

Chassis Ground Connection

There is one wire connection to be made between the Power Supply Board and the 8800 chassis.

- (1) Referring to the procedure on page 58, connect a terminal lug to an insulated wire approximately 14 inches long.
- (1) In the same manner as the connections on page 59, connect the wire to the Power Supply board. Connect the end opposite the terminal lug to the hole on the board located between the bottom hole of jumper "J1" and the positive end of C14.
- (1) The terminal lug end of the wire should be routed around the transformers and mounted to the chassis with the same connection as the power cord ground wire as described on page 61.

POWER SUPPLY BOARD MOUNTING

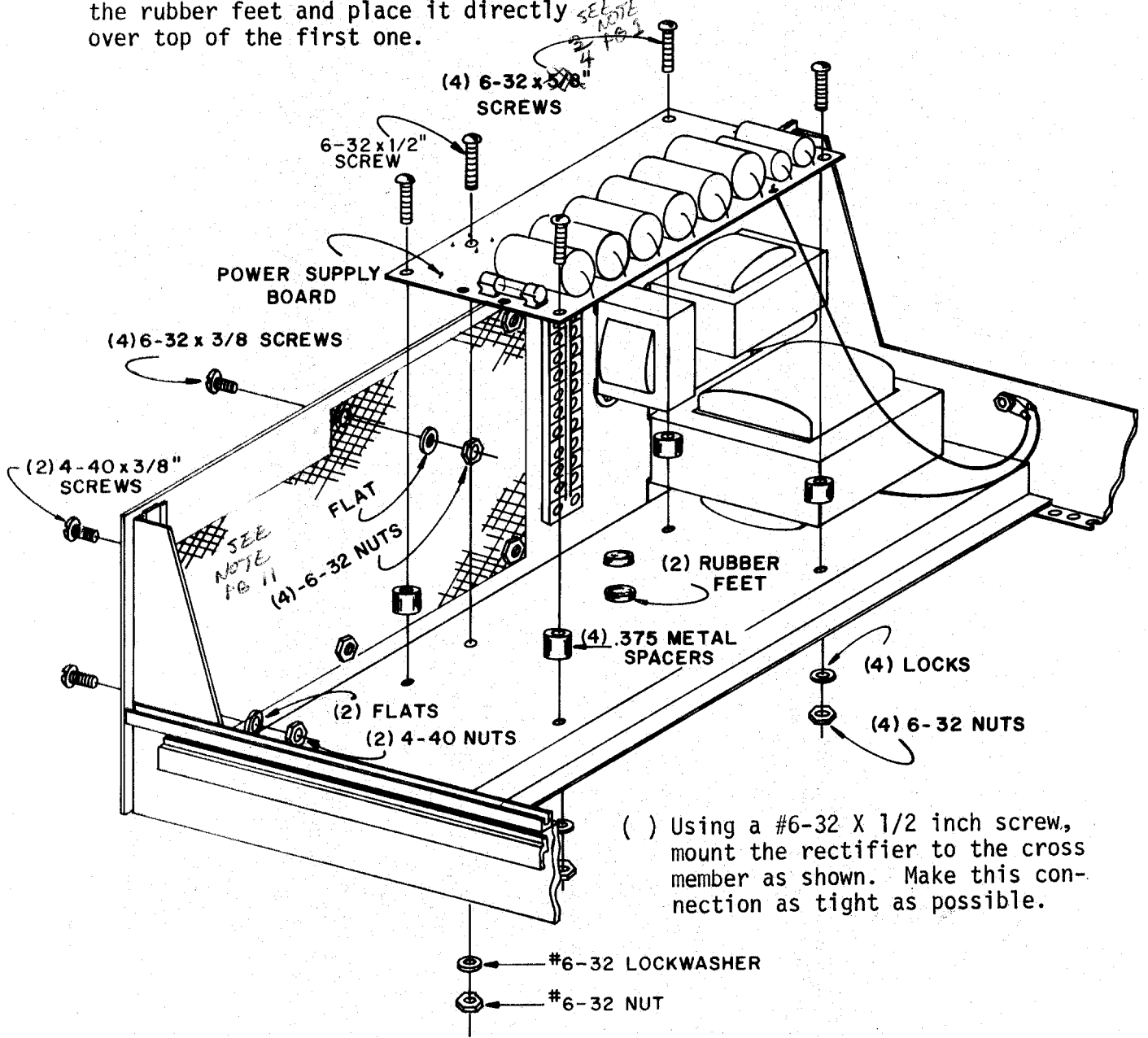
The 8800 Power Supply Board is mounted directly to the chassis cross member.

(✓) Referring to the drawing, remove the backing from one of the small flat rubber feet included in your kit and place it in the center of the four mounting holes for the power supply board on the cross member.

(✓) Remove the backing from another of the rubber feet and place it directly over top of the first one.

(✓) Referring to the drawing, mount the screen on the inside of the back panel.

(✓) Refer to the drawing and mount the power supply board to the cross member as shown. Be careful not to catch any of the wires underneath the board as you mount it. Tighten it securely into place.



() Using a #6-32 X 1/2 inch screw, mount the rectifier to the cross member as shown. Make this connection as tight as possible.

POWER SUPPLY CONNECTIONS

There are 15 connections to be made to the terminal block on the 8800 back panel.

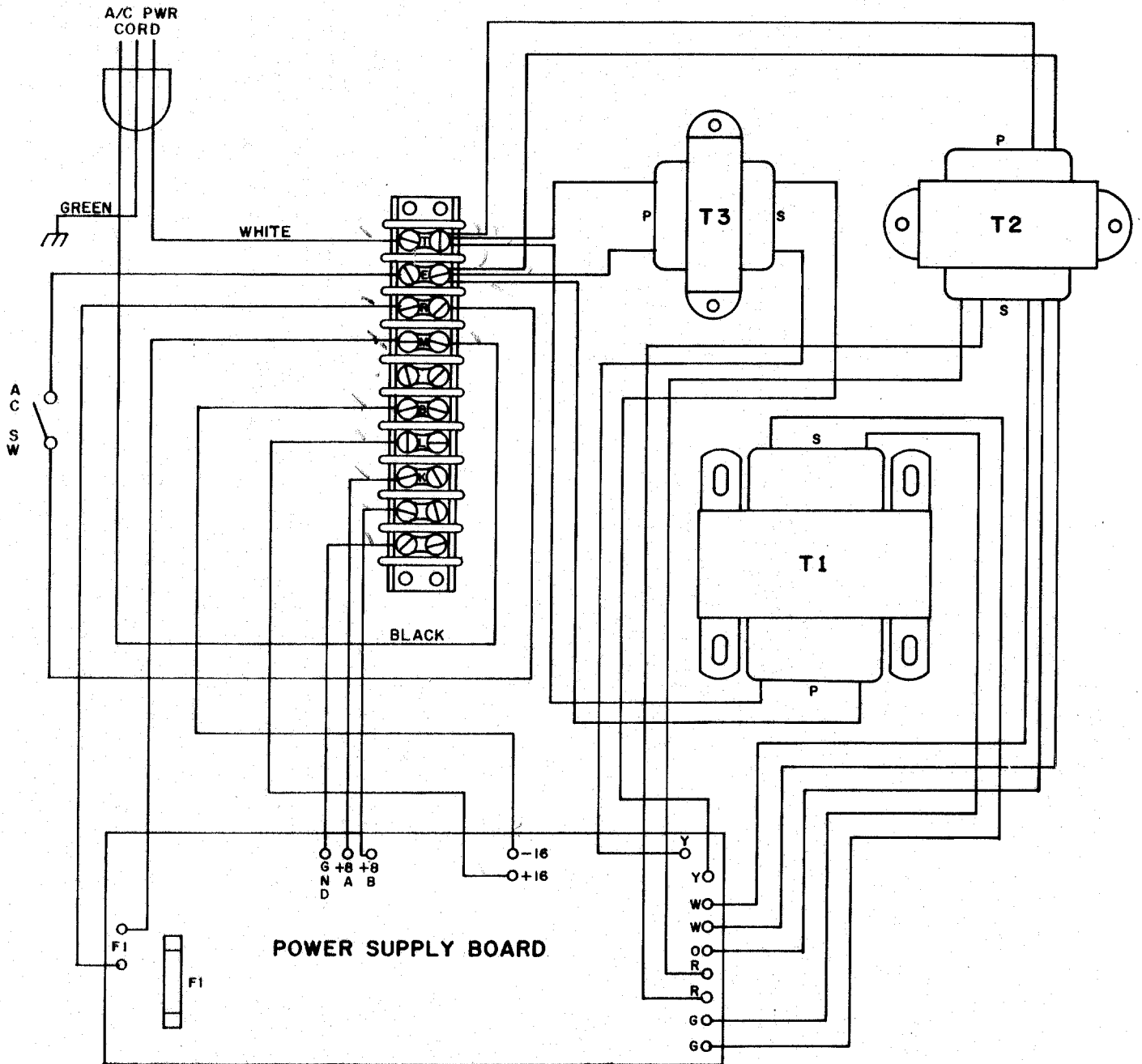
- (✓) Refer to the "POWER SUPPLY WIRING DIAGRAM" on the following page and connect all of the wires shown to the terminal block, except "AC SW".

NOTE: These are all wires to which you have attached terminal lugs earlier. Be sure to connect the lugs to the exact locations indicated in the wiring diagram. Use a screwdriver to make the connections, and be sure they are as tight as possible.

- (✓) The green ground wire on the AC Power Cord should be routed around behind the transformers and connected to the side of the chassis itself. The wire should reach to approximately the 14th hole from the back and should be attached to the top row of holes.

NOTE: The chassis is anodized, so use a piece of sandpaper or steel wool to scratch the finish around the hole for the wire. Use a #6-32 X 1/4 inch screw and a #6-32 nut to mount the lug. The screw head should be on the outside of the chassis.

POWER SUPPLY WIRING DIAGRAM



EXPANDER BOARD 8800 M/BD ASSEMBLY

There are up to four edge connectors to be mounted on each 8800 M/BD expander board. These connectors are all to be mounted in the same manner.

Observe that the edge connectors each have a double row of pins; one side is numbered 1 through 50 and the other side is lettered A through AF. These markings are indicated on both the top and the bottom of the connectors.

Observe that the expander board has a foil pattern only on one side. The connectors will be mounted on the blank side of the board.

(✓) Orient the expander board in front of you with the foil pattern on the bottom. The board designation markings (MITS 8800 M/BD, etc.) should be underneath, in the right corner towards you. Looking at the blank side of the board, this will place pin 1 on the left and pin 50 on the right.

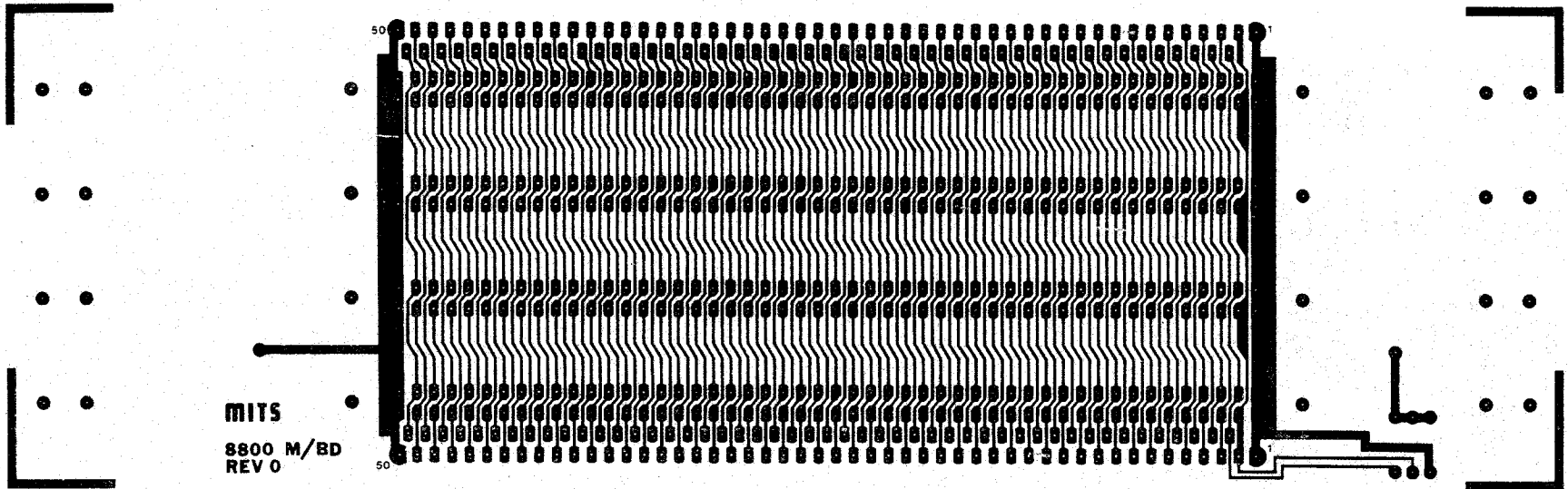
(✓) Orient one of the edge connectors so that the numbered pins are towards you and the lettered pins towards the back, with the pins themselves pointing downward. This should place pins 1 and 50 with the same orientation as the 1 and 50 on the bottom (foil side) of the board.

(✓) The edge of the board towards you has four rows of holes close together. The first two rows are staggered from each other and will be used later for wiring. The second two rows are in line and match the pins on the connector. Insert the connector into the 2nd two rows of holes keeping the same orientation as above. It may be necessary to use the tip of a scribe or a screwdriver to help guide the pins into the holes.

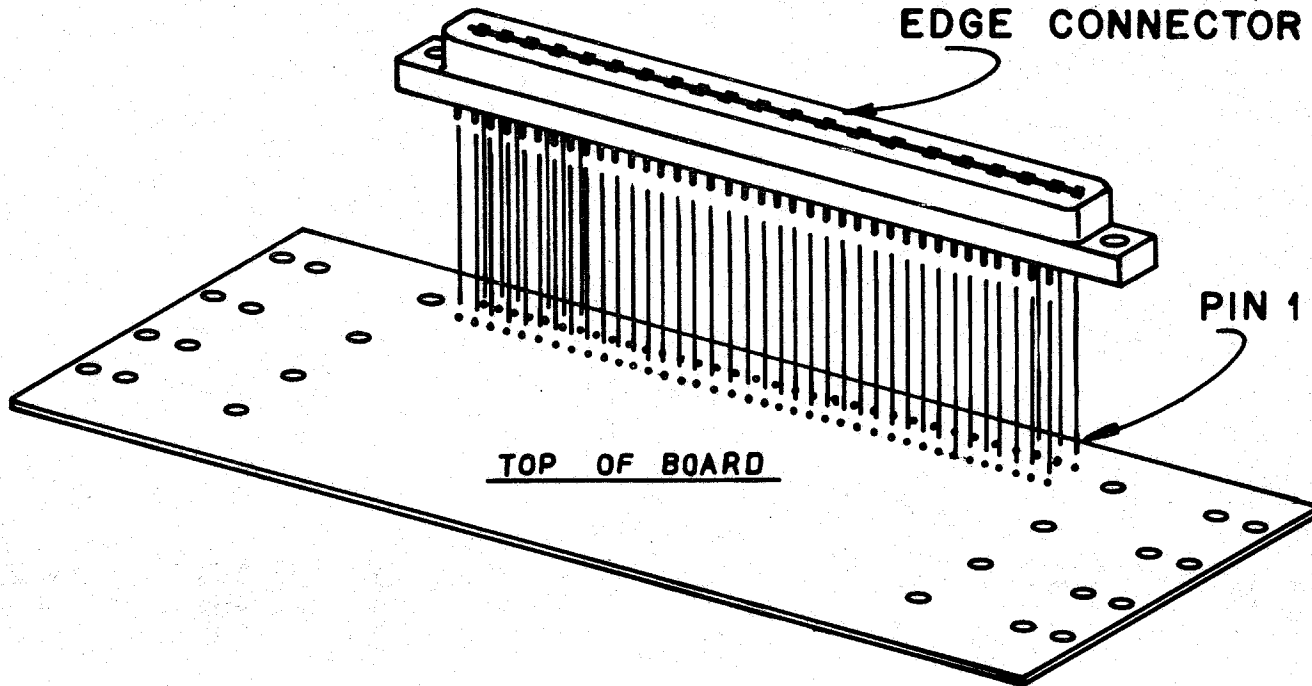
(✓) Be sure that the connector is tight against the board and that all 100 pins are in their holes; then turn the board over and solder the pins to the foil pattern. Be careful not to leave any solder bridges between the pins or the lands.

(✓) Mount all of the edge connectors to the expander board in the same manner.

BOTTOM OF BOARD



EDGE CONNECTOR



BOARD INSTALLATION

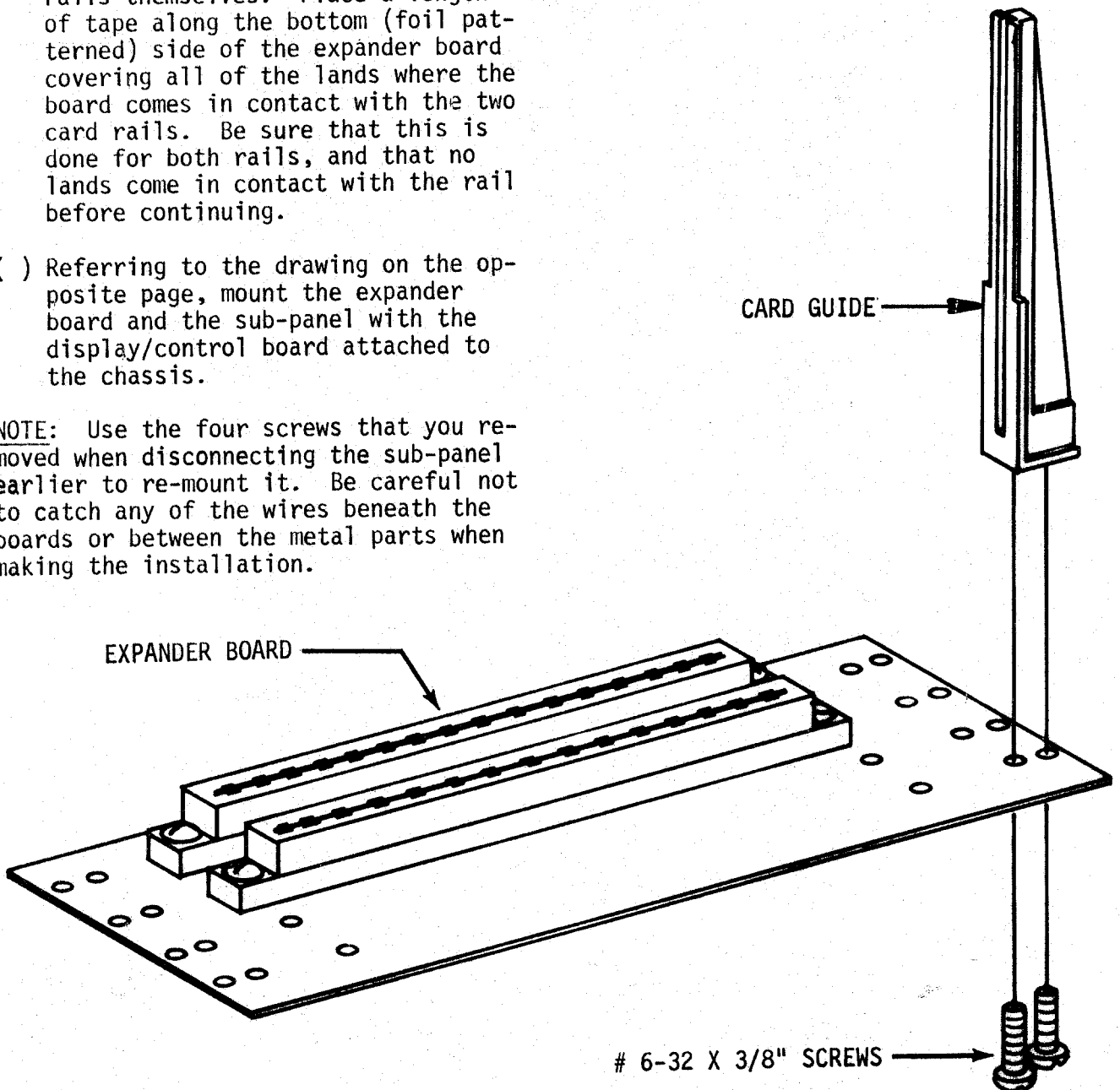
The expander board and the display/control board can now be mounted onto the chassis.

- () Before mounting the expander board, refer to the drawing on the opposite page and set the board in place on the card rails. Observe where the board comes in contact with the rails themselves. Place a length of tape along the bottom (foil patterned) side of the expander board covering all of the lands where the board comes in contact with the two card rails. Be sure that this is done for both rails, and that no lands come in contact with the rail before continuing.

- () Referring to the drawing on the opposite page, mount the expander board and the sub-panel with the display/control board attached to the chassis.

NOTE: Use the four screws that you removed when disconnecting the sub-panel earlier to re-mount it. Be careful not to catch any of the wires beneath the boards or between the metal parts when making the installation.

- () Install card guides into the pairs of holes along the outside edges of the expander board as shown below. Install them in the holes corresponding to each of the edge connectors you have previously installed.



EXPANDER BOARD WIRING

SEE COMPUTER NOTES
PG. 19

Place the expander board in front of you with the same orientation as at the beginning of the previous step. Observe the two staggered rows of holes towards the front edge of the board. These holes correspond with the pins on the connector. The row of holes closest to the edge of the board corresponds to pins 1 through 50 consecutively from left to right. The second row corresponds to pins 52 through 99 consecutively from left to right. (52 = B, 99 = AE) (see drawing and bus chart)

NOTE: Pins 51 and 100 are electrically common with pins 1 and 50 and thus are not used for wiring the bus.

- (✓) Orient the Display/Control Board in front of you with the sub-panel and switches facing down and the row of wire connections along the longer edge of the board towards you.
- () Orient the expander board so that it is approximately 4 inches away from the back edge of the Display/Control Board. It should be setting so that the two rows of holes described above are to the right and the shorter edge of the board towards you. (see drawing)
- (✓) Referring to the drawing, remove the nut and lockwasher from the front right corner of the Display/Control Board. Place all of the wires, except "GND", "(+8V)B", and "AC SW", through the cable clamp and remount the clamp to the corner with the same nut and lockwasher.*

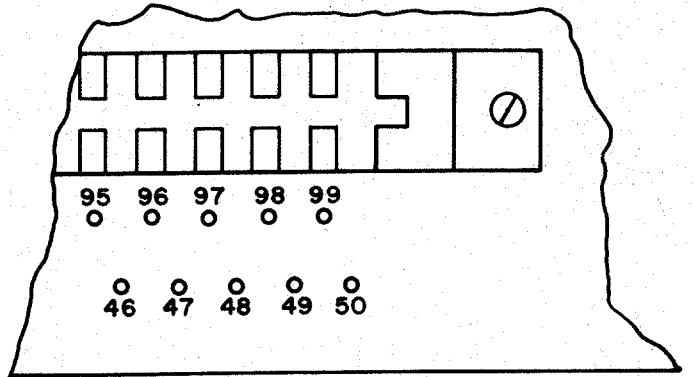
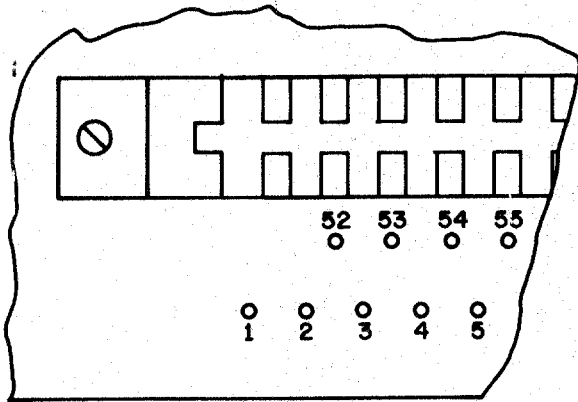
SEE
NOTE
PERTAINING
TO CABLE
CLAMPS
PG II

- () Connect the wires from the Display/Control Board labeled with numbers to the expander board according to the following procedure.
- () One at a time, take one of the wires and stretch it out to the hole on the expander board corresponding to the same number as the label on the wire.
- () Cut the wire 1/2 inch longer than the length necessary to reach its hole; then strip 3/8 inch of insulation from the cut end. Tin the exposed portion of the wire by applying a thin coat of solder.
- () Insert the end of the wire into its hole from the blank side of the board, being careful not to push any of the insulated portion of the wire into the hole.
- () Turn the board over and solder the wire to the foil pattern on the bottom side. Clip off any excess lead length.
- () Follow this same procedure for each of the wires.

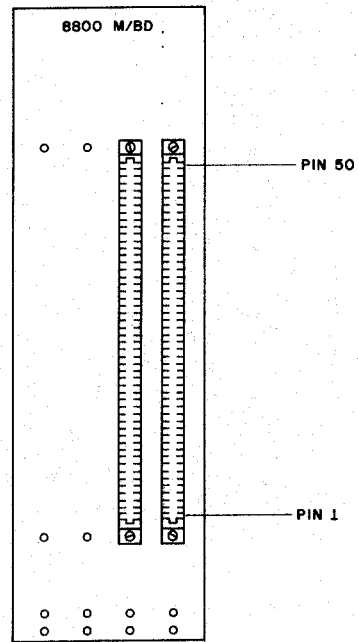
MAKE SURE THAT THE NUMBER ON THE WIRE LABEL CORRESPONDS WITH THE NUMBER OF THE HOLE ON THE EXPANDER BOARD AS YOU CONNECT EACH ONE.

- () In the same manner as the connections above, connect the free end of the 4 24-inch wires with terminal lugs attached to holes number 1, 2, 50 and 52.

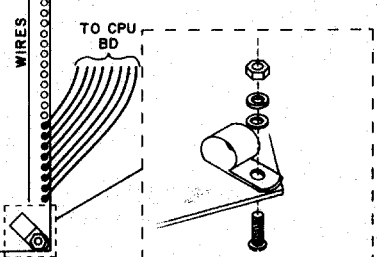
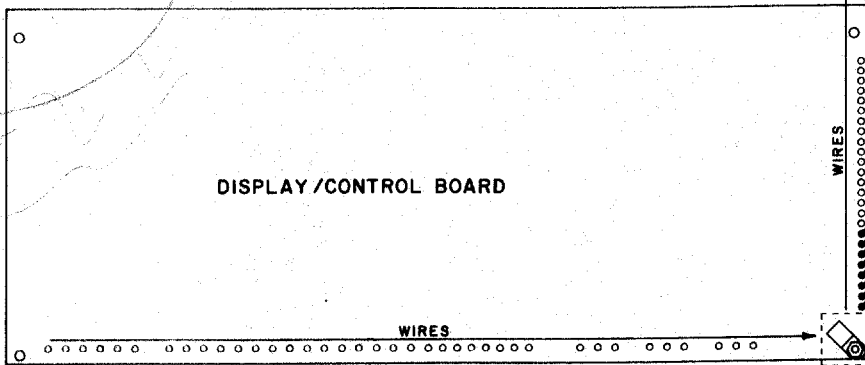
- ()*In the same manner, install cable clamps on the two screws on the left side of the board and route the other four wires through these.



**8800 M/BD
EXPANDER
BOARD
WIRING**



*SEE
NOTE PG II*



BOARD INSTALLATION

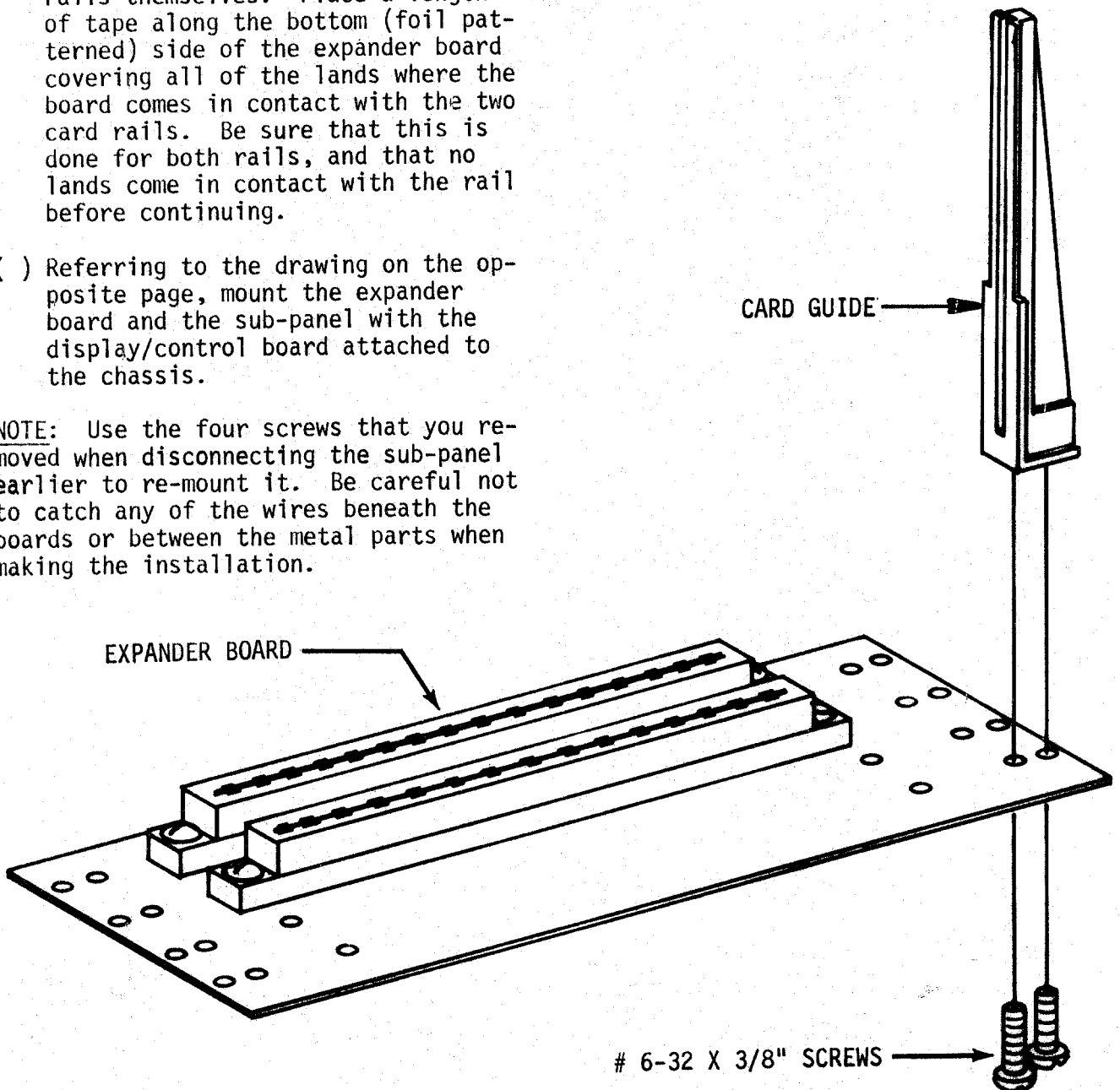
The expander board and the display/control board can now be mounted onto the chassis.

- () Before mounting the expander board, refer to the drawing on the opposite page and set the board in place on the card rails. Observe where the board comes in contact with the rails themselves. Place a length of tape along the bottom (foil patterned) side of the expander board covering all of the lands where the board comes in contact with the two card rails. Be sure that this is done for both rails, and that no lands come in contact with the rail before continuing.

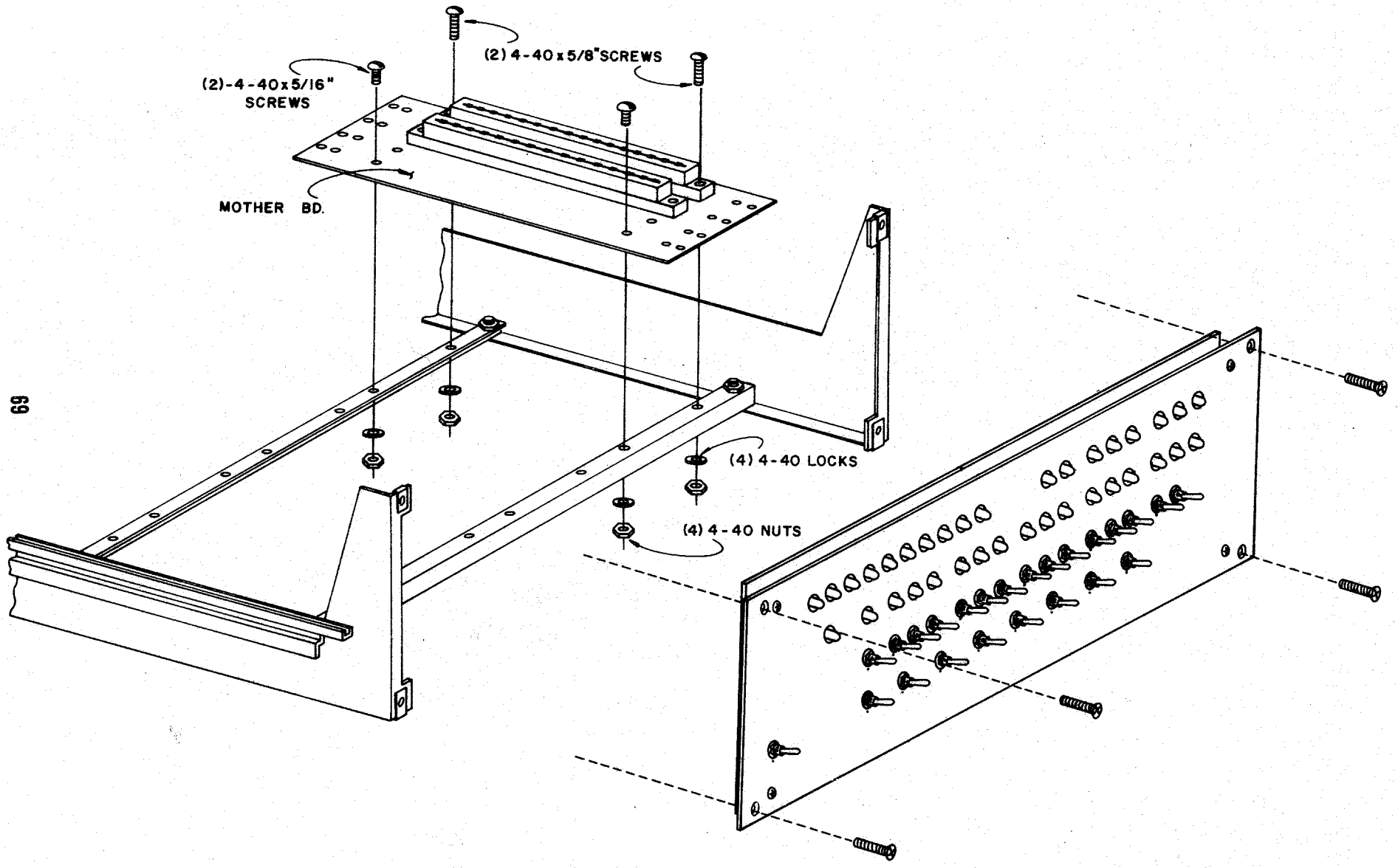
- () Referring to the drawing on the opposite page, mount the expander board and the sub-panel with the display/control board attached to the chassis.

NOTE: Use the four screws that you removed when disconnecting the sub-panel earlier to re-mount it. Be careful not to catch any of the wires beneath the boards or between the metal parts when making the installation.

- () Install card guides into the pairs of holes along the outside edges of the expander board as shown below. Install them in the holes corresponding to each of the edge connectors you have previously installed.



SEE
NOTE
PG 11



BUS POWER CONNECTIONS

There are 7 wires with terminal lugs attached to be connected to the terminal block.

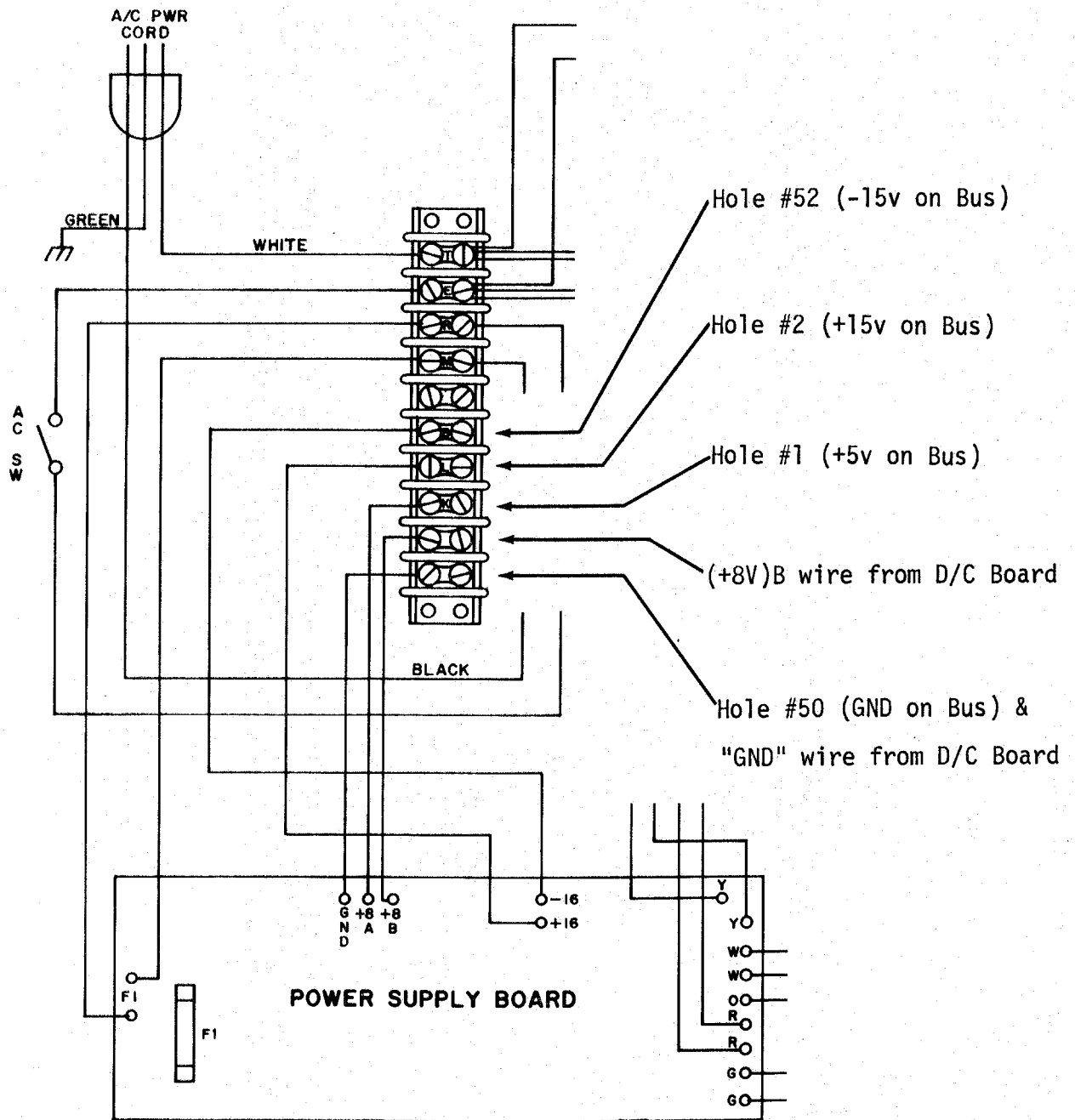
- (✓) Referring to the drawing on the opposite page, connect the four 24 inch wires from holes 1, 2, 50 and 52 on the expander board to the terminal block as shown. Be sure to place them in the exact location indicated.
- (✓) Refer to the drawing again and connect the two "AC SW" wires and the "GND" and "(+8V)B" wires from the display/control board to the terminal block as shown.

NOTE: It is very important that all of these wires be in the exact locations indicated by the instructions as they provide all of the power to the boards in the unit. Refer to the bus structure chart on page 72 for a complete description of all of the signals and their location on the bus.

NOTE: The 4 wires from the expander board should be routed around the right side of the case. The 4 wires from the Display/Control board should be routed around the left side of the case.

Some additional cable clamps are included with your kit to aid in routing these wires. These may be attached to the card rail mounting screws and the top row of holes along the sides of the chassis as necessary.

SEE NOTE
PG II



8800 BUS STRUCTURE

1	+5 V
2	+15 V
3	XRDY
4	VI ₀
5	VI ₁
6	VI ₂
7	VI ₃
8	VI ₄
9	VI ₅
10	VI ₆
11	VI ₇
12	
13	
14	
15	
16	
17	
18	STAT DISABLE
19	CIC DISABLE
20	UNPROTECT
21	SS
22	ADDR DSBL
23	DD DSBL
24	Φ ₂
25	Φ ₁
26	PHLDA
27	PWAIT
28	PINTE
29	A ₅
30	A ₄
31	A ₃
32	A ₁₅
33	A ₁₂
34	A ₉
35	DO ₁
36	DO ₀
37	A ₁₀
38	DO ₄
39	DO ₅
40	DO ₆
41	DI ₂
42	DI ₃
43	DI ₇
44	SMI
45	SOUT
46	SINP
47	SMEMR
48	SHTA
49	CLOCK (2 MHz)
50	GND

51	+5 V	A
52	-15 V	B
53	33W DSB	C
54	EXT CLR	D
55		E
56		F
57		H
58		J
59		K
60		L
61		M
62		N
63		P
64		R
65		S
66		T
67		U
68	MWRITE	V
69	PS	W
70	PROTECT	X
71	RUN	Y
72	PRDY	Z
73	PINT	a
74	PHOLD	b
75	PRESET	c
76	PSYNC	d
77	PWR	e
78	PDBIN	f
79	A ₀	h
80	A ₁	j
81	A ₂	k
82	A ₆	l
83	A ₇	m
84	A ₈	n
85	A ₁₃	p
86	A ₁₄	r
87	A ₁₁	s
88	DO ₂	t
89	DO ₃	u
90	DO ₇	v
91	DI ₄	w
92	DI ₅	x
93	DI ₆	y
94	DI ₁	z
95	DI ₀	AA
96	SINTA	AB
97	SWO	AC
98	SSTACK	AD
99	POC	AE
100	GND	AF

INTERCONNECTIONS AND BOARD INSTALLATIONS

The CPU and Memory boards can now be installed into the unit.

(✓) The 8080 CPU integrated circuit can now be placed into its socket on the CPU Board. Before proceeding, go back and review the "MOS IC Special Handling Precautions" in the front of this manual.

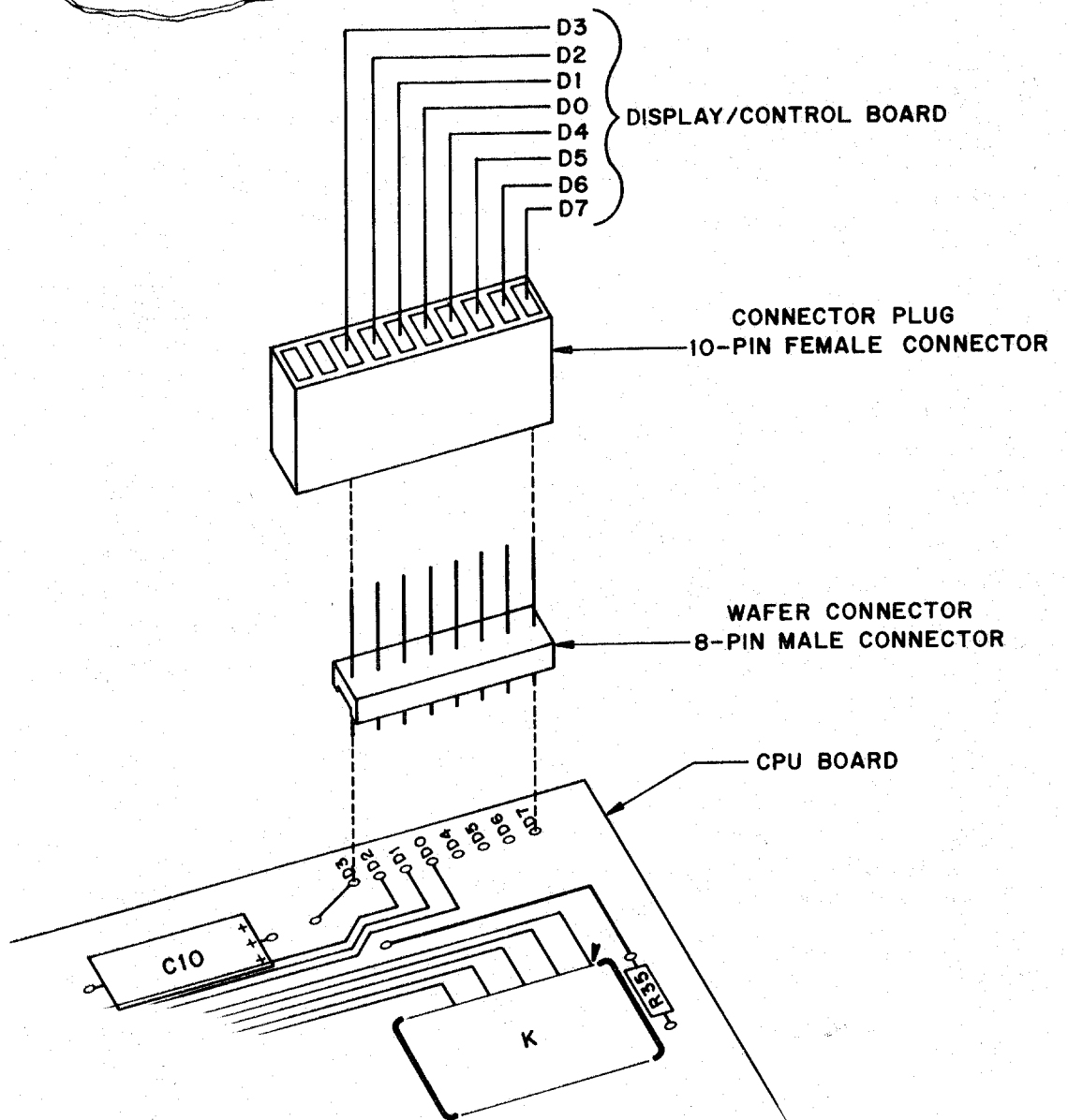
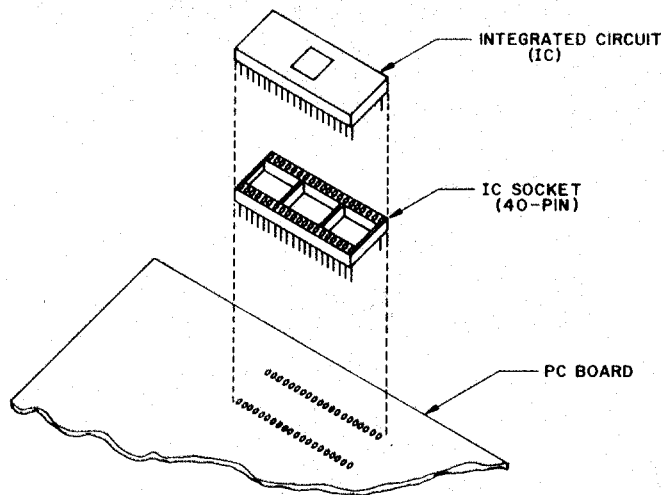
SEE COMPUTER
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(✓) Insert the 8080 IC into its socket. Be very careful in handling it and use as little pressure as possible when inserting it.

(✓) Press the 8800 CPU Board into the first edge connector, with the silk-screened side of the board facing towards the chassis. This should place the wafer connector on the CPU Board towards the back of the unit.

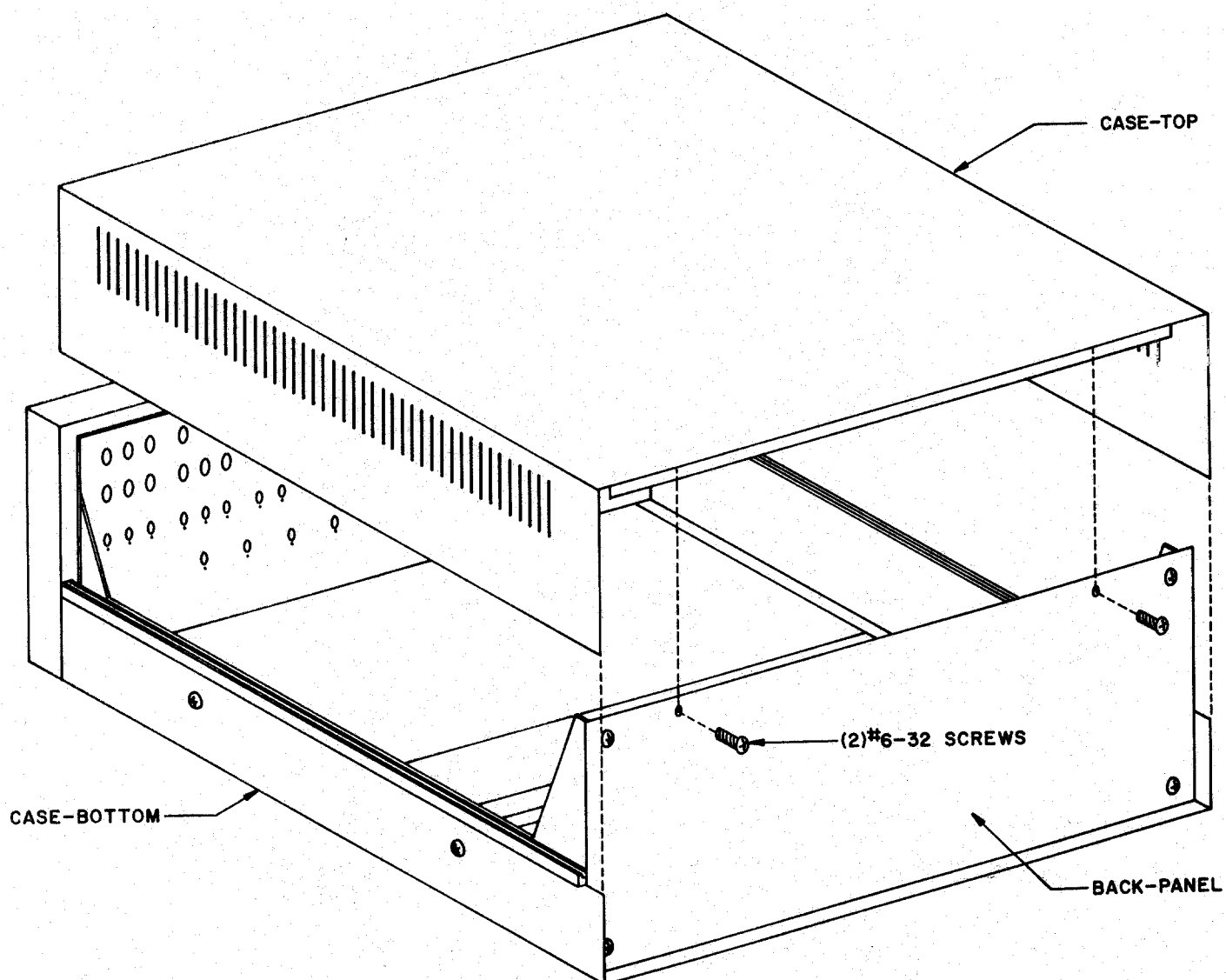
(✓) Referring to the drawing on the opposite page, connect the Connector Plug from the display/control board to the Wafer Connector on the CPU board as indicated. Be sure that the signals match as indicated.

() Insert the Memory board into the second edge connector in the same manner as the CPU Board. It should be oriented so that the silk-screened side of the board is towards the CPU Board.



CASE TOP INSTALLATION

The chassis and the case top should be re-installed into the case bottom in the same manner as they were removed. Use the same hardware which you removed earlier to re-assemble the unit.



NAME PLATE INSTALLATION

The MITS ALTAIR 8800 COMPUTER name plate is to be installed after the entire case has been re-assembled.

WARNING: The adhesive backing on the Altair name plate is extremely strong. Take extra precaution when installing it to be sure that you place it in the correct position the first time.

- (✓) Remove the paper covering from the back of the name plate. Be careful not to touch anything to the adhesive while you have the paper removed.
- (✓) Attach the plate to the dress panel on the very bottom, beneath the switches. Be sure that the dress panel is tight against the case bottom before doing this, as the plate will not fit between the panel and the case.
- (✓) Remove the protective covering from the front of the name plate. This may be tinted pink. The name plate should be silver.

MEMORY ADDRESS SELECTION

There are several hardware connections to be made on the 8800 memory boards for selecting the starting address for each board.

The starting address for each individual board is entirely optional within a few limitations. With only a single memory board in your system there is no problem, as long as the starting address selected is noted and taken into account when programming.

When more than one memory board is in the system, the sequence of starting addresses becomes critical. This is especially true when combining 1K and 4K boards in the same system. The important aspect in this case is to be sure that the individual blocks of memory on each board follow each other sequentially. There should be no gaps between the last address of one board and the starting address of the next.

The best example of this situation would be a system containing a 1K board with only 256 words of static memory together with a full 4K dynamic memory board. As may be noted from the "MEMORY ADDRESS SELECTION CHART", the starting address of the 1K boards may be selected with minimum increments of 1024 words. For the 4K board the minimum increment is 4096 words.

NOTE: Those addresses marked with an asterisk (*) in the chart are the possible address selections for the 4K boards, I1 & I0 being dropped for this board. Any address listed may be selected for the 1K boards.

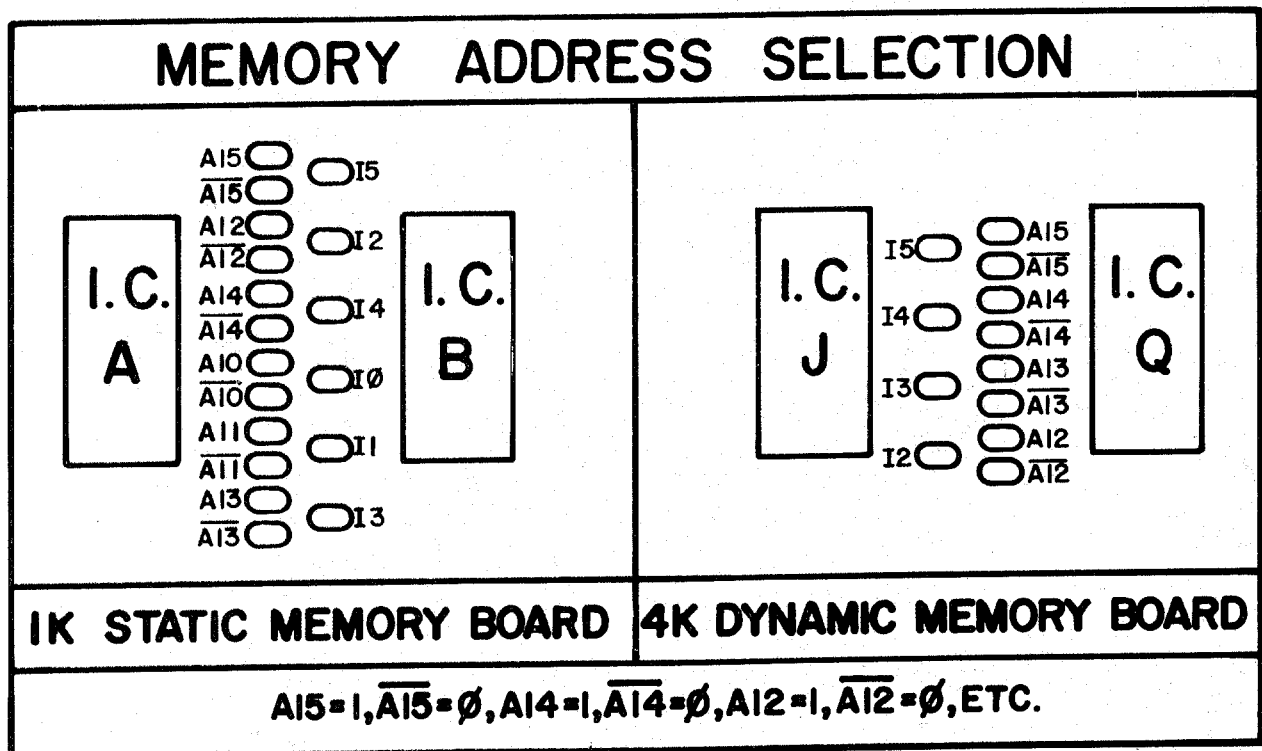
As may be seen from studying the chart, in the example above if the 1K board is placed at an address "before" the 4K board there will be a gap of 3840 words of memory between the boards. Even with the 1K board expanded to its full 1024 words, there would still be a gap of 3072 words of memory.

In this example the 4K board address must be placed "before" the 1K board address in order to keep all possible addresses sequential. (i.e.--place the 4K board at octal address 0 and the 1K board at octal address 10 000)

The same would hold true for two 1K boards, one fully expanded and the other with only 256 words of memory. The full board must be placed first and the second board must be placed so that it follows immediately in sequence.

The chart below illustrates the address selection pads for both the 1K and the 4K memory boards. The "I" prefixed pads correspond to the "I" prefixed headings on the "MEMORY ADDRESS SELECTION CHART". The "A" prefixed pads correspond to the 1's and 0's on the "MEMORY ADDRESS SELECTION CHART" as indicated at the bottom of the chart below. The last number of the pad should always correspond in each connection. (i.e.--pad I5 must go to either A15 or $\overline{A15}$, pad I1 must go to either A11 or $\overline{A11}$)

PROM MEMORY CARD (88-PMC) The 2K PROM Board uses exactly the same addressing format as the 1K and 4K memory boards. The only difference is that five jumpers are used (I1 through I5), and the memory increments in 2K blocks. All of the information in this section applies to the PROM board just as with the other memory boards. The possible addresses for the PROM board are marked "†" on the MEMORY ADDRESS SELECTION CHART.



MEMORY ADDRESS SELECTION CHART

ADDRESS LINES						ADDRESS SELECTED	
15	14	13	12	11	10	DECIMAL ADDRESS	OCTAL ADDRESS
0	0	0	0	0	0	0	0 * †
0	0	0	0	0	1	1,024	2 000
0	0	0	0	1	0	2,048	4 000 †
0	0	0	0	1	1	3,072	6 000
0	0	0	1	0	0	4,096	10 000 * †
0	0	0	1	0	1	5,120	12 000
0	0	0	1	1	0	6,144	14 000 †
0	0	0	1	1	1	7,168	16 000
0	0	1	0	0	0	8,192	20 000 * †
0	0	1	0	0	1	9,216	22 000
0	0	1	0	1	0	10,240	24 000 †
0	0	1	0	1	1	11,264	26 000
0	0	1	1	0	0	12,288	30 000 * †
0	0	1	1	0	1	13,312	32 000
0	0	1	1	1	0	14,336	34 000 †
0	0	1	1	1	1	15,360	36 000
0	1	0	0	0	0	16,384	40 000 * †
0	1	0	0	0	1	17,408	42 000
0	1	0	0	1	0	18,432	44 000 †
0	1	0	0	1	1	19,456	46 000
0	1	0	1	0	0	20,480	50 000 * †
0	1	0	1	0	1	21,504	52 000

ADDRESS LINES						ADDRESS SELECTED	
I5	I4	I3	I2	I1	I0	DECIMAL ADDRESS	OCTAL ADDRESS
0	1	0	1	1	0	22,528	54 000 †
0	1	0	1	1	1	23,552	56 000
0	1	1	0	0	0	24,576	60 000 * †
0	1	1	0	0	1	25,600	62 000
0	1	1	0	1	0	26,624	64 000 †
0	1	1	0	1	1	27,648	66 000
0	1	1	1	0	0	28,672	70 000 * †
0	1	1	1	0	1	29,696	72 000
0	1	1	1	1	0	30,720	74 000 †
0	1	1	1	1	1	31,744	76 000
1	0	0	0	0	0	32,768	100 000 * †
1	0	0	0	0	1	33,792	102 000
1	0	0	0	1	0	34,816	104 000 †
1	0	0	0	1	1	35,840	106 000
1	0	0	1	0	0	36,864	110 000 * †
1	0	0	1	0	1	37,888	112 000
1	0	0	1	1	0	38,912	114 000 †
1	0	0	1	1	1	39,936	116 000
1	0	1	0	0	0	40,960	120 000 * †
1	0	1	0	0	1	41,984	122 000
1	0	1	0	1	0	43,008	124 000 †
1	0	1	0	1	1	44,032	126 000
1	0	1	1	0	0	45,056	130 000 * †
1	0	1	1	0	1	46,080	132 000

ADDRESS LINES						ADDRESS SELECTED	
I5	I4	I3	I2	I1	I0	DECIMAL ADDRESS	OCTAL ADDRESS
1	0	1	1	1	0	47,104	134 000 †
1	0	1	1	1	1	48,128	136 000
1	1	0	0	0	0	49,152	140 000 * †
1	1	0	0	0	1	50,176	142 000
1	1	0	0	1	0	51,200	144 000 †
1	1	0	0	1	1	52,224	146 000
1	1	0	1	0	0	53,248	150 000 * †
1	1	0	1	0	1	54,272	152 000
1	1	0	1	1	0	55,296	154 000 †
1	1	0	1	1	1	56,320	156 000
1	1	1	0	0	0	57,344	160 000 * †
1	1	1	0	0	1	58,368	162 000
1	1	1	0	1	0	59,392	164 000 †
1	1	1	0	1	1	60,416	166 000
1	1	1	1	0	0	61,440	170 000 * †
1	1	1	1	0	1	62,464	172 000
1	1	1	1	1	0	63,488	174 000 †
1	1	1	1	1	1	64,512	176 000
Highest Directly Addressable Memory Location →						65,535	177 777

*4K Dynamic Memory Board Selections

† PROM MEMORY CARD SELECTIONS

CHECKOUT PROCEDURE FOR ALTAIR 8800

1. Before applying power (with the aid of a magnifying glass if available) check all boards and components for solder bridges, cold solder joints, broken PC lands or wires, and correct component orientation.

Careful attention to this step will eliminate most of the common machine failure causes.

2. With all boards removed from the mother board, apply power to the machine and check both the terminal block and the bus pins for the proper unregulated voltages.

Without the boards loading the supply, these voltages should read as follows:

Bus Pins	Approximate voltages referenced to power supply GND
Pins 1 & 51	+10VDC <i>+10</i>
Pin 2	+20VDC <i>+18.2</i>
Pin 52	-17VDC <i>-16</i>
Pins 50 & 100	0VDC

3. Now check to see that none of the above voltages are present on any of the bus pins adjacent to those listed.

NOTE: Pin 49 will be open without the CPU board in place, and thus will read the same as pin 50.

W A R N I N G

UNDER NO CONDITIONS REMOVE OR INSTALL

BOARDS TO THE UNIT WITH THE POWER ON.

4. Power the machine down and insert the boards into the mother board. Apply power to the machine again and check the output of the voltage regulators for +5vdc. Also check to see that the 12v zener diode on the CPU board is regulating at +12vdc.

Be sure the regulated supplies are correct on all of your boards.

CHECKOUT PROCEDURE, cont.

5. Power the machine down again and install the plug connecting the Display/Control Board to the CPU Board.

Re-apply power to the machine. The machine comes up in an undetermined state so what you do is hold the STOP switch in the stop position and give it a RESET. Then check to see if the PROTECT light is on; if it is, push the PROTECT-UNPROTECT switch in the unprotect position.

6. Now you can check out the different switches and indicators. All address switches should be in the down (0) position. Hold the RESET on -- you should have all the status lights off and all data address lights on. When you release the RESET switch, all the address lights should go off. The MEMR, M1, W0, WAIT lights should be on and whatever data there is in location 0 will be displayed in the data lights.

Now to check the lights and switches for proper operation, turn each address switch on one at a time and make sure that the corresponding address light comes on when the EXAMINE switch is operated. What you are doing here is checking for obvious shorts in the address bus area so only one switch should be on at a time.

The data lights should be checked in the same fashion. Only use the lower 8 switches and the DEPOSIT switch to check these.

Checking the EXAMINE NEXT and DEPOSIT NEXT is fairly simple. Just keep pressing them and observe that the address lights count up in sequential binary order.

Make sure that PROTECT switch turns on the Protect Status light and that UNPROTECT turns it off. With the PROTECT on you shouldn't be able to change the contents of memory with DEPOSIT or DEPOSIT NEXT (or instructions either).

Now you're ready to try a program. Use the one in the Operator's Manual on pages 33-38. After you load everything in be sure to RESET so that you start from LOC 0. SINGLE STEP through it first to check out the SINGLE STEP switch and then run it. Every time you stop it to examine the results be sure to RESET prior to restarting.