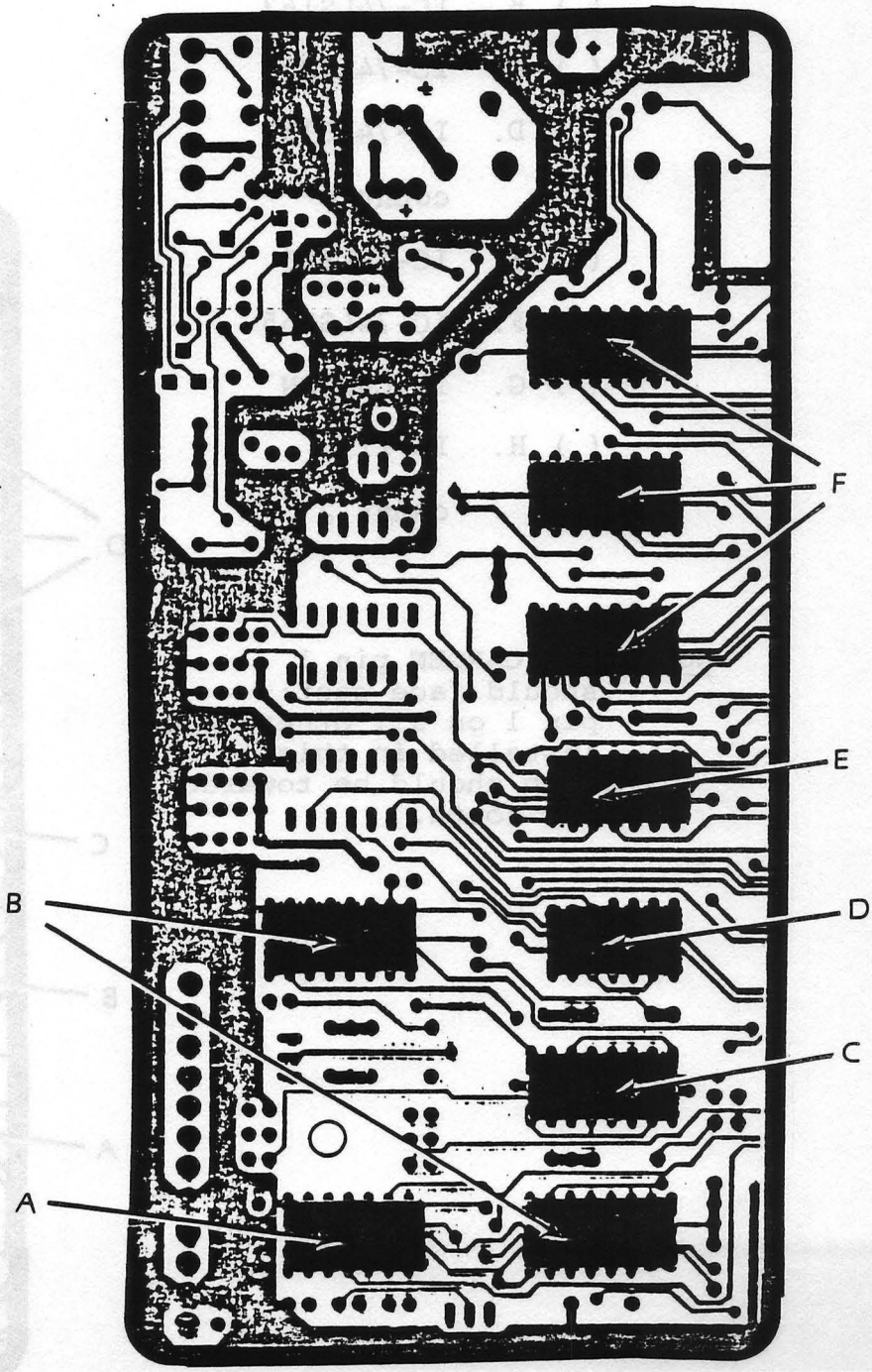
( ) C. IC-74LS76

( ) D. IC-7474

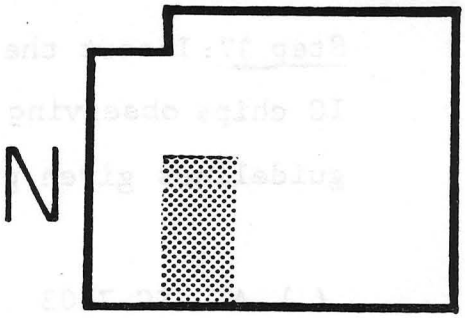
( ) E. IC-74LS04

( ) F. IC-74LS163
count 3

Note: Pin 1 on all IC's installed in this step should be towards the south.



Step 38: Insert the following IC chips observing the guidelines given previously.



( ) A. IC-7400

( ) B. IC-74LS163

( ) C. IC-74LS20

( ) D. IC-74LS157
count 4

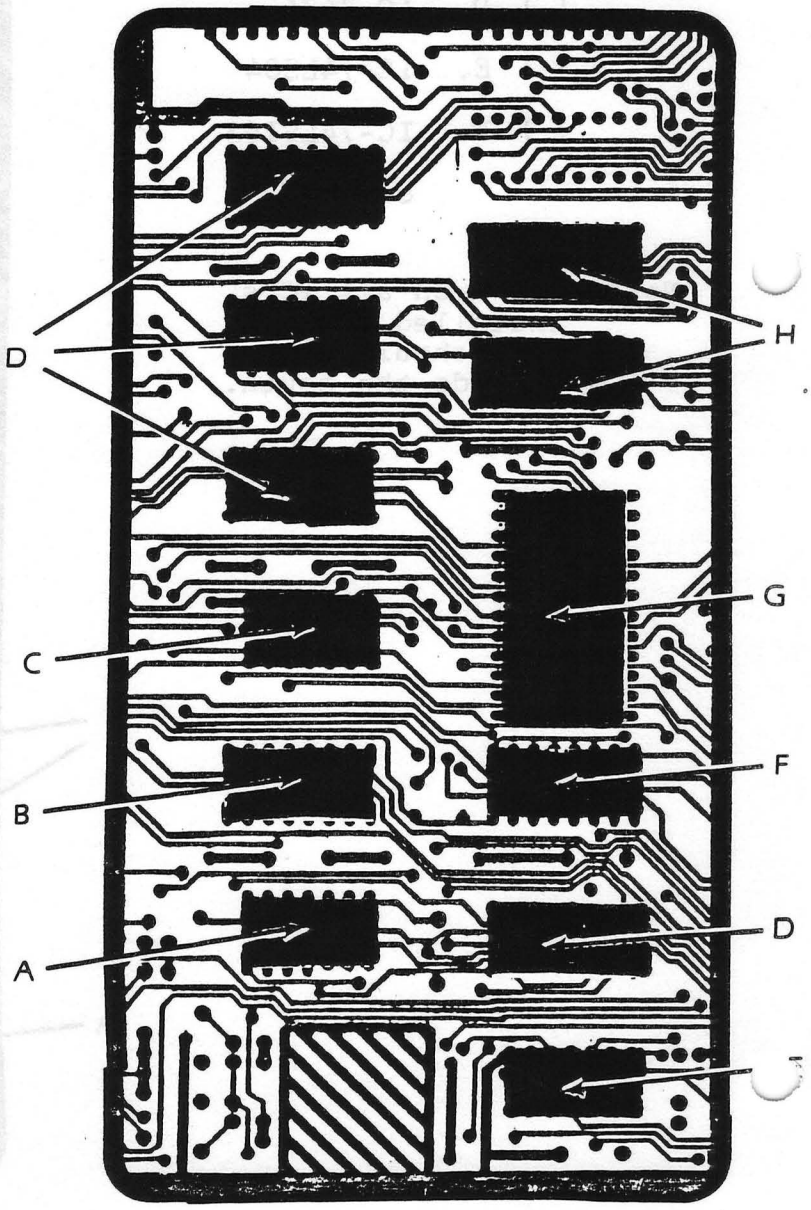
( ) E. IC-74LS86

( ) F. IC-74LS165

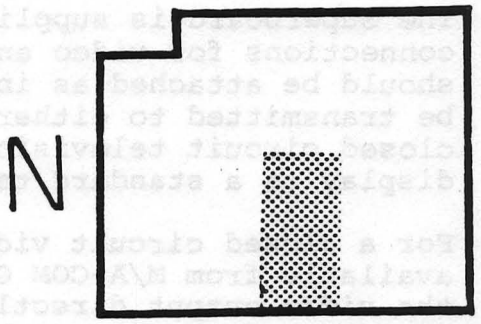
( ) G. IC-CARGEN

( ) H. IC-2114
count 2

Note: The CARGEN pin 1 should face east; pin 1 on all other IC's installed in this step should be towards the south.



Step 39: Insert the following IC chips observing the guidelines given previously.



( ) A. IC-74LS163

( ) B. IC-74LS93

( ) C. IC-7474

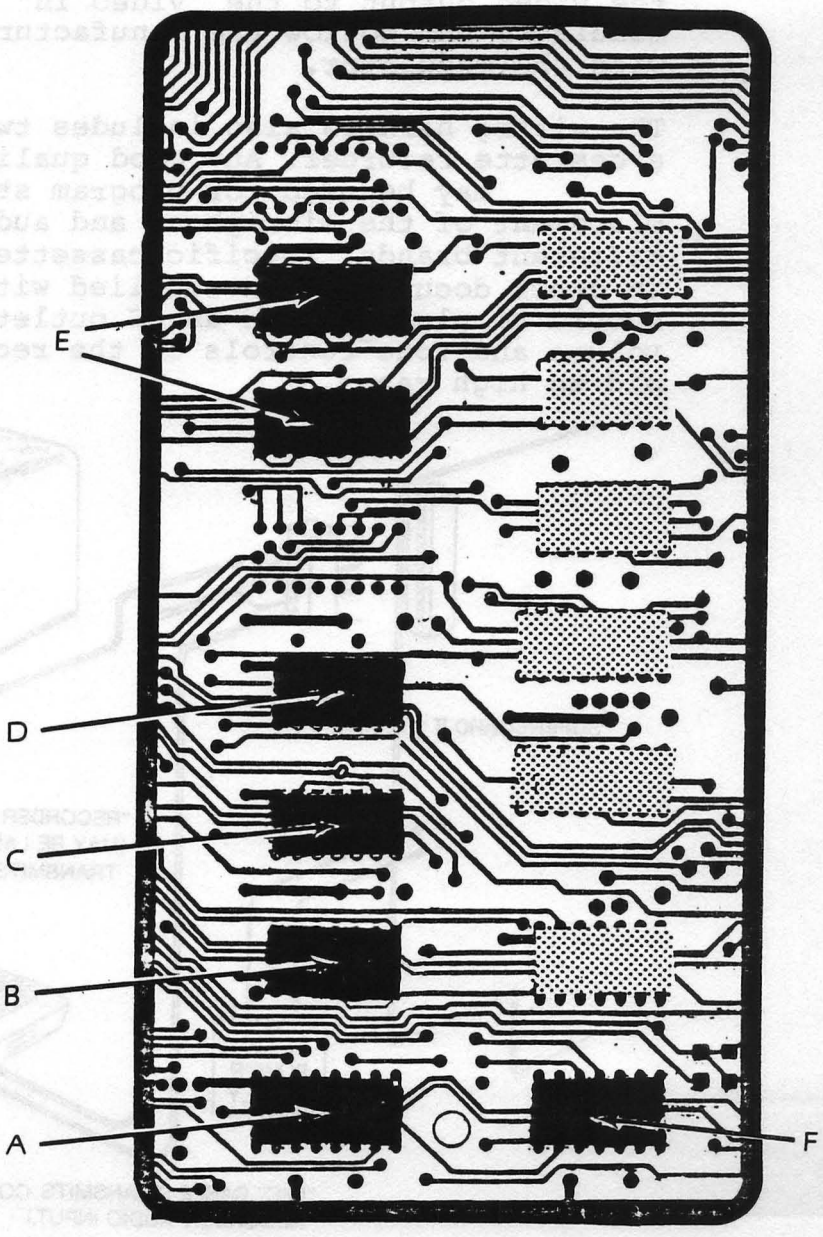
( ) D. IC-7408

( ) E. IC-8T28

count 2

( ) F. IC-74LS20

Note: All IC's installed in this step should have pin 1 facing towards the south.



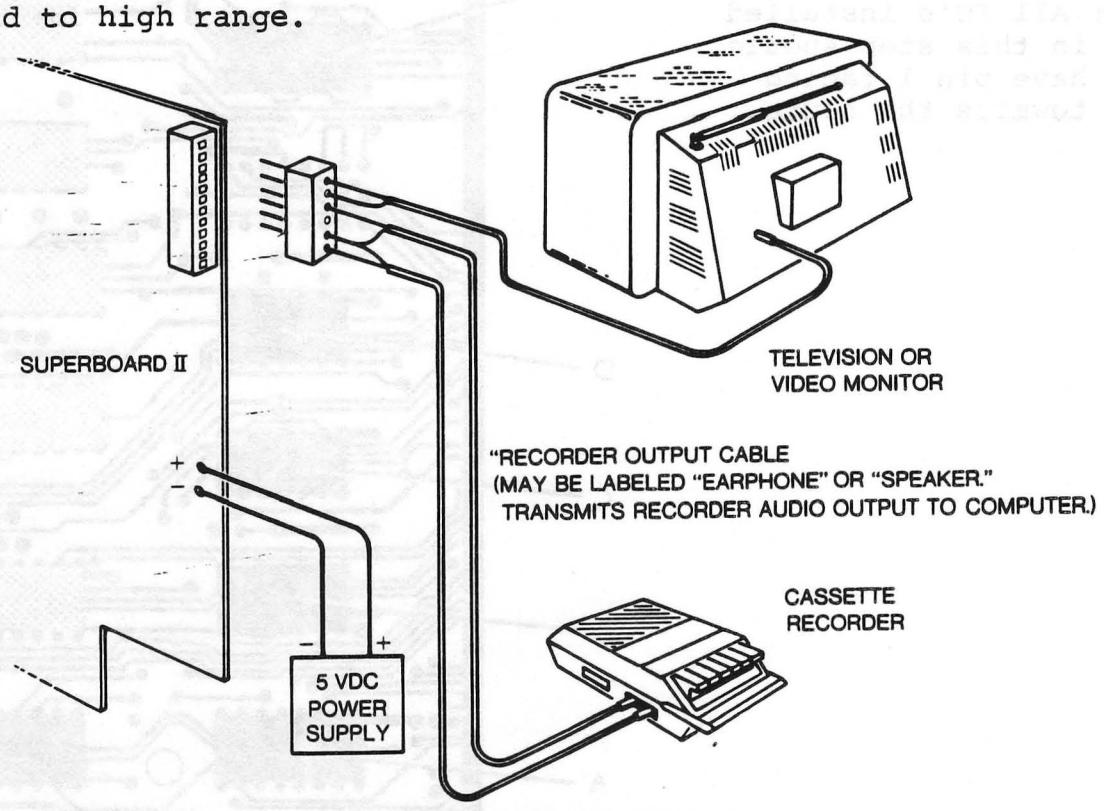
Video and Cassette Connection Notes

The Superboard is supplied with a wiring harness which provides connections for video and cassette input/output. This harness should be attached as indicated in Step 40. The video signal can be transmitted to either the high impedance (HI-Z) input of a closed circuit television video monitor or an RF modulator for display on a standard television.

For a closed circuit video monitor (such as the model AC-3 available from M/A-COM OSI) use the cable supplied to connect the video output directly to the video input jack of the monitor. If there is a high impedance-low impedance selector switch or two or more inputs on the monitor, follow the monitor manufacturer's instructions.

With a standard television, use the cable supplied to connect the video output to the "video in" port of a video-to-RF modulator and follow the manufacturer's instructions supplied with the modulator.

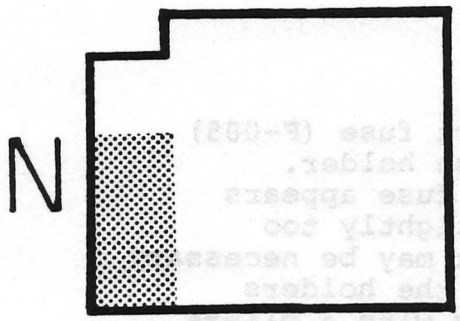
The wiring harness also includes two cables for connection to a cassette recorder. Any good quality cassette tape recorder may be used for program storage and retrieval. The placement of the microphone and audio jacks may vary with different brands. Specific cassette I/O commands are discussed in other documentation supplied with this kit. The tape recorder should be plugged into an AC outlet, not run on batteries. The volume and tone controls of the recorder should be set at the mid to high range.

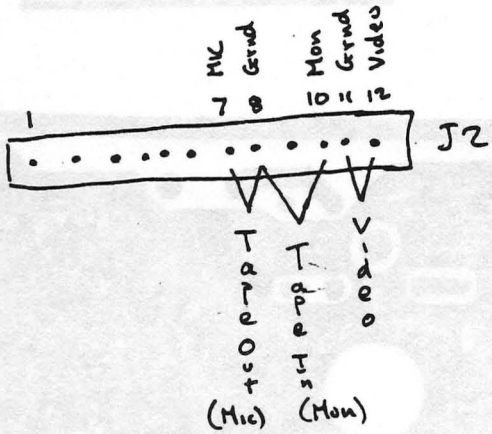


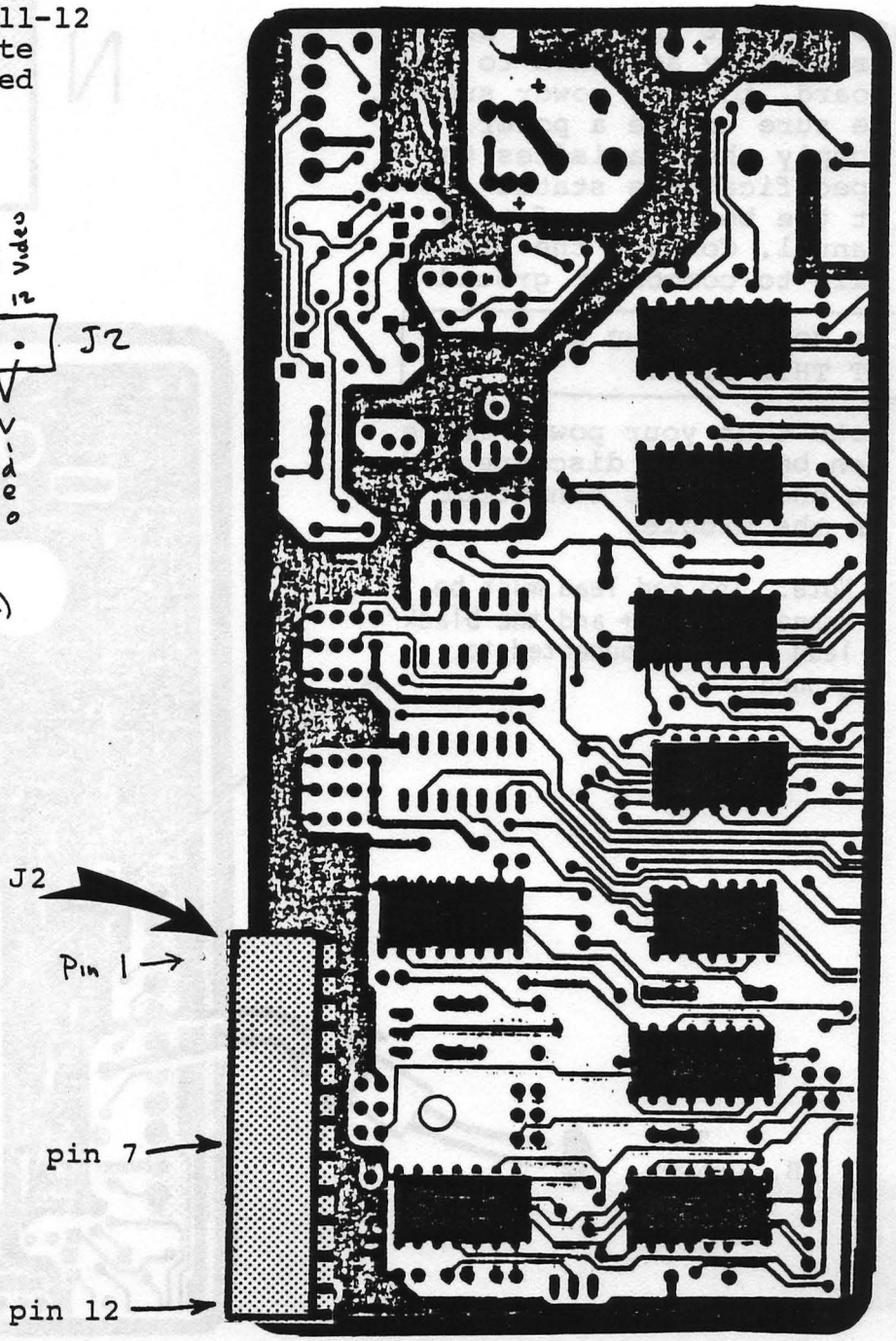
Superboard II Cassette Recorder Connections

Step 40 :

( ) Connect the Video/Cassette harness (Y-WA-3SB). The three cables in this harness are attached to a six-pin connector. This connector should be inserted into pins 7 through 12 on the female molex connector J2. It is inserted properly if the video cable is connected to pins 11-12 and the two cassette cables are connected to pins 7-10.

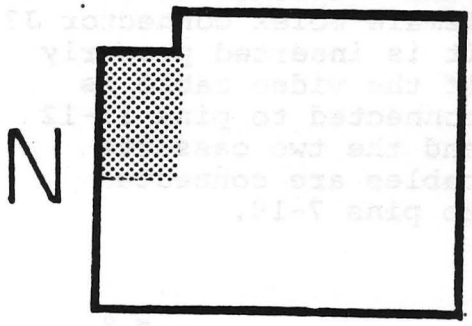






Step 41:

( )A. Insert fuse (F-005) into fuse holder. (If the fuse appears to be slightly too long, it may be necessary to bend the holders slightly with a pliers, or resolder them further apart.)

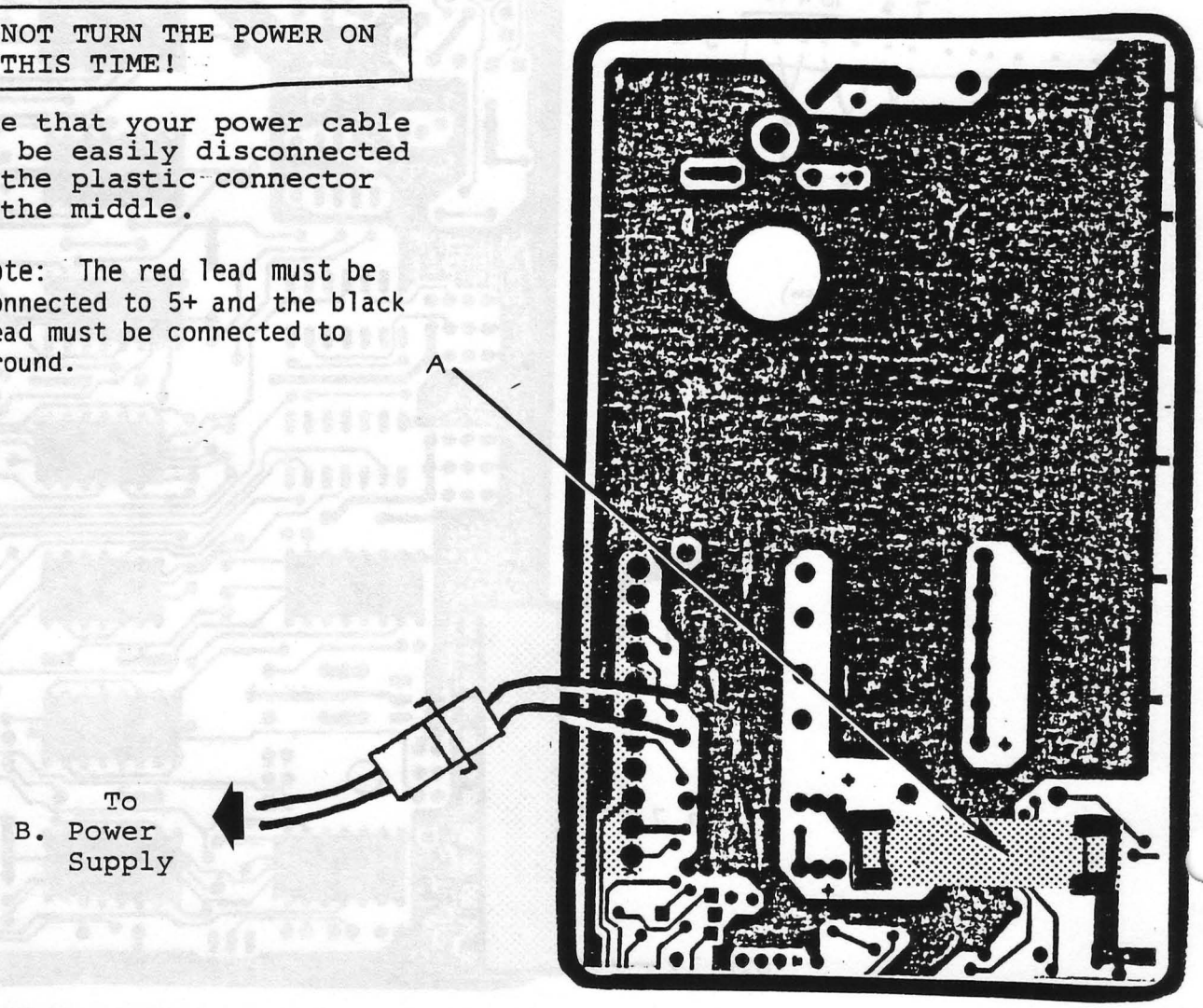


( )B. Connect the power cable, previously attached to the board, to your power supply. Be sure to use a power supply that satisfies the specifications stated at the beginning of this manual. Connect the black wire to common or ground.

DO NOT TURN THE POWER ON AT THIS TIME!

Note that your power cable can be easily disconnected at the plastic connector in the middle.

Note: The red lead must be connected to 5+ and the black lead must be connected to ground.



Test Procedure 4: Perform after Step 41.

Purpose: Check of power supply.

Equipment Needed: AC/DC VOM multimeter.

Procedure:

( ) 1. Be sure the power supply is unplugged. Verify that the RED and BLACK wires from the Superboard are connected to the + and - terminals (respectively) of the power supply.

( ) 2. Attach an AC/DC multimeter to the terminals of the power supply and set the meter to a DC range which will accurately measure 5 Volts.

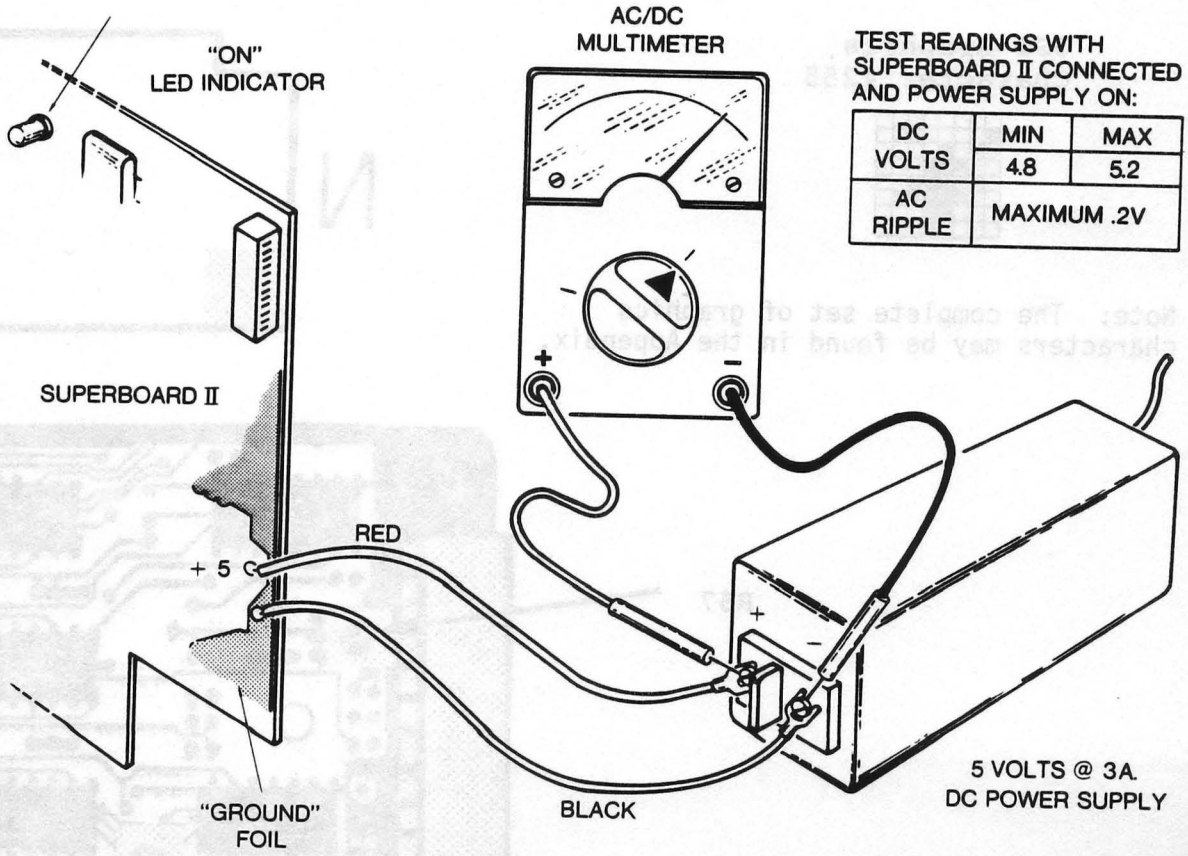
( ) 3. Briefly turn on the power supply. The red LED on the Superboard should glow. If it doesn't, turn off the power supply and check all connections to be sure they are not reversed.

( ) 4. Again turn on the power supply and measure the DC voltage. The reading should be between 4.8 and 5.2 Volts.

> CAUTION: A reading of more than 5.2 Volts may damage your board.

( ) 5. Turn the power off. Without changing the connections, set the meter to measure on AC voltage of approximately 0.5 Volts.

( ) 6. Turn the power supply on and measure the AC voltage. This reading measures ripple. It must not exceed 0.2 Volts AC.



Superboard II Power Supply Connections

Test Procedure 5 - Perform after Test Procedure 4

Purpose: Check video portion of the Superboard.

Equipment Needed: TTL Logic Probe

Procedure:

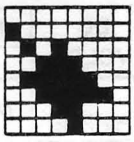
( )1. Connect the video cable, previously attached to J2 in Step 40, to your monitor.

( )2. Turn on the monitor and the power to the Superboard. Locate controls (trimmer potentiometers) R57 and R58 using the diagram below (northwest corner of the board).

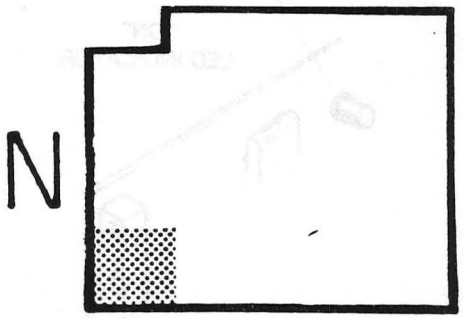
( )3. R58 controls the monitor screen brightness and horizontal tearing. Adjust this with a screwdriver until the display is steady. You should see a screen full of the graphics character illustrated below (OSI Character Graphics #255); however, a random mixture of graphics characters is not necessarily incorrect. If there is no display of characters, check all connections and check IC chips for bent pins.

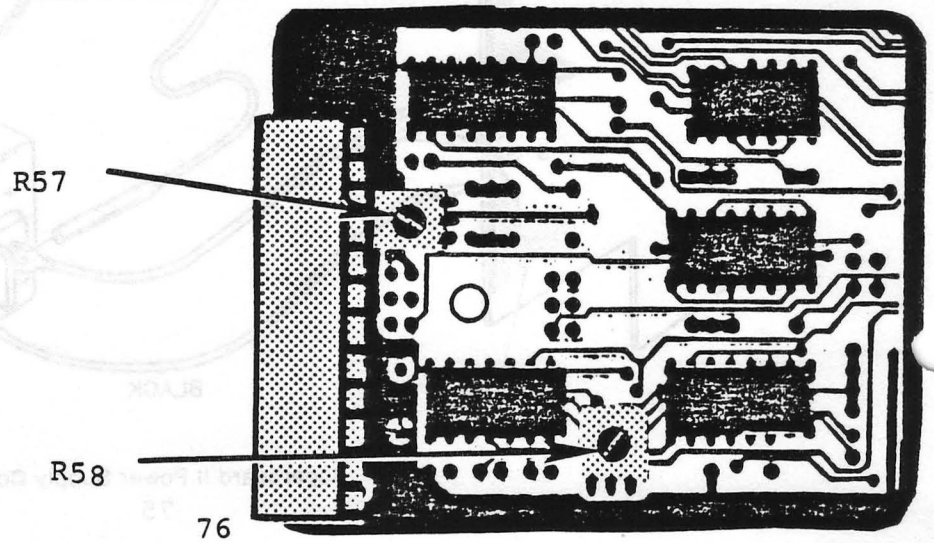
( )4. R57 adjusts the cassette interface. To set this properly, turn it full clockwise and then back one quarter of a turn. (this setting can be fixed in place with a drop of nail polish or paint)

OSI Graphics Character #255



Note: The complete set of graphics characters may be found in the Appendix.





If you have a logic probe capable of testing TTL cicuitry, perform the following additional tests:

( )5. Locate J2, U8, U30, U58 and U60 on the Superboard.

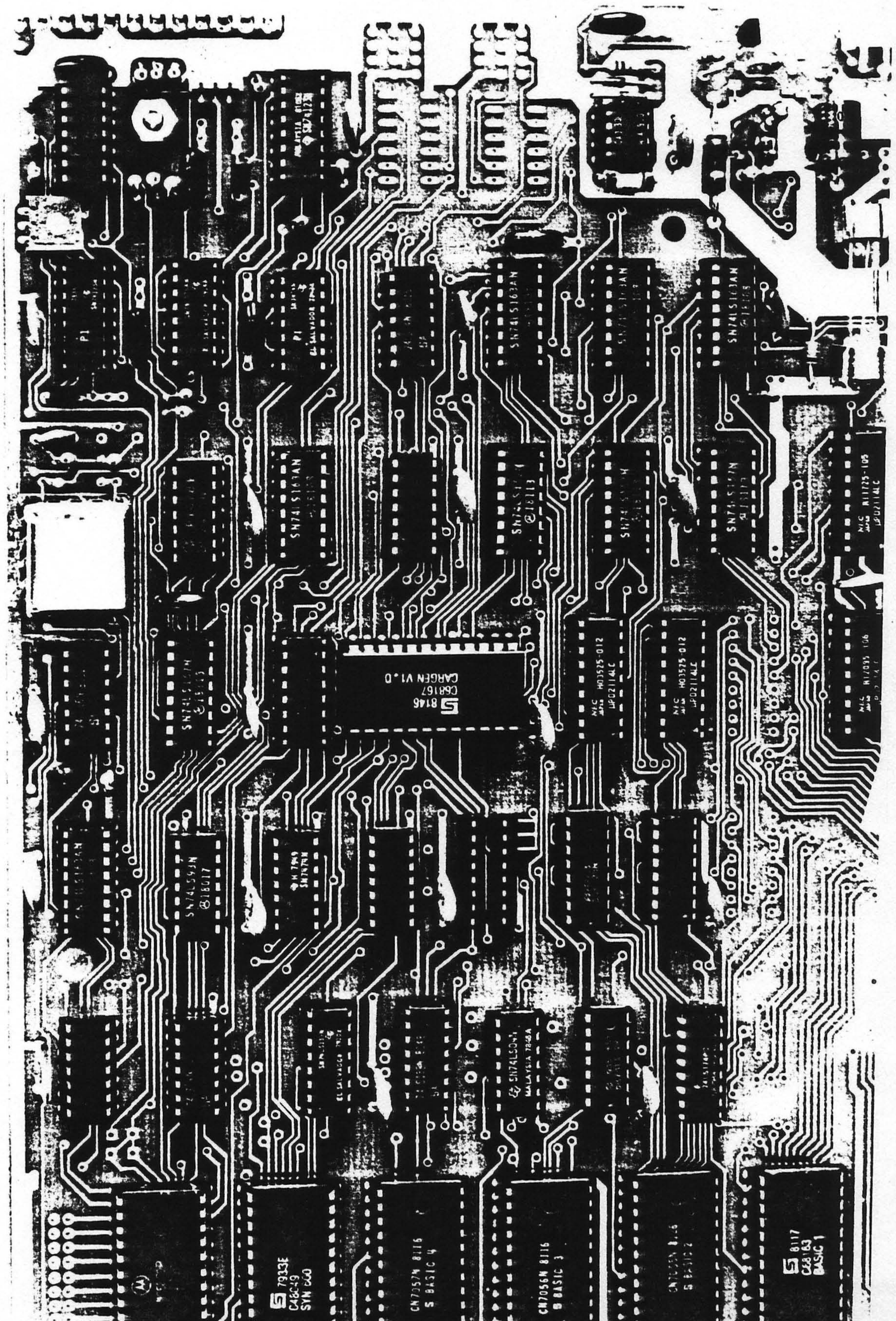
( )6. Check the following pins for a high-low pulse:

J2 - pin 12
U60 - pin 14
U30 - pins 11, 12, 13, 14, 15

These checks basically verify operation of circuitry that generates video and sync pulses.

( )7. Check for a high-low pulse on pin 37 of U8. This will check operation of chip portions associated with the clock.

( )8. Check for a high-low pulse on pin 8 of U58. This will confirm operation of the crystal and associated circuitry. (Note: This last check may fail if your logic probe has a maximum input signal frequency of less than 3.93 MHz, the frequency of the Superboard crystal.)



STAGE IV: Final Assembly and Test

STAGE IV of your Superboard assembly will be carried out in three parts. Each part will have more than one step. Part one will be the inserting and testing of the 6502 microprocessor, the memory select, and the machine code monitor ROM chips in conjunction with 1K of RAM. Part two will be the inserting and testing of the rest of the ROM section. Also, the ACIA (Asynchronous Communications Interface Adapter) will be inserted here. The third part will be the installing of the rest of the RAM chips and the final testing of the Superboard. Figure IV-1 below shows the location of these areas.

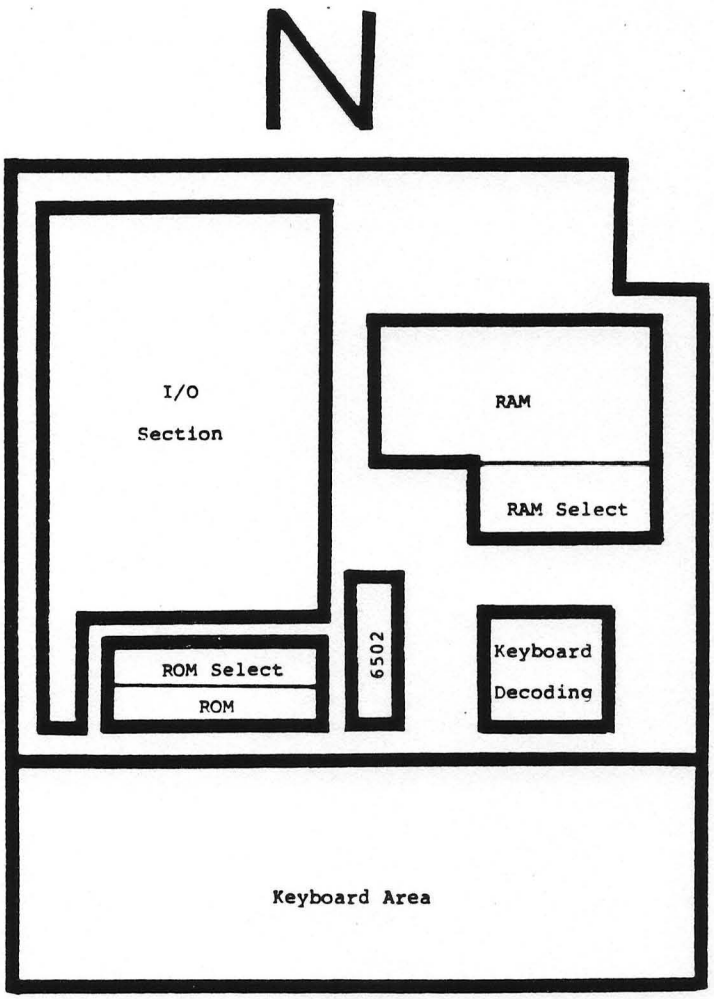


Figure IV-1

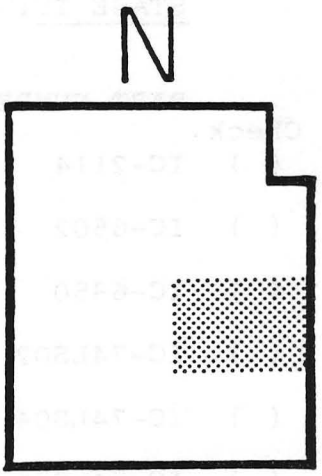
STAGE IV: Parts List (Bag H)

Check	PART NUMBER	QUANTITY	DESCRIPTION
( )	IC-2114	16	RAM
( )	IC-6502	1	CPU
( )	IC-6850	1	ACIA
( )	IC-74LS02	1	TTL
( )	IC-74LS04	3	TTL
( )	IC-74LS75	2	TTL
( )	IC-74LS125	2	TTL
( )	IC-74LS138	4	TTL
( )	IC-74LS139	1	TTL
( )	IC-74LS174	1	TTL
( )	IC-BASIC 1	1	ROM
( )	IC-BASIC 2	1	ROM
( )	IC-BASIC 3	1	ROM
( )	IC-BASIC 4	1	ROM
( )	IC-SYN600	1	ROM

Note: As you locate each piece, check the appropriate box.

STAGE IV, Part One: Microprocessor, Memory Select, Monitor ROM and 1K RAM Installation.

NOTE: BE CERTAIN THE POWER TO YOUR SUPERBOARD IS OFF! All of the chips inserted during STAGE IV must be oriented with pin one toward the south end of the board.



Step 42 Use the procedure (observing the precautions) described at the beginning of STAGE III to insert the following IC chips.

( ) A. 6502 (microprocessor)

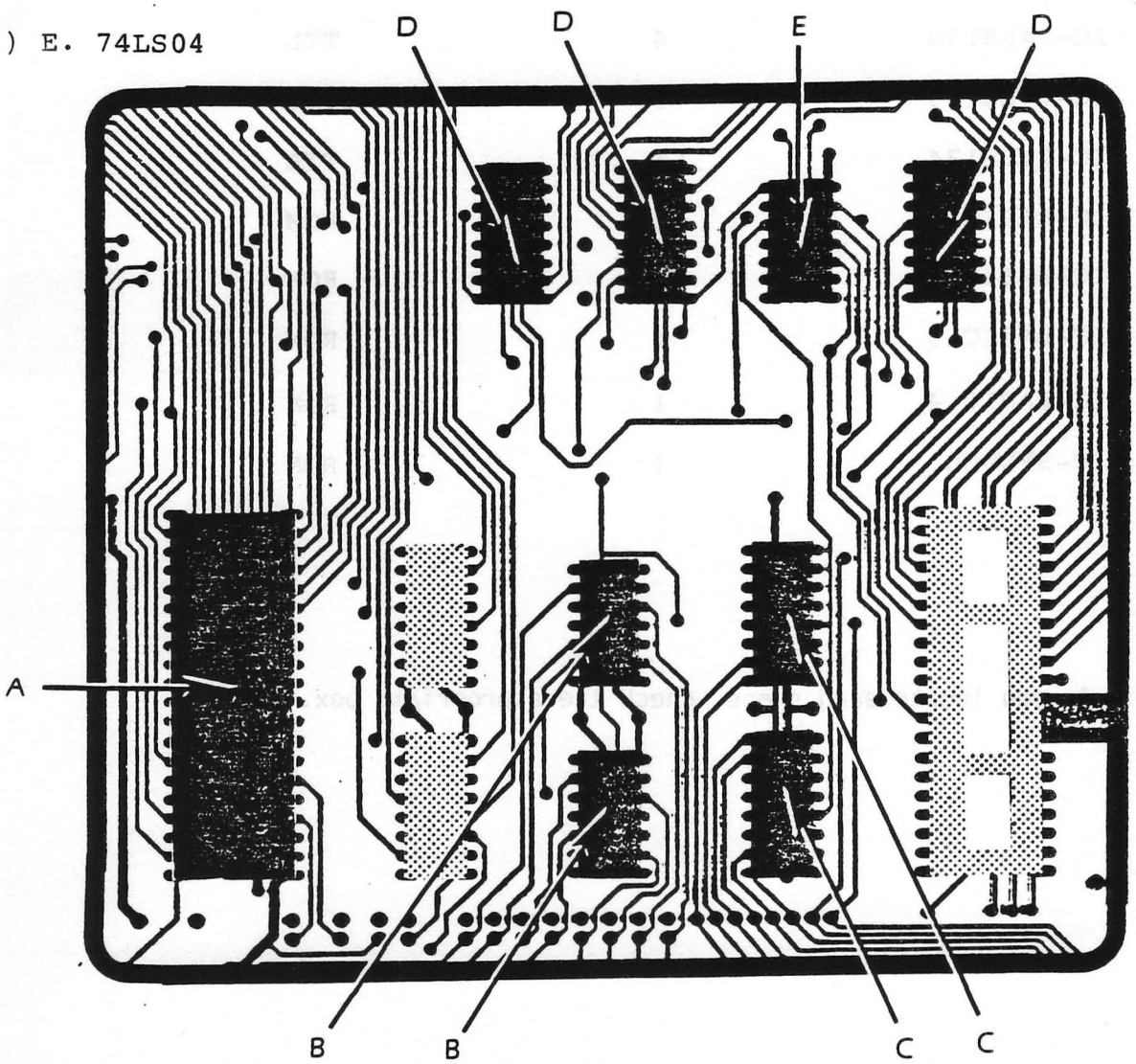
( ) B. 74LS125
count 2

( ) C. 74LS75
count 2

( ) D. 74LS138
count 3

( ) E. 74LS04

Note: All IC's installed in this step should have pin 1 facing towards the south.



Step 43 Insert the following IC chips observing the guidelines given previously.

( ) A. SYN 600

( ) B. BASIC 4

( ) C. 74LS174

( ) D. 74LS02

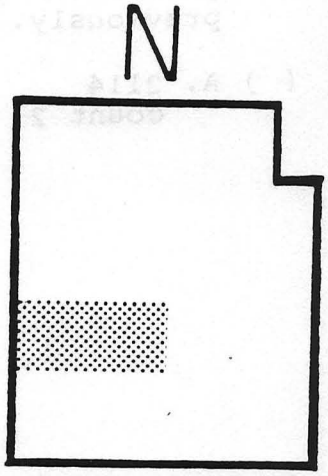
( ) E. 74LS04
count 2

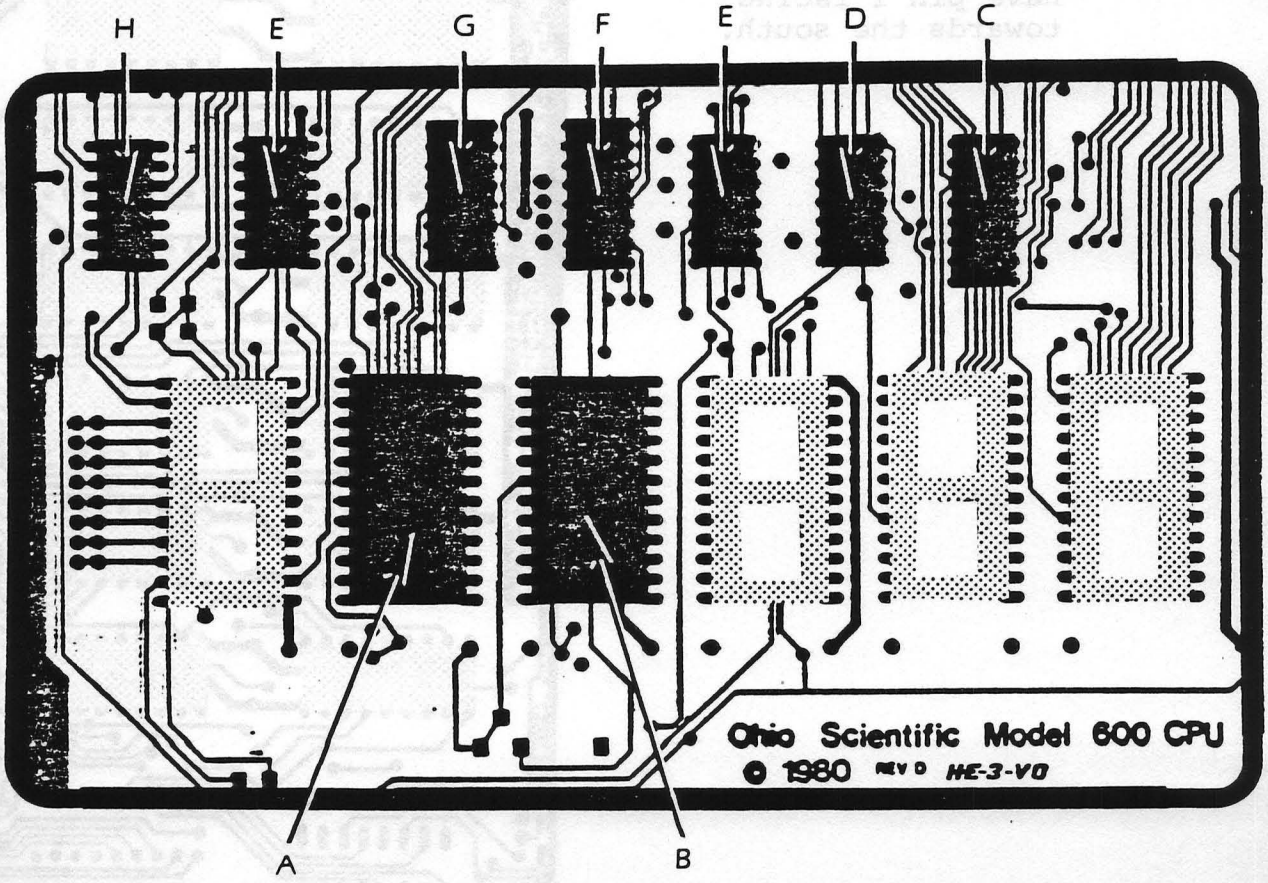
( ) F. 74LS138

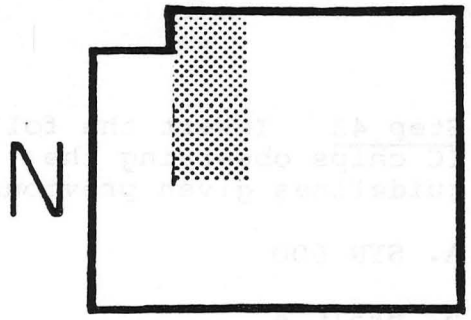
( ) G. 74LS139

H. Inserted previously
(STAGE III, Step 39F)

Note: All IC's installed in this step should have pin 1 facing towards the south.

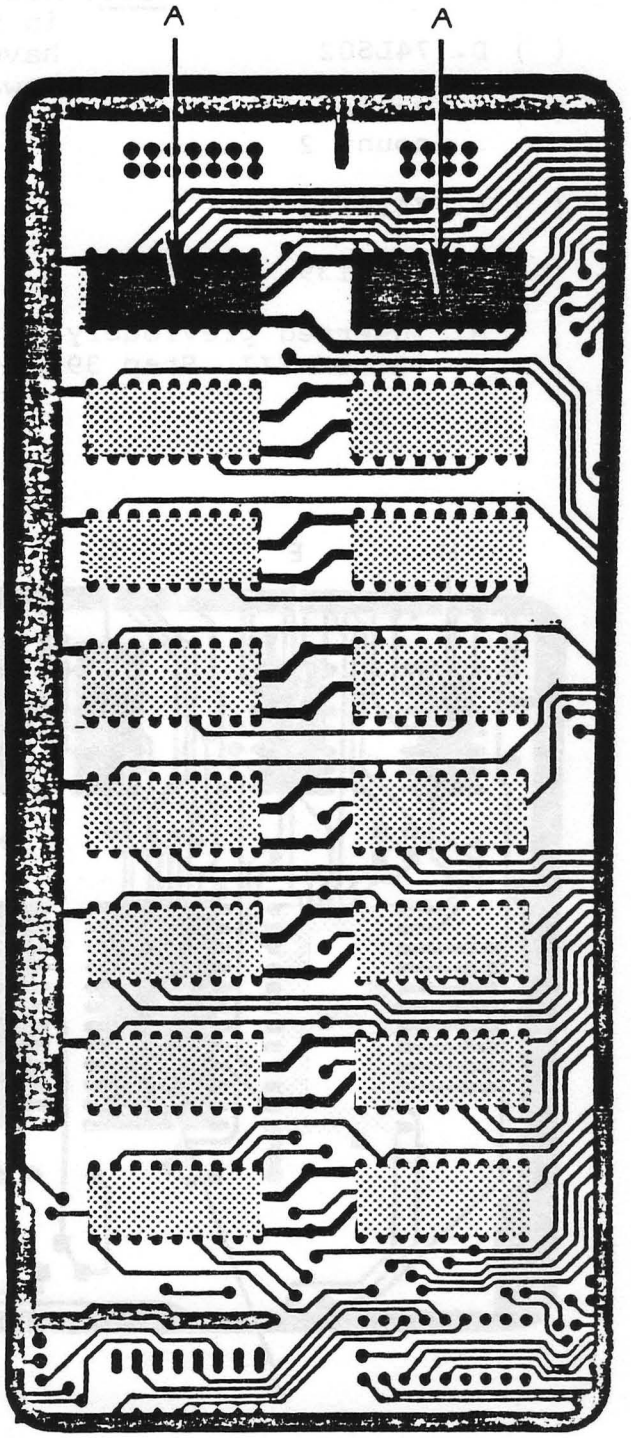






Step 44 Insert the following IC chips observing the guidelines given previously.

( ) A. 2114
count 2



Note: All IC's installed in this step should have pin 1 facing towards the south.

( ) Test Procedure 6: Perform after step 44.

Purpose: Testing the function of the 6502 microprocessor, the memory select chips, and the machine code monitor ROM.

Carefully check all the IC chips you have installed to be certain no pins were bent during installation. Apply power to the board with the video monitor attached. The message

```
D/C/W/M ?_
```
*

should appear in the lower left of your screen. If the message does not appear, refer to the Trouble Shooting Chart at the end of the manual.

When the D/C/W/M ? message appears, check to be certain the SHIFT LOCK key is depressed. At this point, your Superboard will respond to only two keys. They are the 'M' key and the BREAK key. Press the 'M' key. The set of numbers

```
0000 XX
```
*

should appear in the upper left of the screen. The XX set may be any combination of the numbers 0 - 9 and the letters A - F. If nothing happens, check that the SHIFT LOCK key is down and then press the BREAK key holding it down for about two seconds before releasing it. There should be a blink in the D/C/W/M ? message. Again press the 'M' key.

The four zeros are the address (in hexadecimal notation) for the lowest memory location. The two characters following the address value are the contents (in hexadecimal) of that memory location. The address value can be changed by simply pressing number keys or letter keys for A - F. To change the contents of a memory location, first press the '/' key (slash key) and then press number or A - F letter keys. In this mode of operation, pressing the RETURN key will increment to the next address. If a new value was entered before pressing the RETURN key, the new value will be stored in the memory location. If no change is made, the original value will remain in the location. Pressing the '.' key (period key) will allow you again to bring up any address by typing the value.

Try various combinations of address values and content values being sure to use all numbers 0 - 9 and letters A - F. You may bring up an address which corresponds to a ROM location or a non populated RAM location. In this case, the contents will be displayed, but you will be unable to change it. For example, if you bring up address F800, the contents will be A0. You can change this value on the screen, but when you again bring up F800, the contents will still be A0.

* The exact screen display is shown within a box for clarity.

STAGE IV, Part Two: ACIA and BASIC in ROM Installation.

Step 45 DISCONNECT THE POWER FROM YOUR SUPERBOARD. Insert the following IC chips observing the guidelines given previously.

( ) A. 6850 (ACIA)

( ) B. BASIC 3

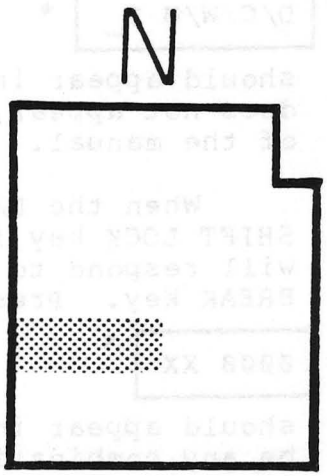
( ) C. BASIC 2

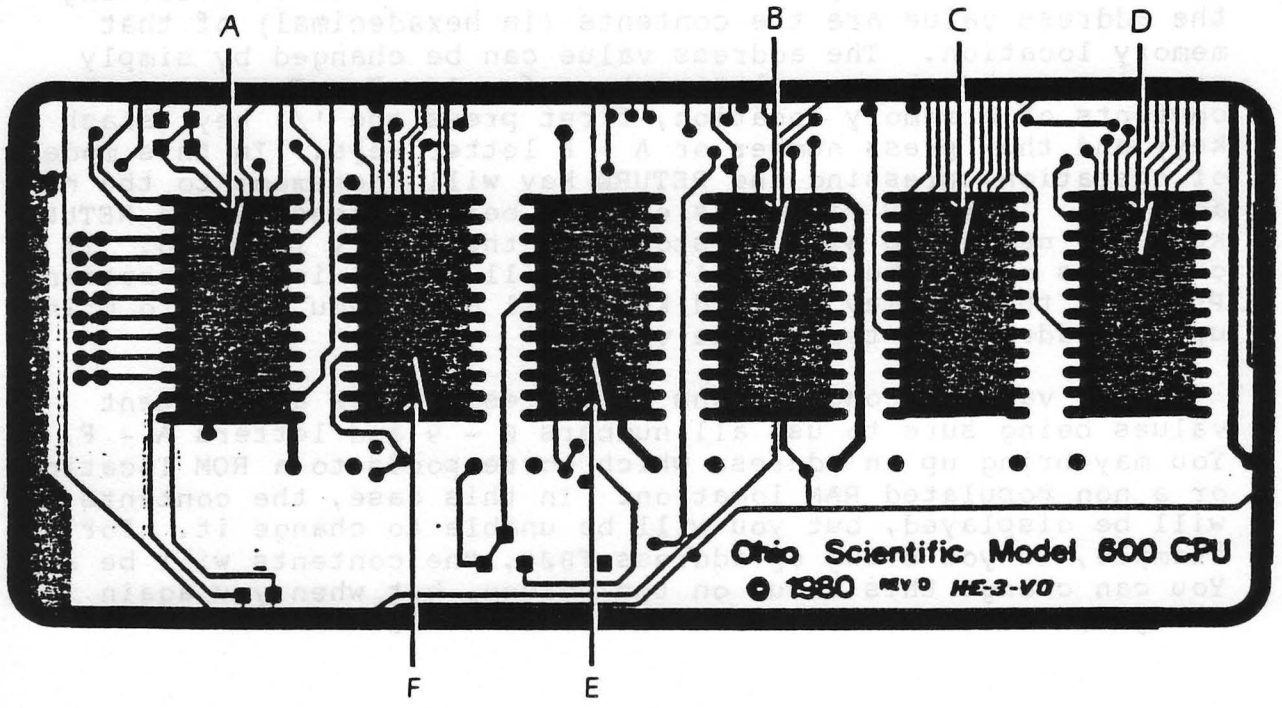
( ) D. BASIC 1

E. Inserted previously (STAGE IV, Step 43B)

F. Inserted previously (STAGE IV, Step 43A)

Note: All IC's installed in this step should have pin 1 facing towards the south.





( ) Test Procedure 7: Perform after step 45.

Purpose: Testing of the BASIC-in-ROM chips.

Carefully check all the IC chips you have installed to be certain no pins have been bent. Apply power to the board with the video monitor attached. The message

```
D/C/W/M ?_
```

(The underline after the ? is the cursor.)

should appear in the lower left of your screen. Check to be certain that the SHIFT LOCK key is depressed. Press the 'C' key. The message

```
MEMORY SIZE?_
```

should appear under the D/C/W/M ? message (the first message will scroll up). Press the RETURN key to get the message

```
TERMINAL WIDTH?_
```

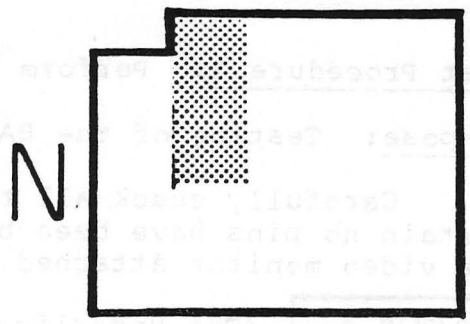
Again press the RETURN key. (Responses to these messages other than pressing RETURN are explained in the user's manuals available for your Superboard.) You should now see on the video display

```
D/C/W/M ?
MEMORY SIZE?
TERMINAL WIDTH?

 255 BYTES FREE

OSI 65Ø2 BASIC VERSION 1
.Ø REV 3.2
COPYRIGHT 1977 BY MICROS
OFT CO.

OK
_
```

Now hold down the BREAK key until the D/C/W/M ? message appears. When you press the 'W' key, the BASIC prompt, OK, with the cursor under it, i.e.,

```
OK
_
```

should be displayed. Whenever this prompt and cursor combination is the bottom line on the video display, you can enter, list, and run programs in BASIC. At this point, however, you have only 255 bytes of memory workspace.



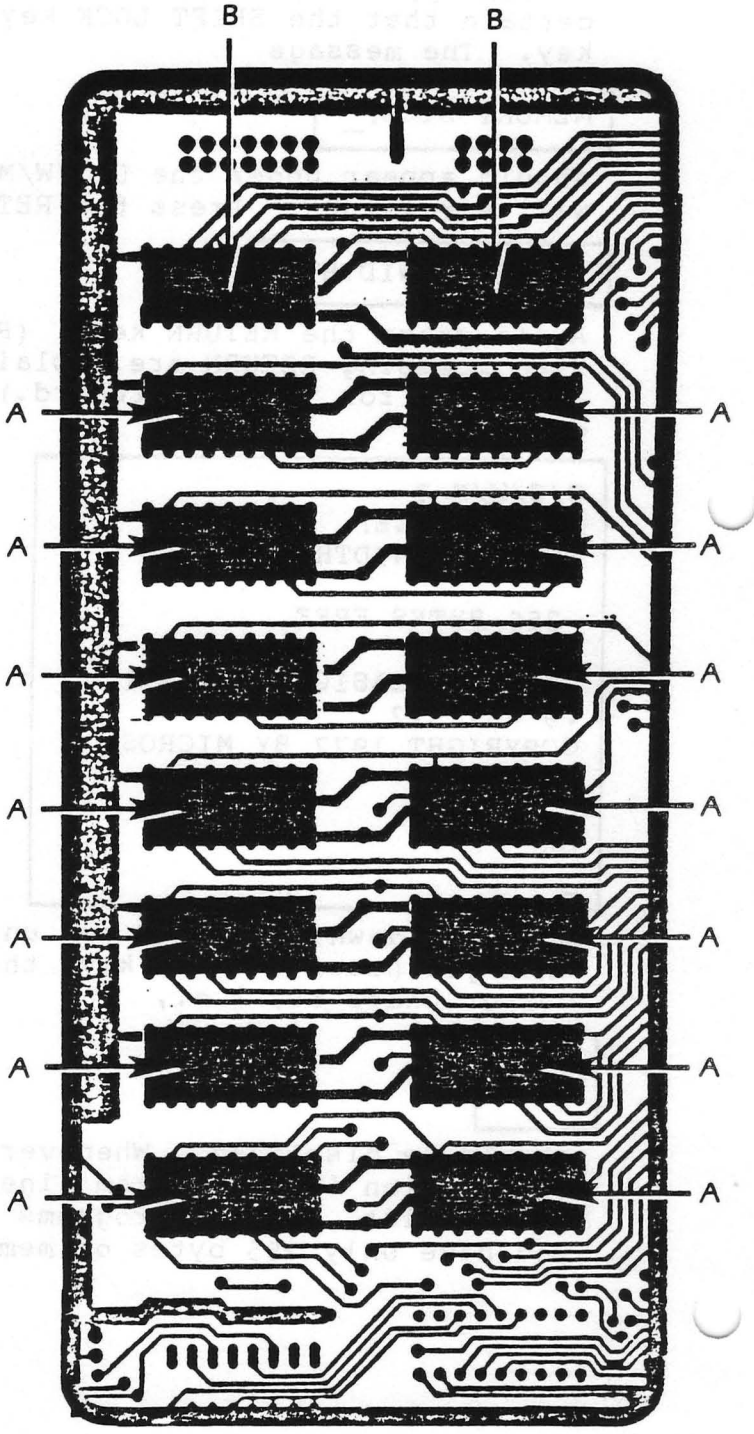
STAGE IV, Part Three:
RAM Installation.

Step 46 DISCONNECT THE POWER FROM YOUR SUPERBOARD. Insert the following IC chips observing the guidelines given previously.

( ) A. 2114
count 14

B. Inserted previously
(STAGE IV, Step 44A)

Note: All IC's installed in this step should have pin 1 facing towards the south.



( ) Test Procedure 8: Perform after step 46.

Purpose: Test for proper memory size.

Carefully check all the IC chips you have installed to be certain no pins have been bent. Apply power to the board with the video monitor attached. The message

```
D/C/W/M ?_
```

should appear in the lower left of your screen. Check to be certain that the SHIFT LOCK key is depressed. Press the 'C' key. The message

```
MEMORY SIZE?_
```

should appear. Now press the RETURN key twice. You should now see on the video display

```
D/C/W/M ?
MEMORY SIZE?
TERMINAL WIDTH?

 7423 BYTES FREE

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.Ø REV 3.2
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OK

_
```
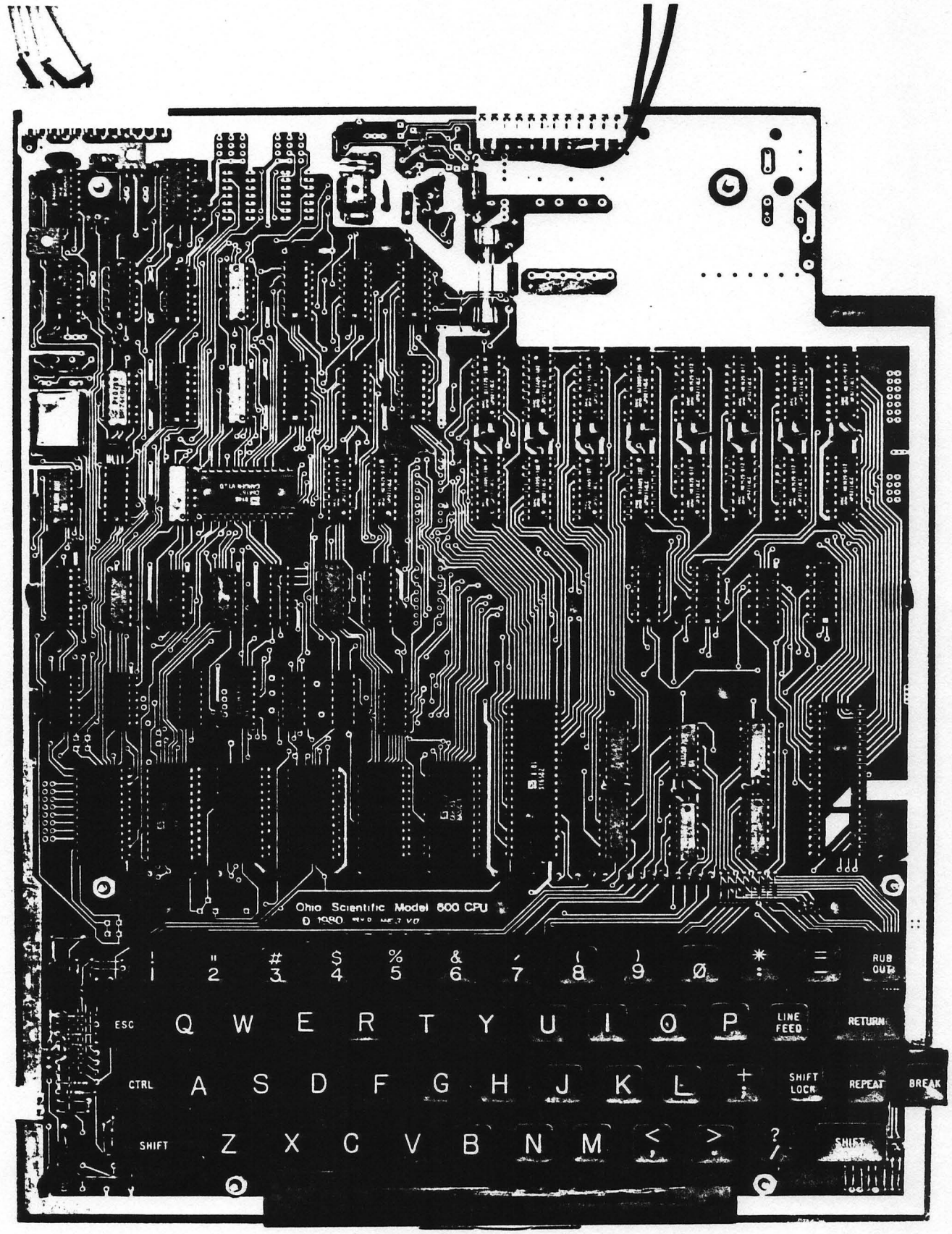
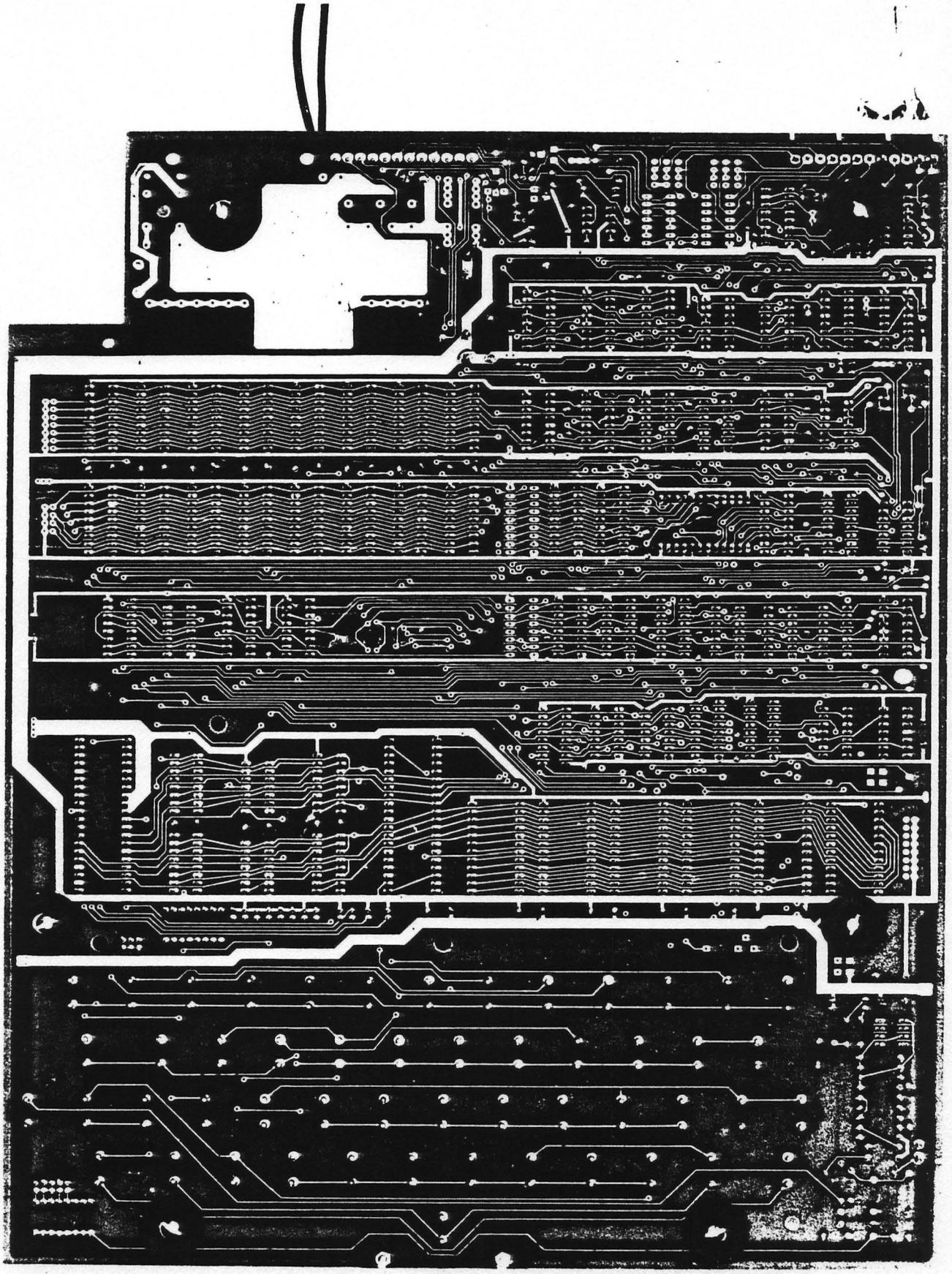

Note particularly the number of bytes free. The number should be 7423. If it is not, there is a problem with one or more of the RAM chips or with the RAM chip select section. If the number is 7423, then your Superboard should now be completed and in proper operating condition. The functioning of the Superboard is the same as the Ohio Scientific C1P. Refer to the manuals supplied with your kit for operating instructions.

CONGRATULATIONS! You've done it.


Ohio Scientific Model 600 CPU
ESC
CTRL
SHIFT
LINE FEED
RETURN
SHIFT LOCK
REPEAT
BREAK
RUB OUT



Appendix 1 Superboard II and C1P Documentation

1.	C1P and C1P MF Introductory Manual	$ 6.95
2.	The C1p User's Manual	8.95
3.	C1P Technical Reference (Sam's schematics)	7.95
4.	BASIC and the Personal Computer	12.95
5.	65V Primer (assembler introduction)	5.95
6.	Understanding Your C1P and C4P	7.95
7.	OSI BASIC Reference Manual	6.95
8.	AE and EM Reference Manual (assembler editor and extended monitors)	6.95
9.	How to Program Microcomputers (Barden)	8.95

Note: All manuals written for the C1p and C1P MF (mini floppy) also apply to the Superboard II with appropriate adjustments for memory size, peripherals and so forth.

Appendix 2 Parts Bags -- Cross Reference

		WHERE USED
STAGE I		
BAG A -	Capacitors	I.4
BAG B -	IC-3130, IC-393, Diodes & Transistors	I.2 , I.5
BAG C -	Resistors & Pots	I.3 , I.5
BAG D -	Misc. Hardware, Sockets, LED	I.1 , I.5
STAGE II		
Bag E -	Keys, Keyswitches & Key Hardware	II.1
STAGE III		
BAG F -	IC-7400, IC-7403, IC-7408, IC-74123, IC-7474, IC-74LS157, IC-74LS163, IC-74LS165, IC-74LS20, IC-74LS76, IC-74LS86, IC-74LS93, IC-8T28, (2)IC-2114-450, IC-74LS04	III.1
BAG G -	Y-WA-3SB, IC-CARGEN	III.1
STAGE IV		
BAG H -	IC-6502, IC-6850, IC-74LS02, IC-74LS04, IC-74LS125, IC-74LS138, IC-74LS139, IC-74LS174, IC-74LS75, IC-BASIC1, IC-BASIC2, IC-BASIC3 IC-BASIC4, IC-SYNMON	IV.1

BAG A - Capacitors

PART #	DESCRIPTION	Count	Where Used
C-102	.001mf.	4	I.4
C-103	.01 mf.	2	
C-104	.1 mf	3	
c-151	150 pf.	3	
C-270	27 pf.	1	
C-506	50 pf.*	3	
C-680	68 pf.	1	
CB-10410	.1 mf bypass 10 volt	39	
		56 pieces	

* 47pf. capacitor may be substituted here.

BAG B - Diodes, Transistors, and TTL

PART #	DESCRIPTION		where used
Q-1N4001	Diode rectifier	1	I.2
Q-1N914	Diode	26	
Q-2N5225	Transistor	1	I.5
Q-2N5226	Transistor	1	
IC-3130	8-pin chip (TTL)	1	
IC-393	8-pin chip (TTL)	1	

31 pieces

BAG C - Resistors & Pots

Where Used	PART #	Ohms	1/4w	5%	#	Color Code
I.3	R1-101	100	"	"	1	brown-black-brown-gold
	R1-102	1K	"	"	7	brown-black-red-gold
	R1-103	10K	"	"	8	brown-black-orange-gold
	R1-104	100K	"	"	4	brown-black-yellow-gold
	R1-105	1M	"	"	4	brown-black-green-gold
	R1-106	10M	"	"	1	brown-black-blue-gold
	R1-153	15K	"	"	1	brown-green-orange-gold
	R1-163	16K	"	"	1	brown-blue-orange-gold
	R1-202	2K	"	"	1	red-black-red-gold
	R1-221	220	"	"	3	red-red-brown-gold
	R1-333	33K	"	"	1	orange-orange-orange-gold
	R1-391	390	"	"	1	orange-white-brown-gold
	R1-392	3.9K	"	"	1	orange-white-red-gold
	R1-471	470	"	"	4	yellow-violet-brown-gold
	R1-472	4.7K	"	"	12	yellow-violet-red-gold
	R1-511	510	"	"	2	green-brown-brown-gold
	R1-683	68K	"	"	1	blue-gray-orange-gold
	R1-822	8.2K	"	"	1	gray-red-red-gold
	R2-102	1K	1/2	10%	2	brown-black-red-silver
I.5	RP-103	10K	pot		1	
	RP-502	5K	"		1	
					58	pieces

Note: At times resistors of equal value but different tolerance level (5% or 10%) will be substituted. The fourth color band may, therefore, be gold or silver. This will not affect the performance of your computer.

BAG D - Miscellaneous Hardware

where used	Part #	count	Description
I.5	HW-FH2	2	
	SC-12FM	2	
	SC-14FI	16	
	SC-16FI	25	
I.1	SC-18FI	18	
	Solder	1	(36-48 inches)
	SC-24FI	7	
	SC-40FI	2	
	X-395	1	
	HW-N632	6	Nut
	HW-RBI	6	Rubber feet
	HW-S632.50	6	Screw
	HW-WM6	6	Flat washer
	HW-WMI6	6	Lock washer
I.5	L-LED1	1	
	SC-2FM	1	
	Y-WA-SBCF	1	Power connector asmbly - female
	Y-WA-SBCM	1	" " " - male

109 pieces

BAG E Keys, Keyswitches and Key Hardware

Parts List

where used	Part Number	Quantity	Description
II.1	HW-KEYS 1-0	10	Numerical Keyboard Caps
	HW-KEYS A-Z	26	Letter Keyboard Caps
	HW-KEYS(Misc)	17	Misc. Keyboard Caps: RETURN RUB OUT LINE FEED SHIFT LOCK SHIFT (2) REPEAT BREAK ESC CTRL *: =- +; ?/ <, >. Spacebar
	HW-KEYS SWITCH	52	Keyboard Switches
	HW-KEYS SW ALT.	1	Locking Keyboard Switch
	Spacebar Hardware	8	Hardware for Mounting Spacebar: Left bracket Right bracket Spacebar mount Spacebar metal bar Screws (2) Nuts (2)
		114 pieces	

Stage III IC's

BAG F -

where used	Part #	Count	Description
III.1	IC-7400	1	
	IC-7403	1	
	IC-7408	1	
	IC-74123	2	
	IC-7474	2	
	IC-74LS157	4	
	IC-74LS163	5	
	IC-74LS165	1	
	IC-74LS20	2	
	IC-74LS76	1	
	IC-74LS86	1	
	IC-74LS93	1	
	IC-8T28	2	
	IC-2114-450	2	
	IC-74LS04	1	

27 pieces

BAG G - Video/Cassette Subassembly

where used	Part #	Count	Description
III.1	Y-WA-3SB	1	Video Cassette wiring harness
	IC-CARGEN	1	24 pin chip
	F-005	1	Fuse
		3 pieces	

Stage IV Ic's

BAG H -

where used	Part #	Count	Description
IV.1	IC-6502	1	
	IC-6850	1	
	IC-74LS02	1	
	IC-74LS04	3	
	IC-74LS125	2	
	IC-74LS138	4	
	IC-74LS139	1	
	IC-74LS174	1	
	IC-74LS75	2	
	IC-BASIC1	1	
	IC-BASIC2	1	
	IC-BASIC3	1	
	IC-BASIC4	1	
	IC-SYNMON	1	
	IC-2114	16	
		37 pieces	

Appendix 3

TROUBLE SHOOTING CHART

PROBLEM	POSSIBLE CAUSE
Blank screen on power up	Defective video cable Improper adjustment of R58 Crystal oscillator circuit failure Video timing chain malfunction Defective monitor ROM Defective BASIC 4
Random graphics on power-up (or) BREAK key not functional	Auto Reset Circuit Malfunction (U80, R76-85, C60-62, C64, D25-27, D30-32)
Rolling screen (after monitor vertical hold adjustment)	Malfunction of Vertical sync (U65) or associated circuitry Improper video timing (U61)
Split screen (2 screens, 4 screens)	Improper video timing (U59) Improper video addressing (U53)
Wrong number of free memory bytes	Bad RAM chip Bad RAM select chip
No OK prompt displayed	Bad BASIC 1
No lower case characters	Bad character generator
Goes to monitor but won't cold start	Bad BASIC chip Bad ROM select chip Bad first 1k of RAM
Key does not functon	Bad keybord decoding chip (U2-5, D1-8, D17-24)

EXTERNAL STORAGE OF PROGRAMS

All models of the Challenger 1P line of computers, including the Superboard II, include an audio cassette interface. This interface allows a standard audio cassette recorder to be used for program storage and playback. Although cassette I/O is not as convenient as disk I/O, it provides an inexpensive means of building a permanent library of programs. Moreover, a large library of applications software is available on cassette from Ohio Scientific through your local Ohio Scientific dealer.

CASSETTE STORAGE

In section seven the user learned how to attach a cassette recorder to the Challenger 1P and was introduced to the procedure for loading and running prerecorded or "canned" programs. This section describes the use of both cassettes and diskettes for saving programs.

The following instructions describe how to record a program onto a cassette tape. These instructions can be used to record any BASIC program contained in the workspace whether the program was entered line-by-line through the keyboard or was itself initially loaded from cassette. Recall that the selector switch on the rear panel of the C1P must be set to the left (cassette) postion in order to do SAVEs and LOADs with cassettes.

These instructions can, for example, be used to create a backup of the Sampler tape provided with your cassette based Challenger 1P by loading each program from the Sampler tape and then recording it onto a blank tape.

It is recommended that you use new or thoroughly erased cassettes of good quality for recording programs to avoid noise and other problems associated with old cassettes.

When your program is in the form you wish to save, place a cassette in the recorder and rewind the cassette so that the tape leader is visible on the right-hand spool (or to the point at which you wish to store the program if you are storing more than one program on a cassette). The following sequence of instructons will then store the program on the cassette.

1. Type SAVE <RETURN>.
2. Type NULL8 <RETURN>.
3. Type LIST but <u>do not</u> press <RETURN> yet.
4. Now turn on the tape recorder in the RECORD mode. When the tape (dark brown) begins to wind onto the right-hand spool, wait 5 seconds and press <RETURN>.

The program will begin listing on the screen and to the cassette port. When the last line of the program is listed, wait a few seconds and turn off the recorder. To reset the computer to keyboard input

5. Type in LOAD <RETURN>.
6. Press <SPACE> followed by <RETURN>.

Each cassette should be labeled to identify the contents. If you wish to protect the contents from accidental erasure, break out the appropriate "record protect" tab from the rear edge of the cassette. The sample programs in Section Nine and Ten can be used to practice saving and loading programs.

Programs stored on cassette using the above procedure can be loaded using the technique described in section seven. This procedure can be modified slightly to store programs on cassette in an autorun format. These programs automatically run themselves once they are loaded from cassette. The procedure described above must be modified in the following manner to make an autorun cassette:

1. The first line of the program to be saved must be

   POKE 515, Ø

2. Follow the SAVE prodecure described above only to step 5. Between steps 4 and 5 type in RUN before you turn off the tape recorder, then type LOAD <RETURN>.

Although a cassette recorder provides an inexpensive means of storing programs, the LOAD and SAVE procedures are slow, and keeping track of the location of multiple programs on a cassette can be cumbersome. A mini-floppy disk unit provides a much faster and more convenient method of saving and loading files. The Challenger 1P MF Series 2 is a mini-floppy disk based version of the C1P. In addition to all the features of the standard C1P, it incorporates a single mini-floppy disk drive and 2ØK of RAM. The C1P MF Series 2 comes complete with two disk operating systems—PICO DOS and OS-65D. The extra RAM memory is necessary to use these disk operating systems since these operating systems are themselves stored in RAM each time the disk is loaded.

The PICO DOS or disk operating system uses ROM BASIC. It allows the use of cassette originated programs on diskettes. PICO DOS occupies approximately 4K of RAM and operates with a fixed 8K workspace. Thus PICO DOS can actually be utilized on a C1P system with a 61Ø expander board and 12K of RAM. This is an intermediate growth step between the C1P Series 2 and the C1P MF Series 2.

The OS-65D operating system is a more powerful disk operating system. This disk operating system occupies somewhat over 12K of RAM and uses 9-digit BASIC by Microsoft rather than the built-in ROM BASIC. With 2ØK of RAM, the C1P MF Series 2 has an 8K workspace under the OS-65D disk operating system. With added memory the workspace under OS-65D can be expanded to 2ØK (or a total of 32K RAM).

Mini-floppy diskettes and disk drives are precision pieces of hardware and require reasonable care to insure continued satisfactory performance. Appendix 8 includes some guidelines on the handling of floppy diskettes ad disk drives.

LOADING CASSETTE PROGRAMS

The standard cassette based Challenger 1P and the Superboard II are supplied with a C1P Sampler cassette, which contains a selection of programs illustrating various capabilities of the Challenger 1P system. The following instructions describe how to load and run programs stored on cassette.

With the cassete recorder attached to the C1P as described in section five and the selector switch on the rear panel set to the left position follow the instructions given in section six to enter BASIC-in-ROM. The BASIC prompt OK should be displayed in the lower left corner of the screen. Place the cassette containing the program to be loaded in the recorder and go through the following sequence of instructions:

1. Rewind the cassette until the tape leader is visible.
2. Type in NEW <RETURN>. This erases any program which might currently be stored in the workspace.
3. Type LOAD but do not press <RETURN> yet.
4. Turn on the tape recorder to play the tape. (Remember to set the volume and tone controls at the mid to high ranges.) When the tape (dark brown) begins to wind onto the right-handed spool press <RETURN>.

Within a few moments, the program will begin listing on the screen. Loading of a program usually takes from 1 to 5 minutes depending upon the length of the program being loaded.

5. When the program loading is complete, the following lines will appear on the screen

```
OK
?S ERROR
OK
```

and the cassette recorder can be turned off.

6. To complete the loading of the program press <SPACE> followed by <RETURN>.

The program is now stored in the workspace and can be executed by entering the command RUN or inspected by entering the command LIST.

The above instructions assume that the program to be loaded is the first program on the cassette tape. When more than one program is stored on a cassette, the tape should be advanced to a point just preceding the program to be loaded rather than being rewound. With the Sampler cassette, load the first program and do not rewind the cassette recorder. Once you have run the first program, the tape will be in place to LOAD and RUN the next program on the cassette.

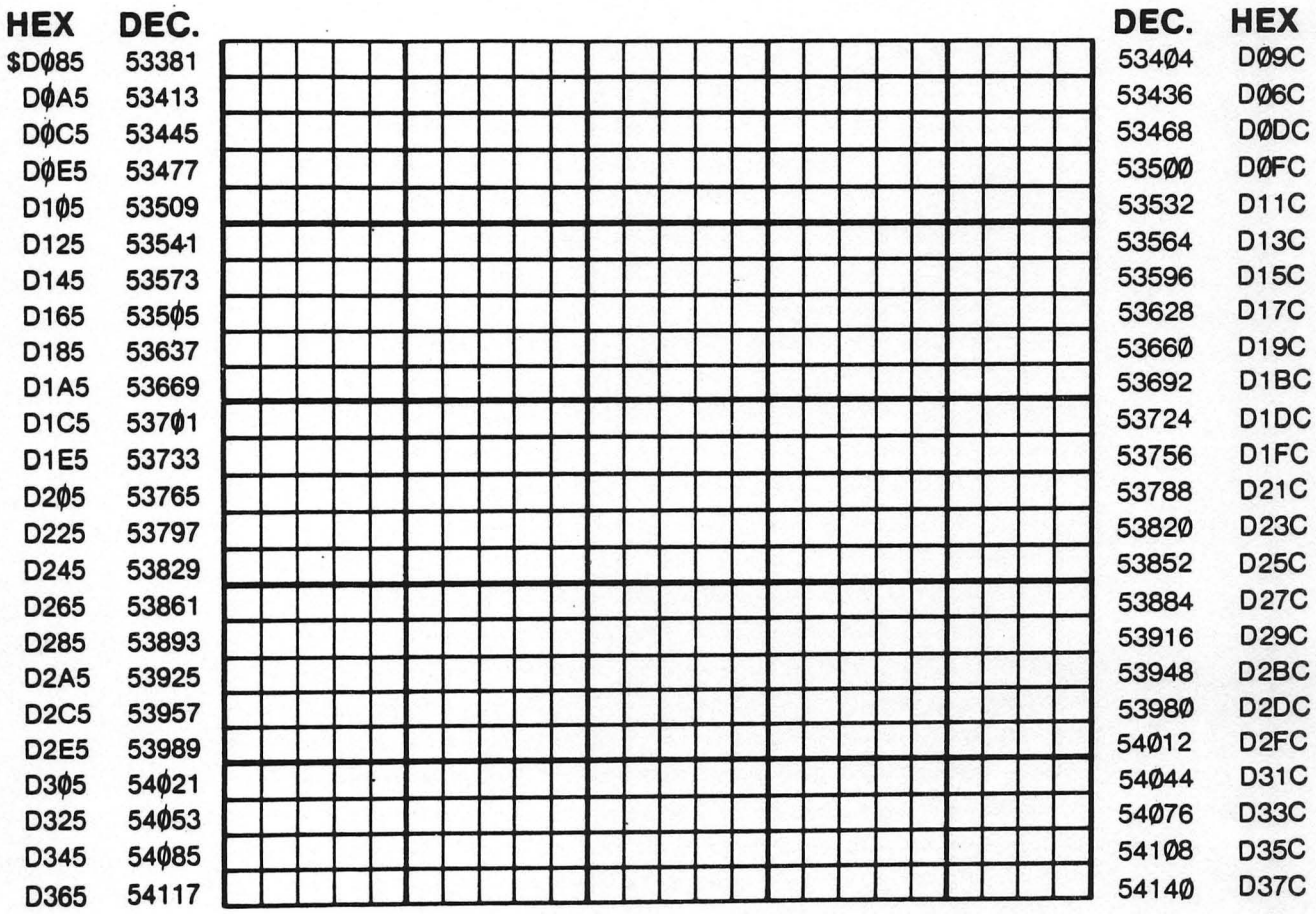


Figure 7: Video Memory Map (24 × 24 Format)

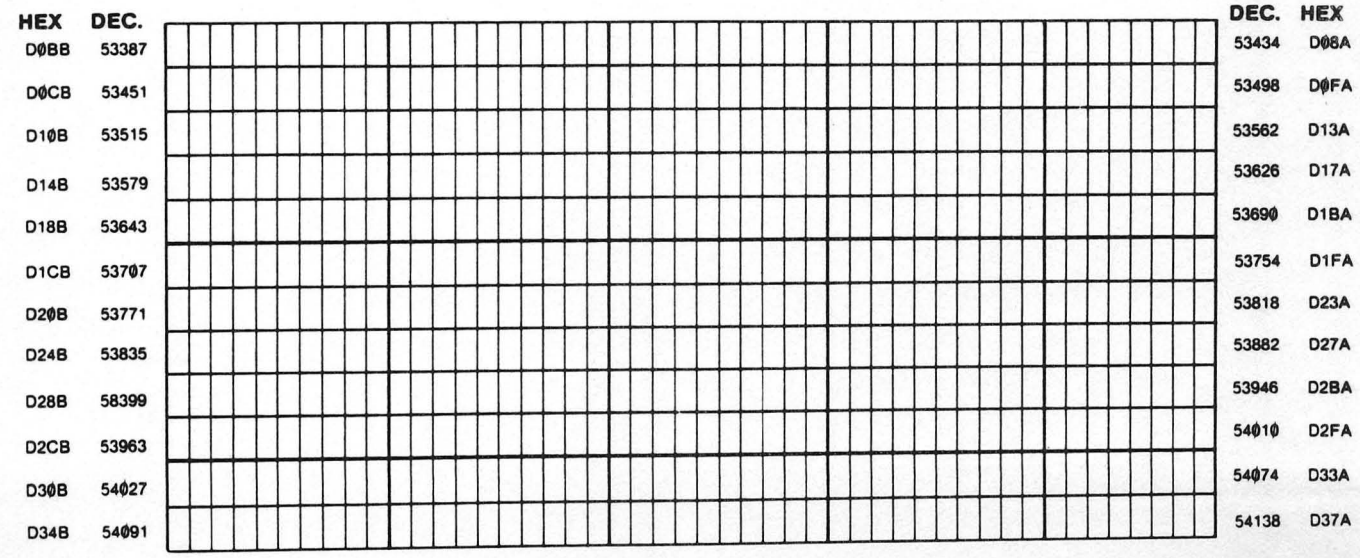
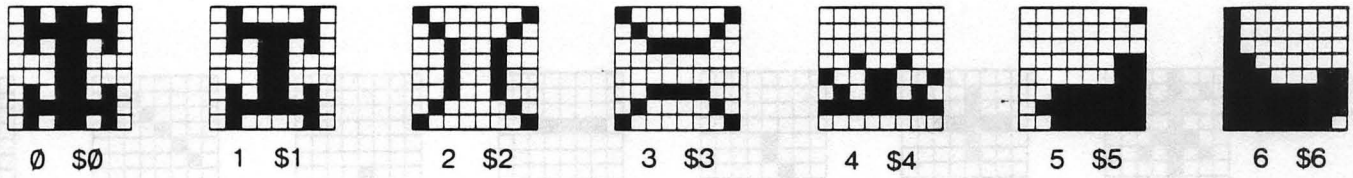
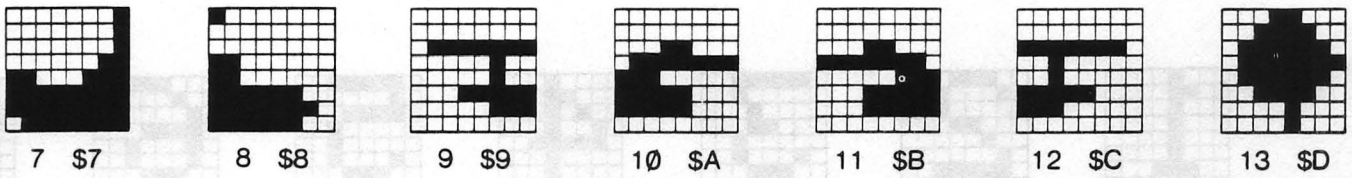


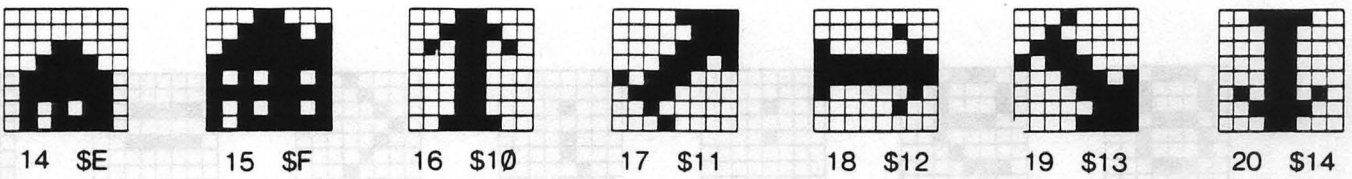
Figure 8: Video Memory Map (12 × 48 Format)

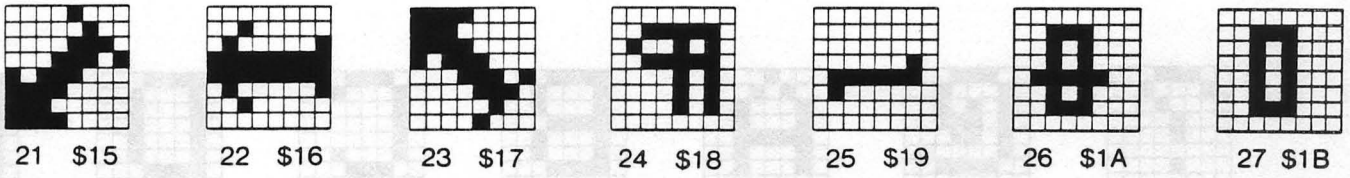
APPENDIX 6

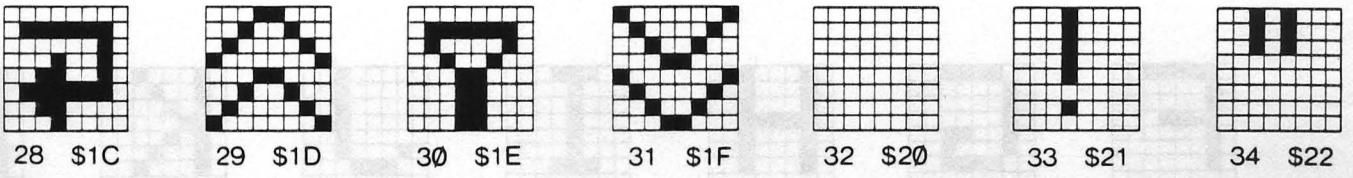
CHARACTER GRAPHICS

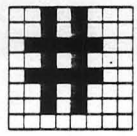


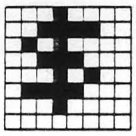


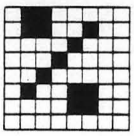


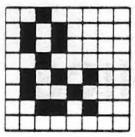


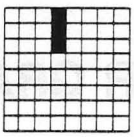



35 $23


36 $24


37 $25


38 $26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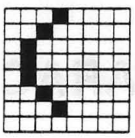
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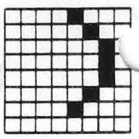
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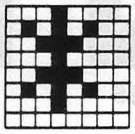
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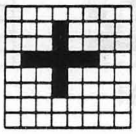
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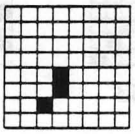
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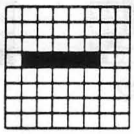
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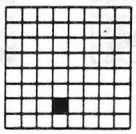
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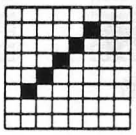
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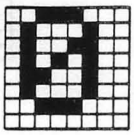
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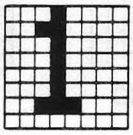
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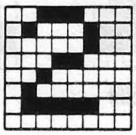
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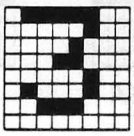
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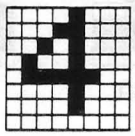
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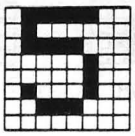
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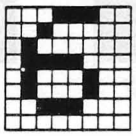
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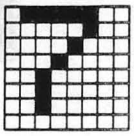
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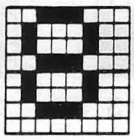
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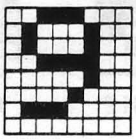
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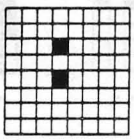
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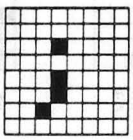
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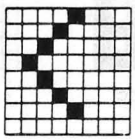
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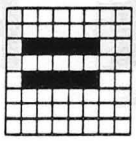
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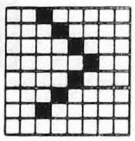
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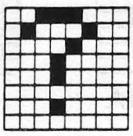
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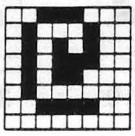
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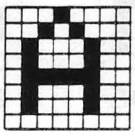
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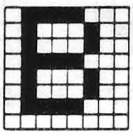
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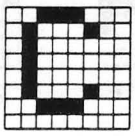
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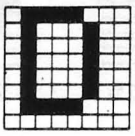
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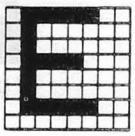
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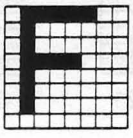
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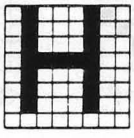
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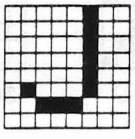
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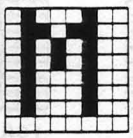
75 $4B

76 $4C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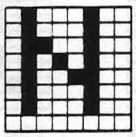
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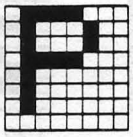
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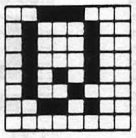
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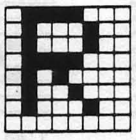
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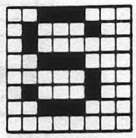
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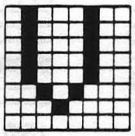
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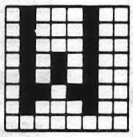
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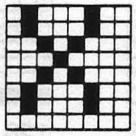
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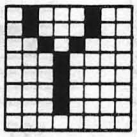
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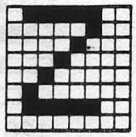
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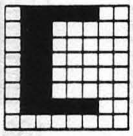
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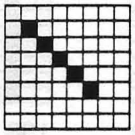
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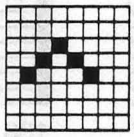
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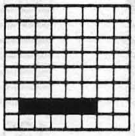
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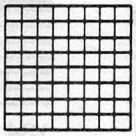
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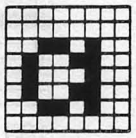
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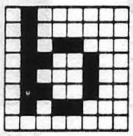
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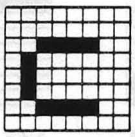
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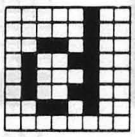
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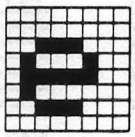
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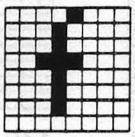
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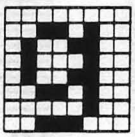
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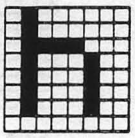
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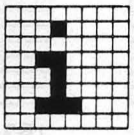
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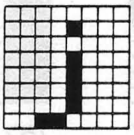
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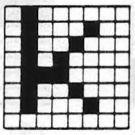
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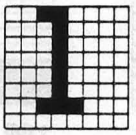
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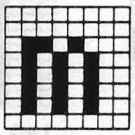
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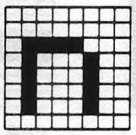
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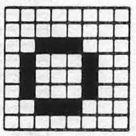
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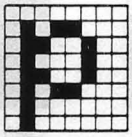
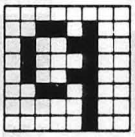

112 $7Ø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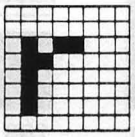
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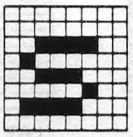
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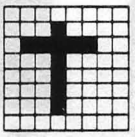
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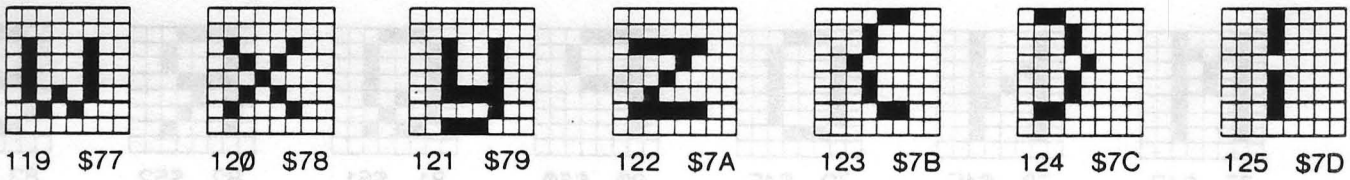
117 $75

118 $76



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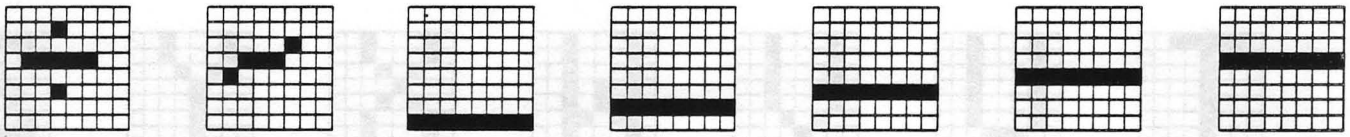

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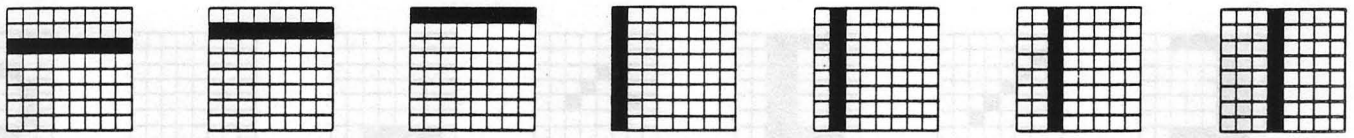

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147 $93 148 $94 149 $95 150 $96 151 $97 152 $98 153 $99

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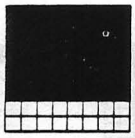
161 $A1


162 $A2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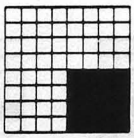
164 $A4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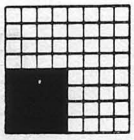
166 $A6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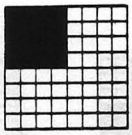
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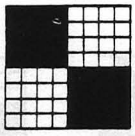
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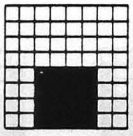
170 $AA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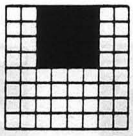
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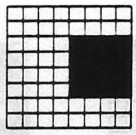
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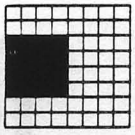
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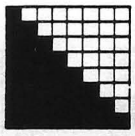
175 $AF

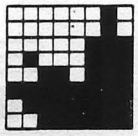

176 $B0


177 $B1

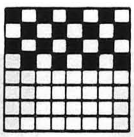

178 $B2


179 $B3


180 $B4


181 $B5


182 $B6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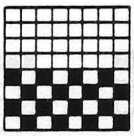
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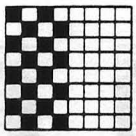
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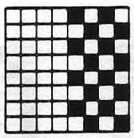
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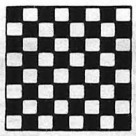
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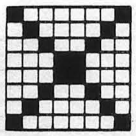
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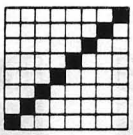
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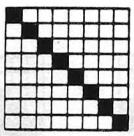
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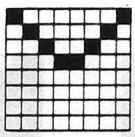
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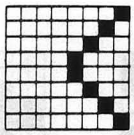
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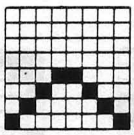
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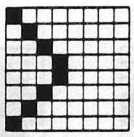
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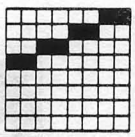
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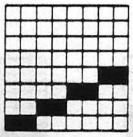
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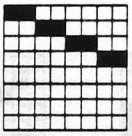
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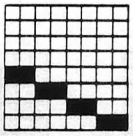
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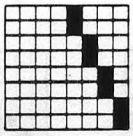
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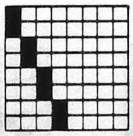
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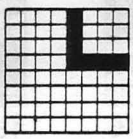
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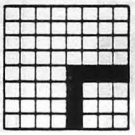
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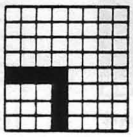
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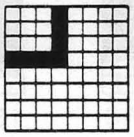
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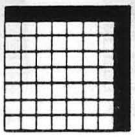
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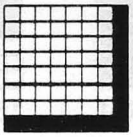
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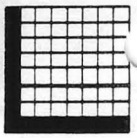
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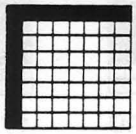
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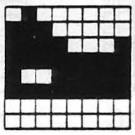
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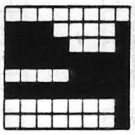
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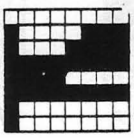
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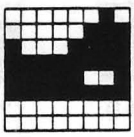
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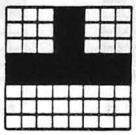
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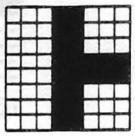
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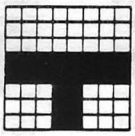
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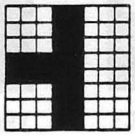
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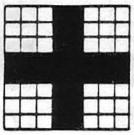
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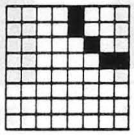
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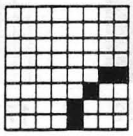
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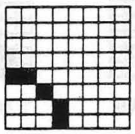
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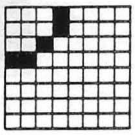
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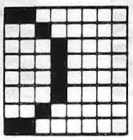
224 $E0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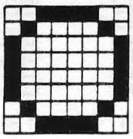
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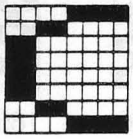
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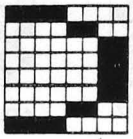
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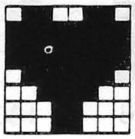
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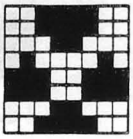
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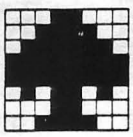
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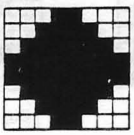
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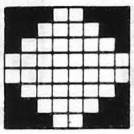
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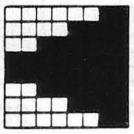
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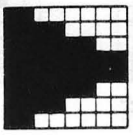
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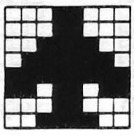
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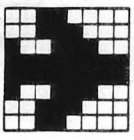
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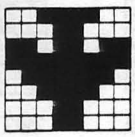
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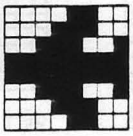
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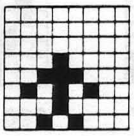
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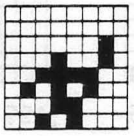
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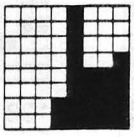
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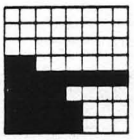
243 $F3

244 $F4


245 $F5


246 $F6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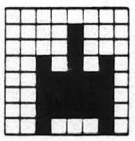
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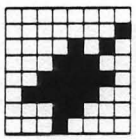
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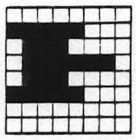
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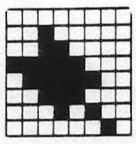
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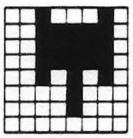
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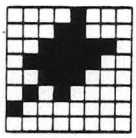
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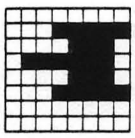
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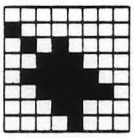

255 $FF

Appendix 7

BASIC-IN-ROM ERROR CODES

	CODE		DEFINITION
DD	D		Double Dimension: Variable dimensioned twice. Remember subscripted variables default to dimension 10.
FC	F		Function Call error: Parameter passed to function out of range.
ID	I		Illegal Direct: Input or DEFIN statements can not be used in direct mode.
NF	N		NEXT without FOR:
OD	O		Out of Data: More reads than DATA
OM	O		Out of Memory: Program too big or too many GOSUBs, FOR NEXT loops or variables
OV	O		Overflow: Result of calculation too large for BASIC.
SN	S		Snytax error: Typo, etc.
RG	R		RETURN without GOSUB
US	U		Undefined Statement: Attempt to jump to non-existent line number
/Ø	/		Division by Zero
CN	C		Continue errors: attempt to inappropriately continue from BREAK or STOP
LS	L		Long String: String longer than 255 characters
OS	O		Out of String Space: Same as OM
ST	S		String Temporaries: String expression too complex.
TM	T		Type Mismatch: String variable mismatched to numeric variable
UF	U		Undefined Function

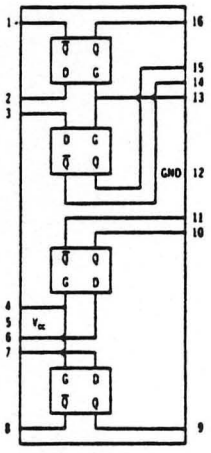
MEMORY MAP

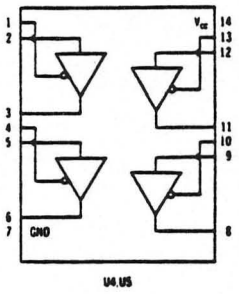
CHALLENGER 1P MEMORY MAP (BASIC-IN-ROM CONFIGURATION)

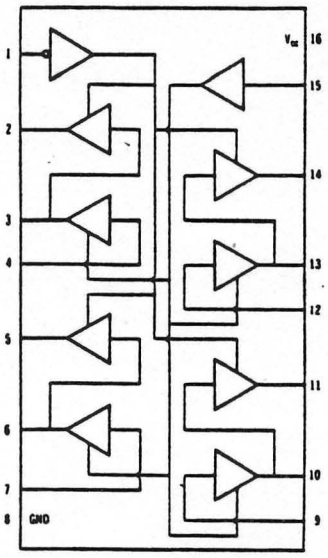
0000—00FF	Page Zero
0100—01FF	Stack
*0130	NMI Vector
*01C0	IRQ Vector
0200—0221	BASIC Flags and Vectors
*0203	LOAD Flag
*0205	SAVE Flag
*0218	Input Vector
*021A	Output Vector
*021C	Control C Check Vector
*021E	LOAD Vector
*0220	SAVE Vector
0222—02FA	Unused
0300 end of RAM	BASIC Workspace
A000—BFFF	BASIC-in-ROM
D000—D3FF	Video RAM
DF00	Polled Keyboard
F000—F001	ACIA Serial Cassette Port
F800—FBFF	ROM
FC00—FCFF	ROM—Floppy Bootstrap
FD00—FDFF	ROM—Polled Keyboard Input Routine
FE00—FEFF	ROM—65V Monitor
FF00—FFFF	ROM—BASIC Support
*FFFA	NMI Vector
*FFFC	Reset Vector
*FFFE	IRQ Vector

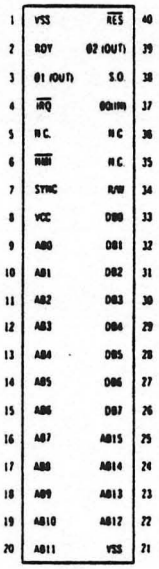
Appendix 9

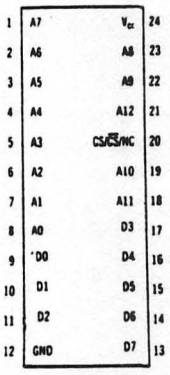
SUPERBOARD II/600 BOARD PINOUTS

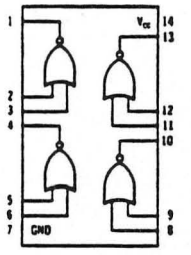


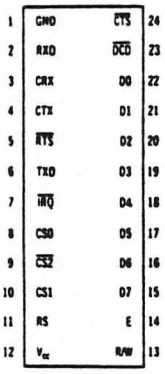


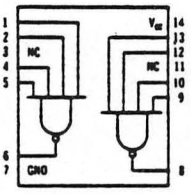


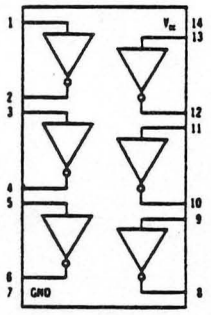


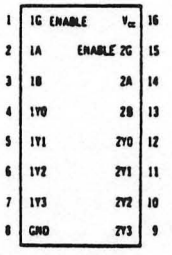


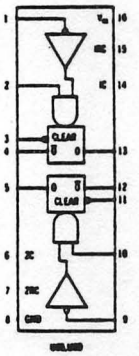


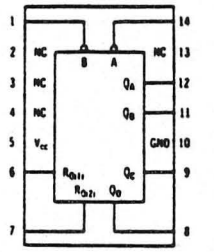


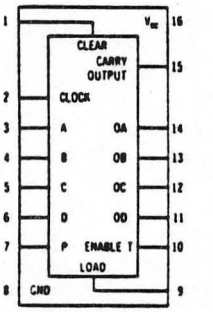


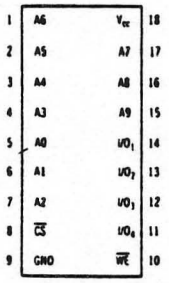


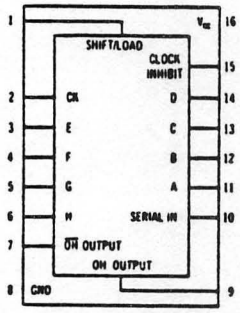


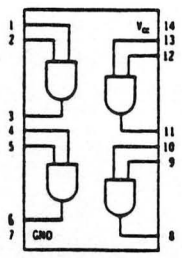


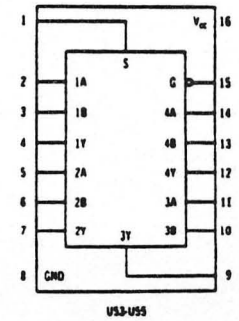


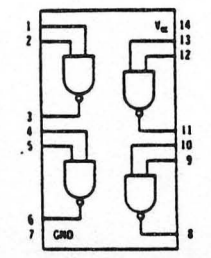


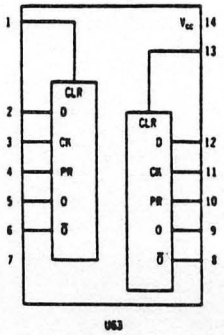


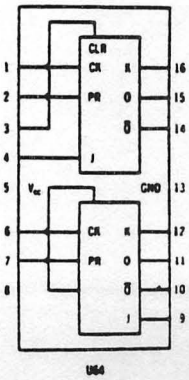










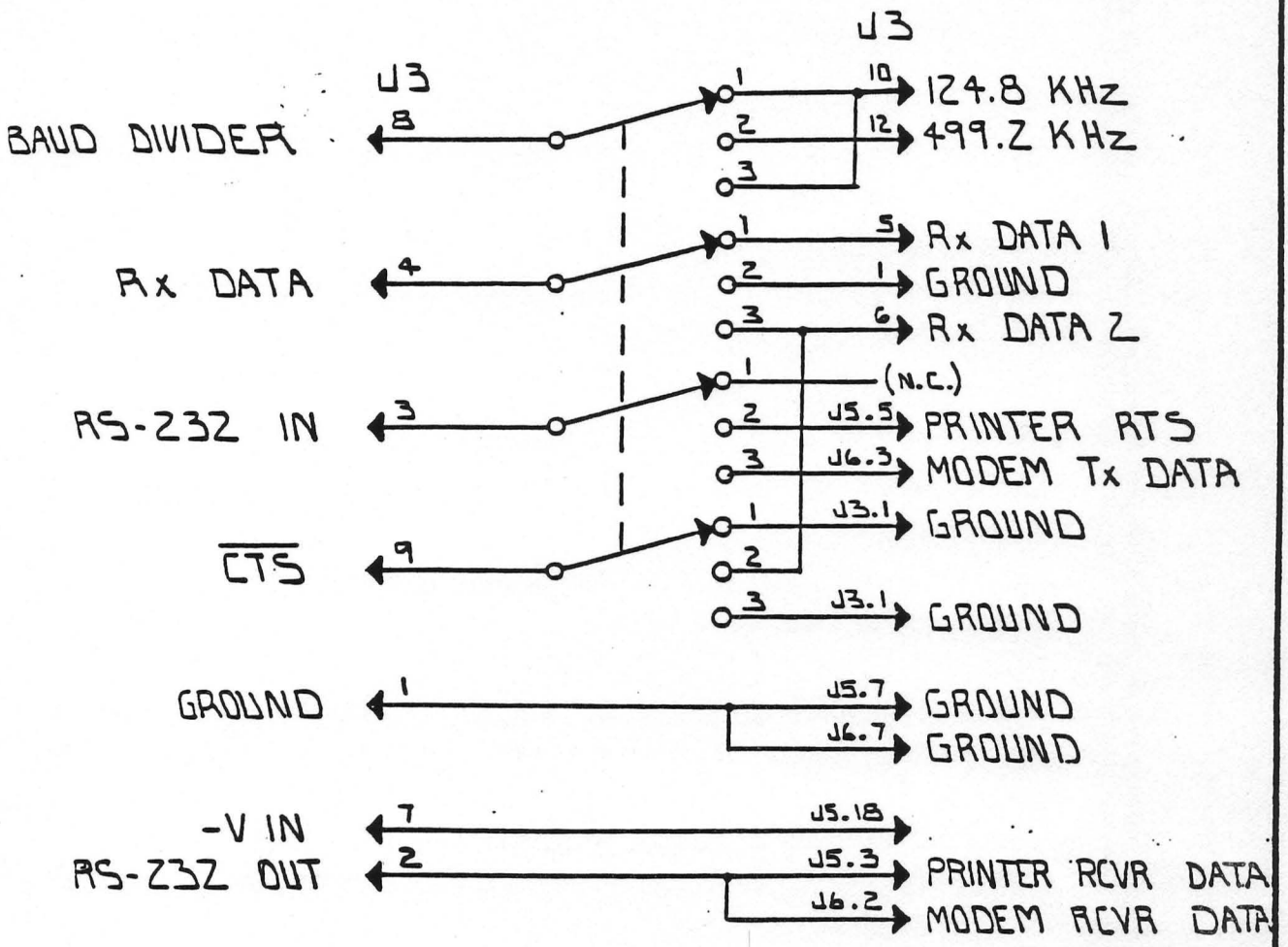


Appendix 10

LEGEND FOR 600 BOARD SCHEMATIC

A0-A15.....Address
ACS.....ACIA Chip Select
AUX.....Auxiliary for Tape
AD0-BD7.....Buffered Data
bRTS.....Transmit Data
BS.....Basic Rom Select
BS0-BS3
CN0-CN7.....Column
C0-C15.....Count
CLK.....Clock
CTS.....Clear to Send
D.....Data
DB.....Video Data Blanking
DD.....Data Direct
HS.....Horizontal Sync.
IRQ.....Interrupt Request
MIC.....Microphone for Tape
MCS.....Monitor Chip Select
VRCS.....Video RAM Chip Select
NMI.....Non-maskable Chip Select
R.....Row
RKB.....Read Keyboard
RS0-RS7.....Ram Select
RVE.....Read Video Enable
R/W.....Read/Write
RX CLK.....Receive Clock
RX DATA.....Receive Data
T1-T4.....Time (Clock) Delays
TX CLK.....Transmit Clock
TX DATA.....Transmit Data
V.....Video
VA.....Video Address
VD.....Video Data
VS.....Vertical Sync.
WKB.....Write Keyboard
WVE.....Write Video Enable
Ø0.....Microprocessor Clock In
Ø2.....Phase Two
NC.....No Connection

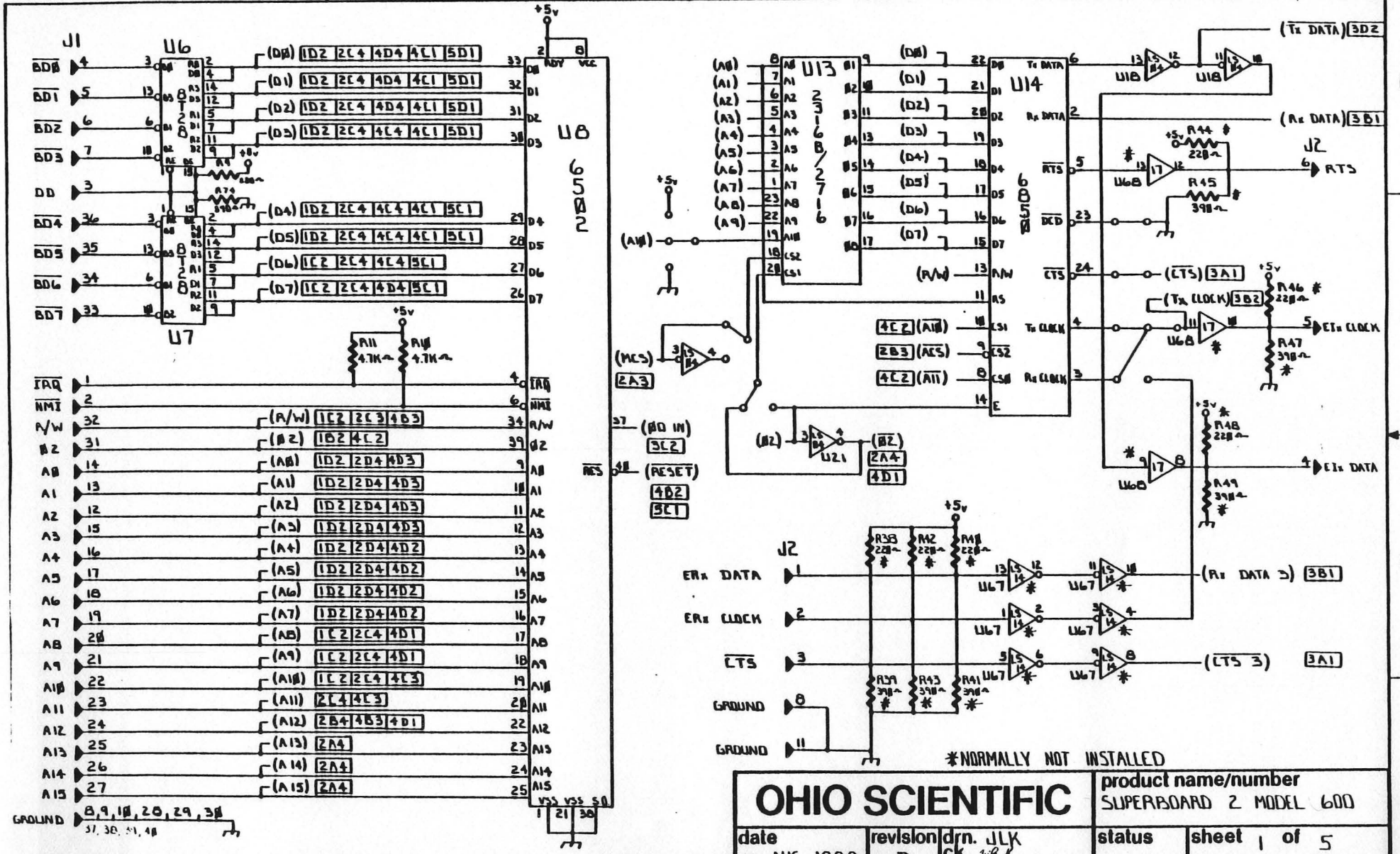
Any $\overline{\text{Bar}}$ above any alphabetical or numerical combination indicates line active in a low (0) state.



J3 IS 12 PIN MOLEX ON 600 BOARD
J5 IS RS-232 DELTA FOR PRINTER
J6 IS RS-232 DELTA FOR MODEM

SWITCH WIRING FOR PRINTER, MODEM, OR CASSETTE OPERATION OF 600 BOARD

OHIO SCIENTIFIC			product name/number CIP SERIES II	
date 21 OCT 1980	revision	page	status	sheet 1 of 1



OHIO SCIENTIFIC				product name/number SUPERBOARD 2 MODEL 600	
date 28 AUG 1980	revision D	drn. JLK ck. app.		status	sheet 1 of 5

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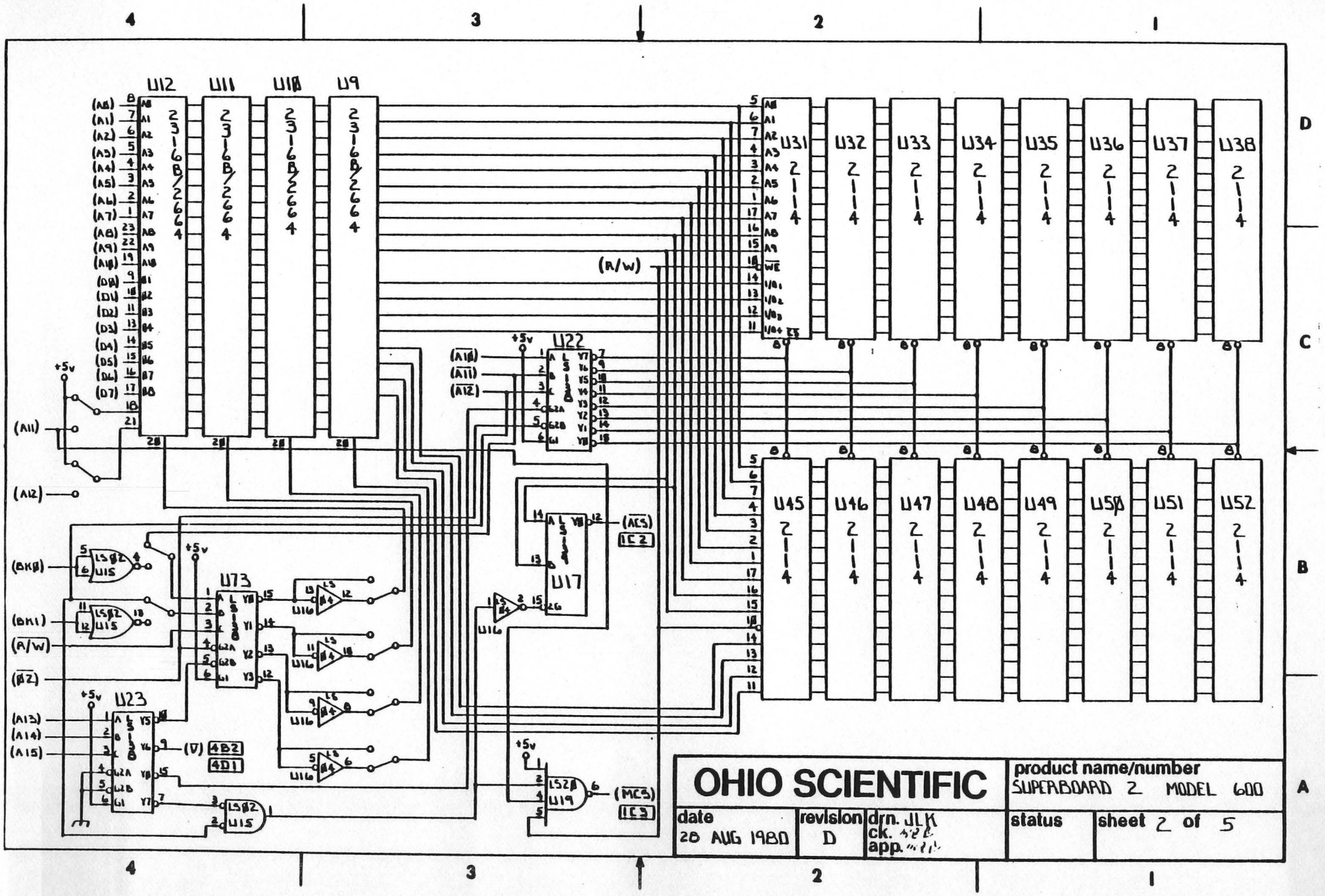
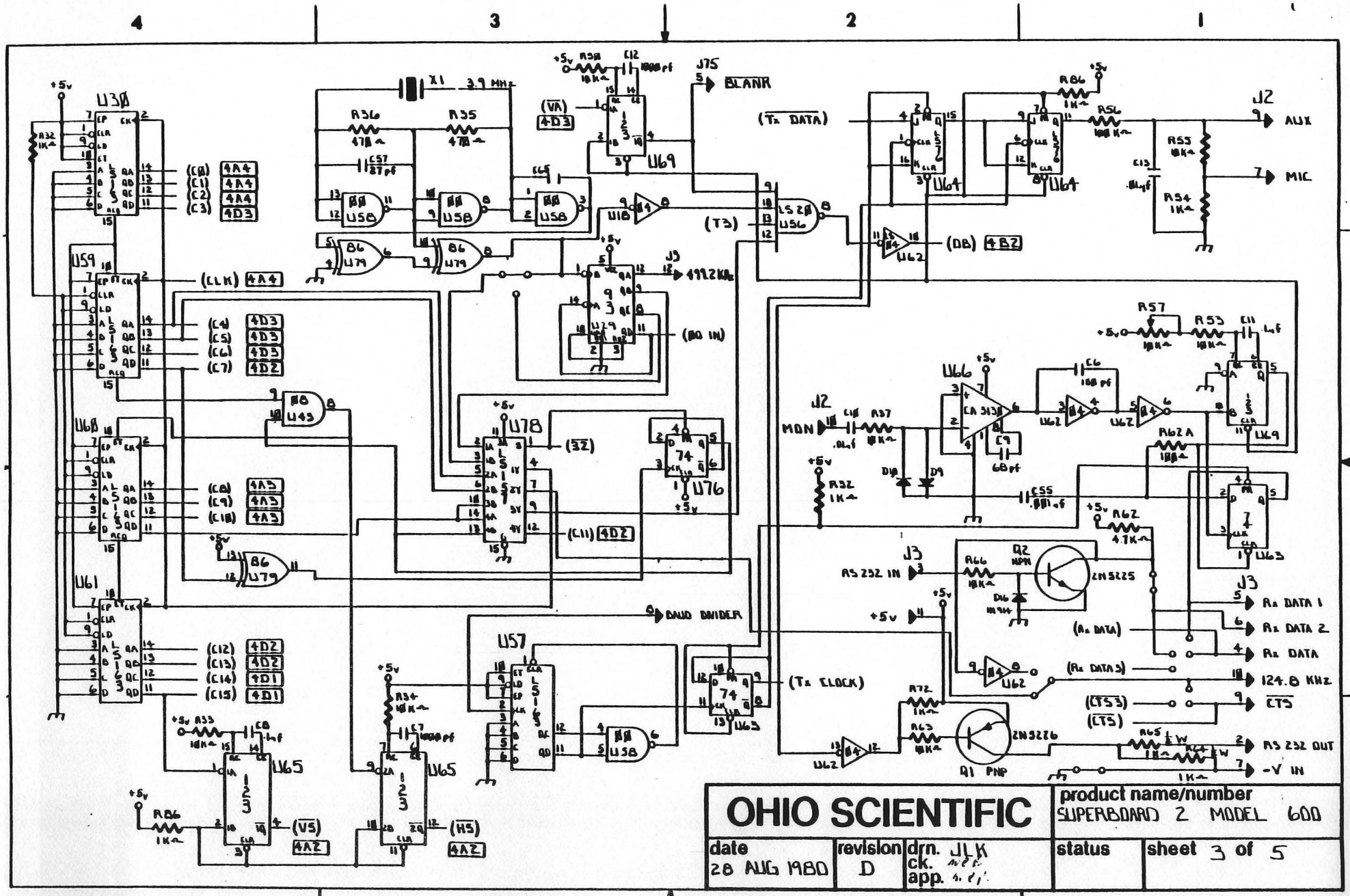
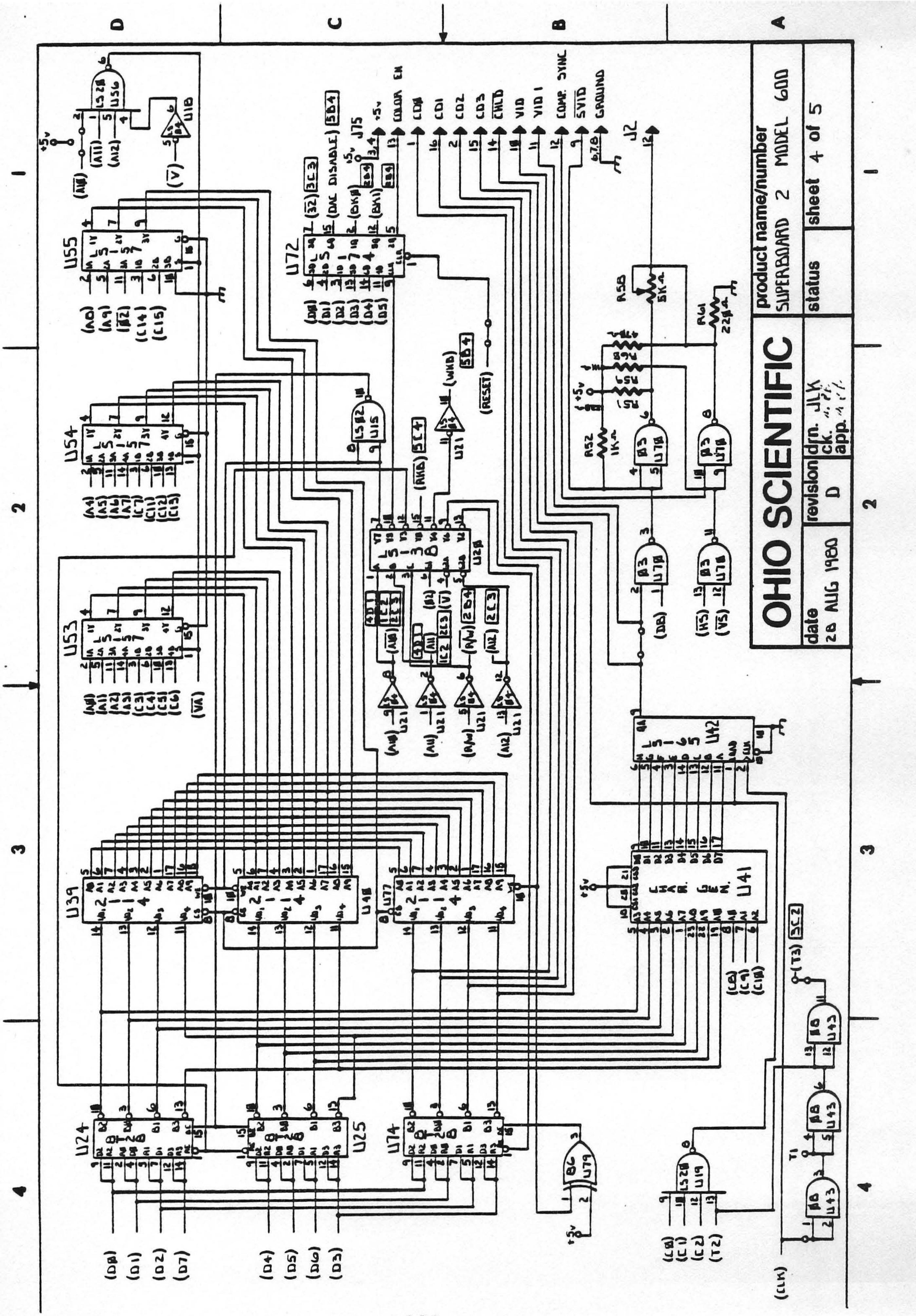
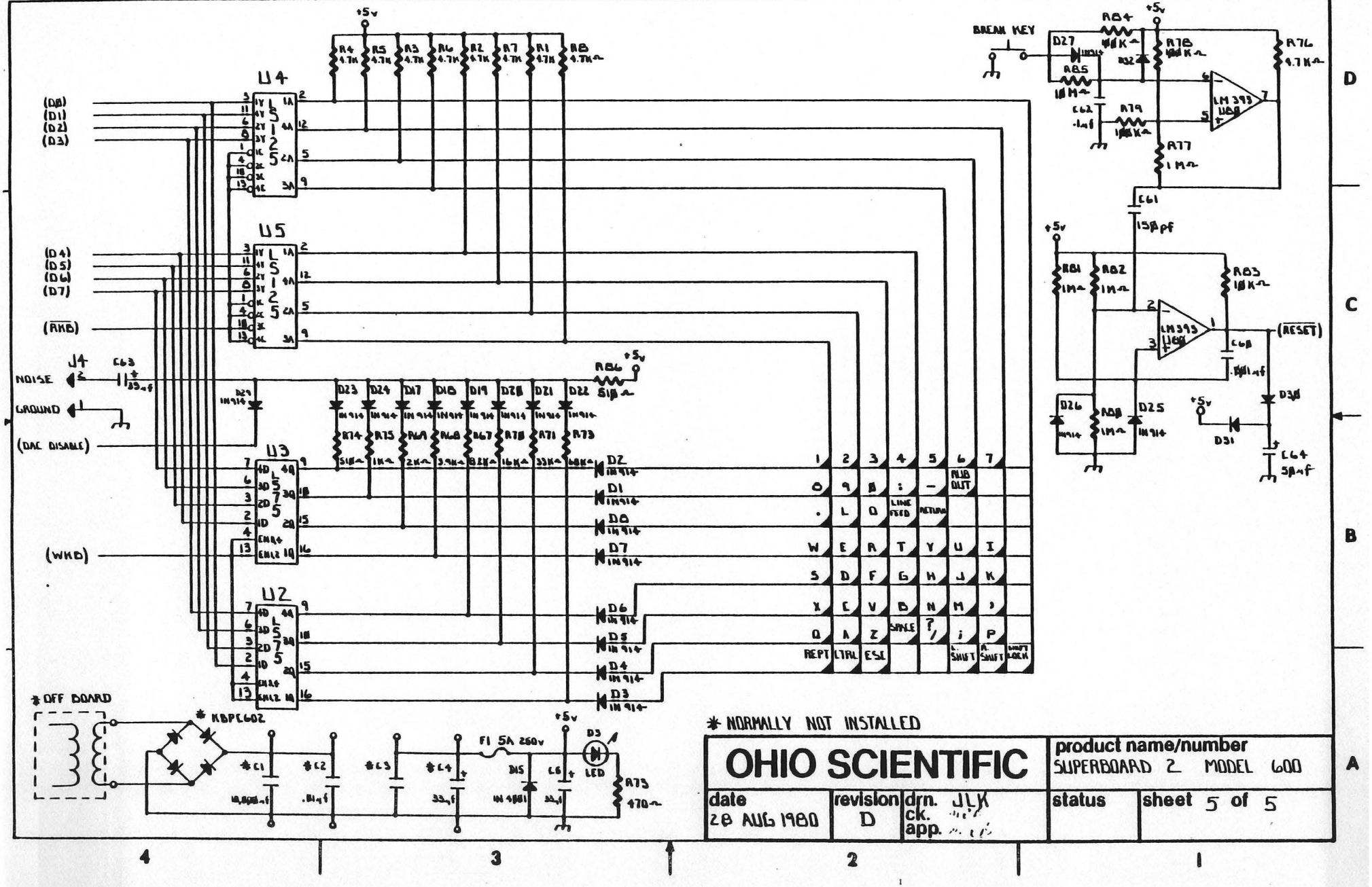

U12
U11
U10
U9
2316B/2664
U31
U32
U33
U34
U35
U36
U37
U38
2114
U45
U46
U47
U48
U49
U50
U51
U52
U22
U17
U16
U73
U23
U15
U19
(R/W)
(A11)
(A12)
(A13)
(A14)
(A15)
(A10)
(A11)
(A12)
(BK0)
(BK1)
(R/W)
(B2)
(V)
4B2
4D1
(ACS)
1C2
(MCS)
1C9
+5v
OHIO SCIENTIFIC
product name/number
SUPERBOARD 2 MODEL 600
date
20 AUG 1980
revision
D
drn. JLK
ck.
app.
status
sheet 2 of 5


OHIO SCIENTIFIC
product name/number
SUPERBOARD 2 MODEL 600
date
28 AUG 1980
revision
D
drn. JLK
ck.
app.
status
sheet 3 of 5
BLANR
AUX
MIC
AS 232 IN
AS 232 OUT
-V IN
BAUD DIVIDER
124.8 KHz
CTS
MON
X1 3.9 MHz


OHIO SCIENTIFIC
product name/number
SUPERBOARD 2 MODEL 600
sheet 4 of 5
status
revision D
date 28 AUG 1980
drn. JLK
ck.
app.


U4
U5
U3
U2
(D0)
(D1)
(D2)
(D3)
(D4)
(D5)
(D6)
(D7)
(RKB)
(WKB)
J4
NOISE
GROUND
(DAC DISABLE)
BREAK KEY
(RESET)
* OFF BOARD
* KBPC602
F1 5A 250v
D3 LED
R73 470Ω
* NORMALLY NOT INSTALLED
OHIO SCIENTIFIC
product name/number
SUPERBOARD 2 MODEL 600
date
28 AUG 1980
revision
D
drn. JLK
ck.
app.
status
sheet 5 of 5

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600 BOARD PARTS LIST AND DESCRIPTION (CONTINUED)

(When ordering parts, state Model, Part Number, and Description.)

CAPACITORS

ITEM No.	RATING	MFGR. PART No.	REPLACEMENT DATA			
			CORNELL-DUBILIER PART No.	MALLORY PART No.	SPRAGUE PART No.	
					Q-LINE	GENERAL LINE
C6	150pF 5%	C-151	CD15FD151J03	SX315	QW1-31	MWA-151
C7	.001 100V 10%	C-102	CD19FD102J03	SX210	QW1-51	MWC-102
C8	.1 50V 10%	C-104	WMF05P1	EWF05010		431P1049R5
C9	68pF 5%	C-680	CD15ED680J03	SX468	QW1-23	MWA-680
C10	.01 100V 10%	C-103	WMF1S1	EWF1A110	QF1-91	1PB-S10
C11	.1 50V 10%	C-104	WMF05P1	EWF05010		431P1049R5
C12	.001 100V 10%	C-102	CD19FD102J03	SX210	QW1-51	MWC-102
C13	.01 100V 10%	C-103	WMF1S1	EWF1A110	QF1-91	1PB-S10
C21	.1 10V	CB-10410	MGP1	MAG1201	QC1-223	HY-360
C22	.1 10V	CB-10410	MGP1	MAG1201	QC1-223	HY-360
C23	.1 10V	CB-10410	MGP1	MAG1201	QC1-223	HY-360
C24	.1 10V	CB-10410	MGP1	MAG1201	QC1-223	HY-360
C25	.1 10V	CB-10410	MGP1	MAG1201	QC1-223	HY-360
C26	.1 10V	CB-10410	MGP1	MAG1201	QC1-223	HY-360
C27	.1 10V	CB-10410	MGP1	MAG1201	QC1-223	HY-360
C28	.1 10V	CB-10410	MGP1	MAG1201	QC1-223	HY-360
C29	.1 10V	CB-10410	MGP1	MAG1201	QC1-223	HY-360
C30	.1 10V	CB-10410	MGP1	MAG1201	QC1-223	HY-360
C32	.1 10V	CB-10410	MGP1	MAG1201	QC1-223	HY-360
C33	.1 10V	CB-10410	MGP1	MAG1201	QC1-223	HY-360
C35	.1 10V	CB-10410	MGP1	MAG1201	QC1-223	HY-360
C36	.1 10V	CB-10410	MGP1	MAG1201	QC1-223	HY-360
C37	.1 10V	CB-10410	MGP1	MAG1201	QC1-223	HY-360
C38	.1 10V	CB-10410	MGP1	MAG1201	QC1-223	HY-360
C39	.1 10V	CB-10410	MGP1	MAG1201	QC1-223	HY-360
C40	.1 10V	CB-10410	MGP1	MAG1201	QC1-223	HY-360
C41	.1 10V	CB-10410	MGP1	MAG1201	QC1-223	HY-360
C42	.1 10V	CB-10410	MGP1	MAG1201	QC1-223	HY-360
C43	.1 10V	CB-10410	MGP1	MAG1201	QC1-223	HY-360
C44	.1 10V	CB-10410	MGP1	MAG1201	QC1-223	HY-360
C45	.1 10V	CB-10410	MGP1	MAG1201	QC1-223	HY-360
C46	.1 10V	CB-10410	MGP1	MAG1201	QC1-223	HY-360
C47	.1 10V	CB-10410	MGP1	MAG1201	QC1-223	HY-360
C48	.1 10V	CB-10410	MGP1	MAG1201	QC1-223	HY-360
C49	.1 10V	CB-10410	MGP1	MAG1201	QC1-223	HY-360
C50	.1 10V	CB-10410	MGP1	MAG1201	QC1-223	HY-360
C51	.1 10V	CB-10410	MGP1	MAG1201	QC1-223	HY-360
C52	.1 10V	CB-10410	MGP1	MAG1201	QC1-223	HY-360
C53	.1 10V	CB-10410	MGP1	MAG1201	QC1-223	HY-360
C54	.1 10V	CB-10410	MGP1	MAG1201	QC1-223	HY-360
C55	.001 100V 10%	C-102				
C56	.1 10V		MGP1	MAG1201	QC1-223	HY-360
C57	27pF 1KV 10%	C-270				
C58	.1 10V	CB-10410	MGP1	MAG1201	QC1-223	HY-360
C59	.1 10V	CB-10410	MGP1	MAG1201	QC1-223	HY-360

RESISTORS

ITEM No.	RATING	REPLACEMENT DATA	
		MFGR. PART No.	WORKMAN PART No.
R1	4700 1/4W 5%	R1-472	22-1112
R2	4700 1/4W 5%	R1-472	22-1112
R3	4700 1/4W 5%	R1-472	22-1112
R4	4700 1/4W 5%	R1-472	22-1112
R5	4700 1/4W 5%	R1-472	22-1112
R6	4700 1/4W 5%	R1-472	22-1112
R7	4700 1/4W 5%	R1-472	22-1112
R8	4700 1/4W 5%	R1-472	22-1112
R9	220 1/4W 5%	R1-221	22-1080
R10	4700 1/4W 5%	R1-472	22-1112
R11	4700 1/4W 5%	R1-472	22-1112
R12	4700 1/4W 5%	R1-472	22-1112
R32	1000 1/4W 5%	R1-102	22-1096
R33	10K 1/4W 5%	R1-103	22-1120
R34	10K 1/4W 5%	R1-103	22-1120
R35	470 1/4W 5%	R1-471	22-1088
R36	470 1/4W 5%	R1-471	22-1088
R37	10K 1/4W 5%	R1-103	22-1120
R38	220 1/4W 5%	R1-221	22-1080
R39	390 1/4W 5%	R1-391	22-1086
R40	220 1/4W 5%	R1-221	22-1080
R41	390 1/4W 5%	R1-391	22-1086
R42	220 1/4W 5%	R1-221	22-1080
R43	390 1/4W 5%	R1-391	22-1086
R44	220 1/4W 5%	R1-221	22-1080
R45	390 1/4W 5%	R1-391	22-1086
R46	220 1/4W 5%	R1-221	22-1080

ITEM No.	RATING	REPLACEMENT DATA	
		MFGR. PART No.	WORKMAN PART No.
R47	390 1/4W 5%	R1-391	22-1086
R48	220 1/4W 5%	R1-221	22-1080
R49	390 1/4W 5%	R1-391	22-1086
R50	15K 1/4W 5%	R1-153	22-1124
	10K 1/4W 5%	R1-103	22-1120
R51	220 1/4W 5%	R1-221	22-1080
R52	1000 1/4W 5%	R1-102	22-1096
R53	10K 1/4W 5%	R1-103	22-1120
R54	1000 1/4W 5%	R1-102	22-1096
R55	10K 1/4W 5%	R1-103	22-1120
R56	100K 1/4W 5%	R1-104	22-1144
R59	1000 1/4W 5%	R1-102	22-1096
R60	470 1/4W 5%	R1-471	22-1088
R61	220 1/4W 5%	R1-221	22-1080
R62	4700 1/4W 5%	R1-472	22-1112
R62A	100 1/4W 5%	R1-101	22-1072
R63	10K 1/4W 5%	R1-103	22-1120
R64	10K 1/4W 5%	R1-103	22-1120
R65	470 1/4W 5%	R1-471	22-1088
R66	10K 1/4W 5%	R1-103	22-1120
R67			
R68			
R69			
R70			
R71			
R72	1000 1/4W 5%	R1-102	22-1096
R73	220 1/4W 5%	R1-221	22-1080
R74	390 1/4W 5%	R1-391	22-1086

CONTROLS (All wattages 1/2 watt, or less, unless listed)

ITEM No.	FUNCTION	RESISTANCE	REPLACEMENT DATA		
			MFGR. PART No.	MALLORY PART No.	TRW PART No.
R57	Duration (Tape Pulse)	10K	RP-103		
R58	Video	5000	RP-502		

600 BOARD PARTS LIST AND DESCRIPTION

(When ordering parts, state Model, Part Number, and Description.)

SEMICONDUCTORS (Select replacement transistor for best results)

ITEM No.	TYPE No.	MFGR. PART No.	REPLACEMENT DATA							
			GENERAL ELECTRIC PART No.	MALLORY PART No.	RAYTHEON PART No.	RCA PART No.	SYLVANIA PART No.	THORDARSON PART No.	WORKMAN PART No.	ZENITH PART No.
D1-D10	1N914	Q-1N914	GE-514	PTC214	REN 177	SK3100/519	ECG519	TM519	WEP925/519	103-131
D15	1N4001	Q-1N4001	GE-504A	1N4001	REN 116	SK3312	ECG116	TM116	WEP156	212-76-02
D16	1N914		GE-514	PTC214	REN 177	SK3100/519	ECG519	TM519	WEP925/519	103-131
D17-D20	1N914		GE-514	PTC214	REN 177	SK3100/519	ECG519	TM519	WEP925/519	103-131
Q1										
Q2										
U2-U3	SN74LS75N	IC-74LS75				SK74LS75	ECG74LS75	TM74LS75		
U4-U5	74125N						ECG74125	TM74125		
	74LS125	IC-74LS125					ECG74125	TM74125		
U6-U7	MC8T28P	IC-8T28								
U8	6502	IC-6502								
U9	BASIC 1	IC-8ASIC 1								
U10	BASIC 2	IC-8ASIC 2								
U11	BASIC 3	IC-8ASIC 3								
U12	BASIC 4	IC-8ASIC 4								
U13	SYN600	IC-SYN600								
	2316B									
	2716(1)									
U14	S6850P	IC-6850								
U15	74LS02N	IC-74LS02				SK74LS02	ECG74LS02	TM74LS02	WEP7402/7402	
U16	74LS04PC	IC-74LS04				SK74LS04	ECG74LS04	TM74LS04		221-Z9076
U17	SN74LS139N	IC-74LS139								
U18	74LS04PC	IC-74LS04	GE-7404			SK74LS04	ECG74LS04	TM74LS04		221-Z9076
U19	SN74LS20J	IC-74LS20				SK74LS20	ECG74LS20	TM74LS20		
U20	SN74LS138N	IC-74LS138				SK74LS138	ECG74LS138	TM74LS138		
U21	74LS04PC	IC-74LS04				SK74LS04	ECG74LS04	TM74LS04		
U22-U23	74LS138N	IC-74LS138				SK74LS138	ECG74LS138	TM74LS138		
U24-U25	MC8T28P	IC-8T28								
U29	7492		GE-7492			SK7492	ECG7492	TM7492		
	74LS92									
U30	74163N						ECG74163	TM74163		
	74LS163	IC-74LS163				SK74LS163	ECG74LS163A	TM74LS163A		
U31-U40	L2114-550	IC-L2114-550								
U41	CARGENV1.0	IC-CARGEN								
U42	SN74LS165N	IC-74LS165					ECG74165	TM74165		
U43	7408N	IC-7408	GE-7408			SK7408	ECG7408	TM7408	WEP7408/7408	
U44	-	PROTO								
U45-U52	L2114-550	IC-L2114-550								
U53-U55	74LS157N	IC-74LS157				SK74LS157	ECG74LS157	TM74LS157		
U56	SN74LS20J	IC-74LS20				SK74LS20	ECG74LS20	TM74LS20		
U57	74LS163N	IC-74LS163				SK74LS163	ECG74LS163A	TM74LS163		
U58	DM7400N	IC-7400	GE-7400		REN 7400	SK74LS00	ECG7400	TM7400	WEP7400/7400	221-Z9075
	74LS00					SK74LS00	ECG74LS00	TM74LS00	WEP7400/7400	
U59-U61	74163N	IC-74LS163					ECG74163	TM74163		
	74LS163					SK74LS163	ECG74LS163A	TM74LS163A		
U62	F5404DM									
	7404		GE-7404			SK7404	ECG7404	TM7404		221-Z9076
U63	SN7474N	IC-74LS74	GE-7474		REN 7474	SK7474	ECG7474	TM7474	WEP7474/7474	
	74LS74					SK74LS74	ECG74LS74A	TM74LS74A		
U64	SNC5476J									
	7476		GE-7476			SK7476	ECG7476	TM7476	WEP7476/7476	
	74LS76									
U65	SN74123N	IC-74123	GE-74123		REN 74123	SK74123	ECG74123	TM74123		221-Z9086
	74LS123					SK74LS123	ECG74LS123	TM74LS123		
U66	CA3130S	IC-3130				SK3568				
U69	SN74123N	IC-74123	GE-74123		REN 74123	SK74123	ECG74123	TM74123		221-Z9086
	74LS123					SK74LS123	ECG74LS123	TM74123		
U70	7403N	IC-7403					ECG7403	TM7403		
	74LS03					SK74LS03	ECG74LS03	TM74LS03		

ELECTROLYTIC CAPACITORS

ITEM No.	RATING	REPLACEMENT DATA				
		MFGR. PART No.	CORNELL-DUBILIER PART No.	MALLORY PART No.	SPRAGUE PART No.	
					Q-LINE	GENERAL LINE
C5	47 16V 33	C-506	WBR50-25 WBR35-50	TT25X50A TT15X30A	QE1-353 QE1-309	TVA-1206 TVA-1205.1

FUSE DEVICES

ITEM No.	DESCRIPTION	REPLACEMENT DATA						
		PART No.		BUSS PART No.		LITTELFUSE PART No.		WORKMAN PART No.
		DEVICE	HOLDER	DEVICE	HOLDER	DEVICE	HOLDER	DEVICE
F1	5A 250V Quick-acting	F-005	HW-FH2	MTH-5	1A1907-02	312005	102068	FGS-2