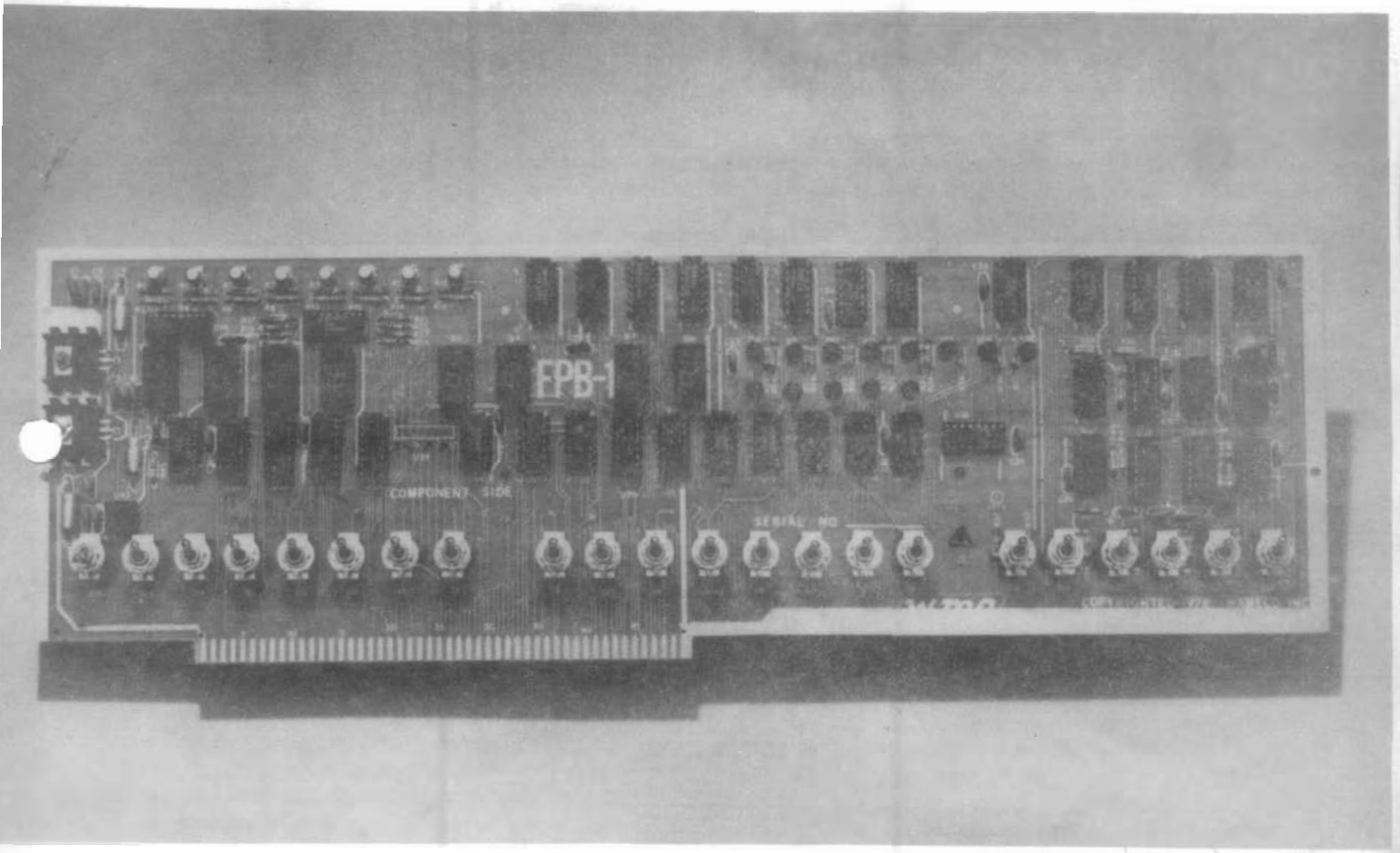
FPB-1

FRONT PANEL BOARD

wmc inc.



The WAMECO Front Panel Board is designed to allow control of an 8080A designed microcomputer. Control of the computer is done through features such as Memory Examine, Memory Deposit, Run, Stop, Reset, Instruction (or Byte) Step and Memory Protect. Status of the computer includes full Memory Address, Data Bus and I/O port (FF) Hexidecimal displays. M1 status is also displayed using discrete LEDs. The FPB-1 is S-100 compatible and does not load either the Address Bus or Data Bus to drive the displays. The FPB-1 will also fit into an IMSAI T.M. computer.

PLEASE NOTE:

The FPB-1 is designed to operate with the S-100 (WAMECO) bus (see Table 1A,B). It is a direct plug replacement for the IMSAI* CP-A front panel assembly but has greatly enhanced capabilities. There are 18 pins not otherwise used in this bus. These pins are available for non-standard configurations. It is advisable to carefull consider any modifications since this will limit board useage to a modified system.

Tools and Supplies needed for construction of FPB-1

1	Q Tip cotton swab
1	pair needle nosed pliers
1	pair diagonal cutting pliers
1	bottle rosin flux
1	tube silicone thermal heat grease
1	jar solder cleaner
1	roll solder wick
1	phillips screw driver
1	small adjustable wrench or socket to fit regulator nuts
1	roll (.031" or .040") SN60/40 rosin core solder
1	25 to 40 watt soldering iron with small spade tip
1	strong light
1	magnifying glass
1	Xacto knife
1	multimeter
1	variable 15V power supply

I. Assembly of FPB-1

I-1 Before placing any parts on the board, check the board for any hairline shorts (slivers). All boards have been inspected at least three times before shipping, still, a good hobbyist checks any board he buys.

I-2 Using a strong light and a magnifying glass, very carefully check all on top of the board (this is the side marked "FPB-1"). If any slivers are found, carefully cut and scrape them with an Xacto knife. The underside of the board will be checked after assembly.

I-3 Place all the 8,14 and 16 pin sockets (except U25) on their positions on the top side of the board. U25 socket is to be soldered on the back side of the FPB-1.

I-4 After positioning all sockets in place, put a book or other flat stiff object on top of the sockets (another way of holding sockets flat during soldering is to tape them down with a piece of masking tape). Hold the book tight against the board and turn them over so the underside of the board is up. Press down the board and solder one pin on each end of each socket. This will ensure the sockets are flat against the board. When tacking all sockets is completed, finish soldering all the other pins

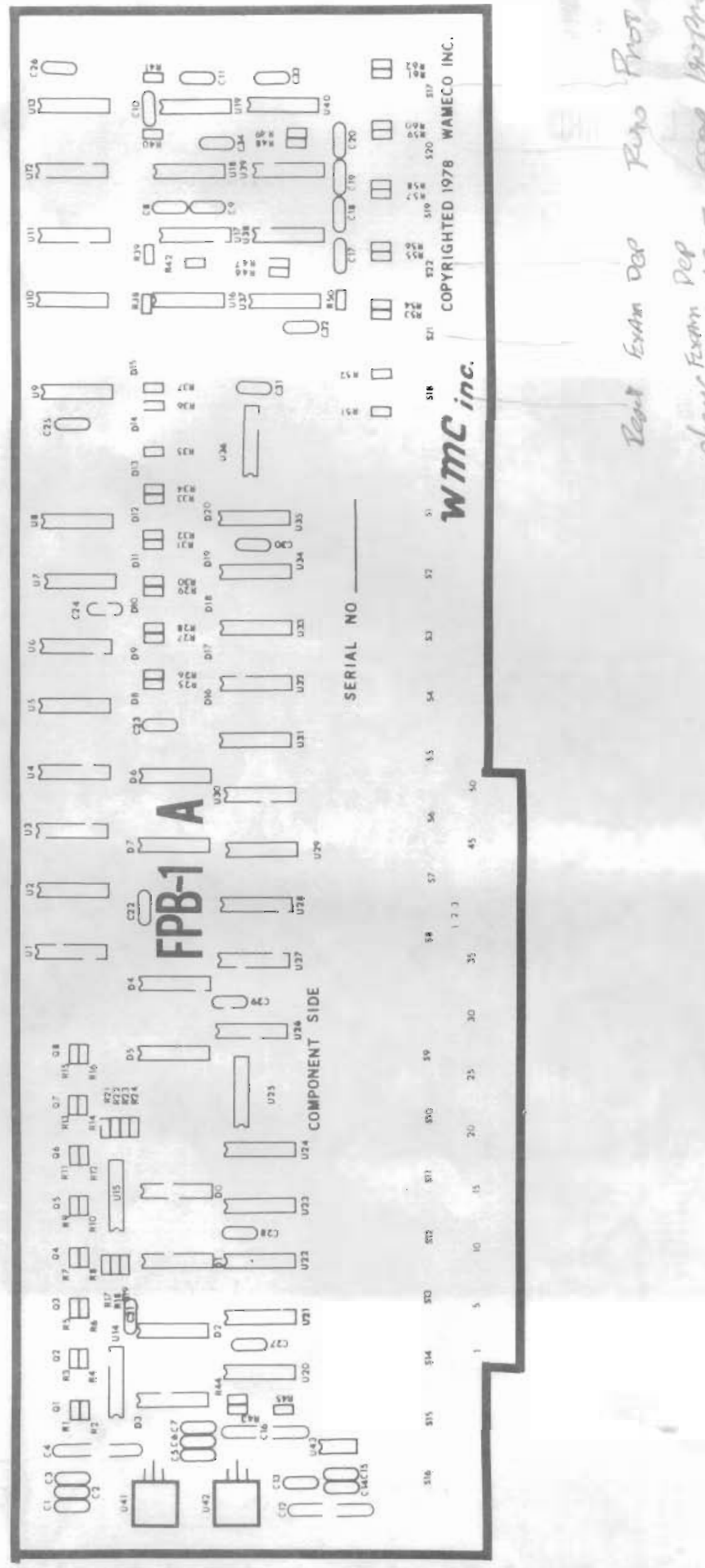


Figure 1. FPB-1 PARTS PLACEMENT DRAWING

QUANTITY	Part Schematic Name	Part Type
10	C1-3,C5-7,C10,C13,C14,C18 (.22)	0.1uf 50V Disc capacitors
3	C4,C12,C16	10uf (minimum) 10V (min) Tantalum
4	C8,C9,C11,C17	33pf ~~4.7uf~~ 10V Tantalum
15	C15,C21-34	0.01uf 50V disc
1	C19	470pf 50V disc
1	C20	330pf 50V disc
8	DSP0-DSP8	7 segment display (MAN-7, DL707, TIL312 or equivalent)
13	DSP8-DSP20	.2" discrete LEDs
8	Q1-Q8	2N2907
16	S1-S16	SPDT switches ON-NONE-ON
6	S17-22	SPDT switches spring loaded center off ON-OFF-ON
8	R1,3,5,7,9,11,13,15	10K ¼w 5% carbon film resistors
8	R2,4,6,8,10,12,14,16	560 ohm ¼w 5% carbon film resistors
7	R17-19,R21-24	100 ohm ¼w 5% carbon film resistors
12	R38,44,R53-62	2.7K ¼w 5% carbon film resistors
13	R25-37	220 ohm ½w 5% carbon film resistors
1	R47	22K ~~47K~~ ¼w 5% carbon film resistor
5	R40,41,39,42,46	30K ~~180~~K ¼w 5% carbon film resistors
1	R43	4.7K ¼w 5% carbon film resistor
1	R45	100K ¼w 5% carbon film resistor
2	R48,49	27K ¼w 5% carbon film resistors
3	R50-52	1K ¼w 5% carbon film resistors
3	U1,40,10	7404/74LS04
1	U2	7410/74LS10
1	U3	7402/74LS02
2	U4,9	7400/74LS00
2	U5,12	7408/74LS08
2	U6,11	7420/74LS20
1	U7	7442/74LS42
2	U8,20	74193,74LS193
7	U26,27,U31-35	7405/74LS05/8812/7406/7416/74LS16
1	(U13)	74107/74LS107
1	(U14)	7445/74145/74LS145
1	U15	Character PROM (included with bare board)
3	U16,18,37	7474/74LS74/74L74
1	U39	74123/74LS123/74L123
4*	U21-24 (1)	74151/74LS151
0	U25	output port it CPU board
3	U19,17,38	74LS123/74L123
1	U28	7430/74LS30
2**	U29,30	74174/74LS174
1	U36	8097/8T97/74367
2	U41,42	7805/340T-5
1	U43	NE555
1		8 pin socket
31		14 pin sockets
17		16 pin sockets
2		T0220 heatsinks (AHAM #362 or equiv)
2		6-32x3/8" nuts & screws

of the sockets. When finished on the front side, solder U25 socket similarly on the reverse side.

NOTE

DO NOT PUT IC'S IN SOCKETS AT THIS TIME. THEY WILL BE INSTALLED LATER

I-5 Bend the leads on R1,R3,R5,R7,R9,R11,R13,R15 (10K ohm brown, black, orange) and place in board. Check parts placement drawing (figure 1) for correct locations. Bend the leads on the resistors on the underside of the board to retain them in place until they are soldered. Turn the board over and solder all the resistors. Clip the leads of the resistors flush with the underside of the board with the diagonal pliers.

I-6 Bend the leads of R2,4,6,8,10,12,14,16 (560 ohm green, blue, brown) and place them in the board. Check parts placement drawing (figure 1) for correct location. Bend the leads of the resistors to retain them in place until they are soldered. Turn the board over and solder the resistors in place. Clip the leads flush with the underside of the board with diagonal pliers.

I-7 Bend the leads of R17-19, R21-24 (100K brown, black, yellow) and place in board. Check parts placement drawing (figure 1) for correct location. Bend the leads of the resistors to retain them in place until they are soldered. Turn the board over and solder the resistors in place. Clip the leads flush with the underside of the board with the diagonal pliers.

I-8 Bend the leads of R38,44,R53-62 (2.7K red, violet,red) and place in board. Check parts placement drawing (figure 1) for correct location. Bend the leads of the resistors to retain them in place until they are soldered. Turn the board over and solder the resistors in place. Clip the leads flush with the underside of the board with the diagonal pliers.

I-9 Bend the leads of R25-37 (220 ohm red, red, brown) and place in the board. Check parts placement drawing (figure 1) for correct location. Bend the leads of the resistors to retain them in place until they are soldered. Turn the board over and solder the resistors in place. Clip the leads flush with the underside of the board with the diagonal pliers.

I-10 Bend the leads of R47 (47K yellow,violet, orange) and place in board. Check parts placement drawing for correct location. Bend the leads of the resistor to retain it in place until it is soldered. Turn the board over and solder the resistor in place. Clip the leads flush with the underside of the board with the diagonal pliers.

I-11 Bend the leads of R39,40,41,42,46 (180K brown, gray, yellow) and place in board. Check parts placement drawing (figure 1) for correct location. Bend the leads of the resistors to retain them in place until they are soldered. Turn the board over and solder the resistors in place. Clip the leads flush with the underside of the board with the diagonal pliers.

I-12 Bend the leads of R43 (4.7K yellow, violet, red) and place in board. Checks parts placement drawing (figure 1) for correct location. Bend the resistor leads to retain it in place until it is soldered. Turn the board over and solder the resistor in place. Clip the leads flush with the underside of the board with the diagonal pliers.

I-13 Bend the leads of R45 (100K brown, black, yellow) and place in board. Check parts placement drawing (figure 1) for correct location. Bend the leads of the resistor to retain it in place until it is soldered. Turn the board over and solder the resistor in place. Clip the leads flush with the underside of the board with the diagonal pliers.

I-14 Bend the leads of R48,49 (27K red, violet, orange) and place in board. Check parts placement drawing (figure 1) for correct location. Bend the leads of the resistors to retain them in place until they are soldered. Turn the board over and solder the resistors in place. Clip the leads flush with the underside of the board with the diagonal pliers.

I-15 Bend the leads of R50-52 (1K brown, black, red) and place in board. Check parts palcement drawing (figure 1) for correct location. Bend the leads of the resistors to retain them in place until they are soldered. Turn the board over and solder the resistors in place. Clip the leads flush with the underside of the board with the diagonal pliers.

NOTE

CHECK DISC CAPACITORS FOR PROPER VALUE BEFORE INSERTING IN BOARD. ENSURE .01uf AND .1uf DISC CAPACITORS ARE NOT INTERCHANGED.

I-16 Put the leads of C1-3,C5-7,C10,C13,C14,C18 (0.1uf) disc capacitors in the board. Check parts placement drawing (figure 1) for correct locations. Bend the leads of the capacitors to retain them in place until they are soldered in place. Turn the board over and rest each end on books. The disc capacitors are higher than the sockets and will bend if the board is not supported. Solder all the capacitors in place. Clip the leads flush with the underside of the board with the diagonal pliers.

I-17 Put the leads of C15, C21-34 (0.01uf) disc capacitors in the board. Check parts placement drawing (figure 1) for correct locations. Bend the leads of the capacitors to retain them in place until they are soldered in place. Turn the board over

and rest each end on books. The disc capacitors are higher than the sockets and will bend if the board is not supported. Solder all the capacitors in place. Clip the leads flush with the underside of the board with the diagonal pliers.

I-18 Put the leads of C19 (470pf) disc capacitor in the board. Check parts placement drawing (figure 1) for correct location. Bend the leads of the capacitor to retain it in place until it is soldered. Turn the board over and rest each end on books. The disc capacitor is higher than the sockets and will bend if the board is not supported. Solder the capacitor in place. Clip the leads flush with the underside of the board with the diagonal pliers.

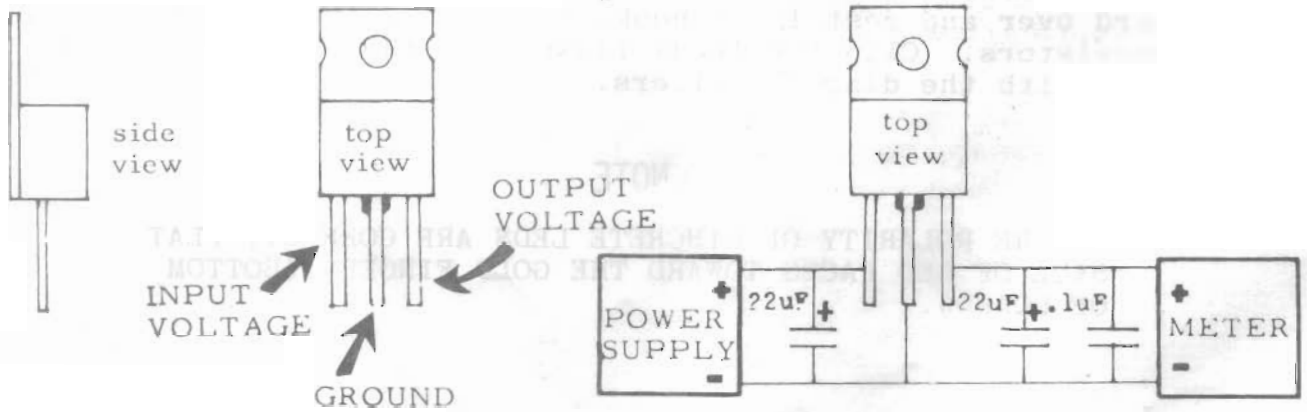
I-19 Put the leads of C20 (330pf) disc capacitor in the board. Check the parts placement drawing (figure 1) for correct location. Bend the leads of the capacitor to retain it in place until it is soldered. Turn the board over and rest each end on books. The disc capacitor is higher than the sockets and will bend if the board is not supported. Solder the capacitor in place. Clip the leads flush with the underside of the board with the diagonal pliers.

I-20 Place C4,C12,C16 (10uf tantalum/electrolytics) in place. Ensure that the polarity is correct. Check parts placement drawing (figure 1) for correct placement and polarity. Bend the leads of the capacitors to retain them in place until they are soldered. Turn the board over and rest it on books as before. Solder the capacitors in place. Clip the leads flush with the underside of the board with the diagonal pliers.

I-21 Place C8,C9,C11,C17 (4.7uf tantalum/electrolytic) in place. Ensure that the polarity is correct. Check parts placement drawing (figure 1) for correct placement and polarity. Bend the leads of the capacitors to retain them in place until they are soldered. Turn the board over and rest it on books as before. Solder the capacitors in place. Clip the leads flush with the underside of the board with the diagonal pliers.

I-22 Before installing the 7805 five volt regulators, it is recommended that they be tested for proper voltage regulation.

Figure 3



Attach the power supply and multimeter leads to the 7805 as shown in figure 3. Place the multimeter in a DC range that will allow 10 volts to be displayed. The 7805 needs a 2.0 volt minimum difference between the input voltage and the regulated output voltage. If the power supply has a voltmeter, observe the input voltage during the test. If the power supply does not have a voltmeter, switch the + meter lead between the output lead and the input lead of the 7805. The input and regulated voltages can be observed.

I-23 Slowly increase the input voltage and observe the output voltage. When the input voltage is between 7.0 and 7.5 volts, the regulated output of a properly operating 7805 should be between 4.8 and 5.2 volts. Replace any 7805 that does not meet these limits.

I-24 When the 7805's have been tested as outlined in I-22, place the 7805's on the board so that the mounting hole on the 7805 lines up with the corresponding hole on the FPB-1. Note where the leads on the 7805 pass over the connection holes on the FPB-1. Bend the leads on the 7805's so that the leads can be inserted into the proper holes. Mount the 7805's on the board using a #6 nut and 3/8" 6-30 screw. Insert a heatsink between between the board and the 7805. Solder the leads of the 7805's in place.

I-25 Remove the nuts and screws from the 7805's. Bend the 7805's upward and remove the heatsinks. Place a moderate amount of silicone thermal heat grease on the underside of the 7805's and the underside of the heatsinks with a Q tip cotton swab. Coat all of the area mentioned with an evan coating of the heat grease. Reinstall the heatsinks, nuts and screws. Ensure the nuts are tight.

CAUTION

ENSURE TRANSISTORS ARE INSTALLED CORRECTLY. INCORRECT INSERTION WILL CAUSE EQUIPMENT TO FUNCTION INCORRECTLY.

I-26 Put Q1-Q8 (2N2907) in board. Check parts location drawing (figure 1) for proper locations. Bend the leads of the transistors to retain them in place until they are soldered. Turn the board over and rest it on books as before. Solder all of the transistors. Clip the leads flush with the underside of the board with the diagonal pliers.

NOTE

ENSURE POLARITY OF DISCRETE LEDS ARE CORRECT, FLAT SIDE OF LED FACES TOWARD THE GOLD FINGERS (BOTTOM OF BOARD).

I-27 Put DSP8-DSP20 (0.2" discrete LED's) in the board. Ensure polarity of LEDs are correct. Bend the leads of the LEDs to retain them in place until they are soldered. Turn the board over and rest it on books as before. Solder all of the LEDs. Clip the leads flush with the underside of the board with the diagonal pliers.

NOTE

ENSURE THAT THE CENTER LEADED SWITCHES ARE PLACED IN THE PLACES FOR S17-S22.

I-28 Put S1-S16 (SPDT on-off-on) in the board. Double check that only two position switches have been installed (see note above). The switches should fit tight enough on the board that they will stay in place when the board is turned over for soldering. Turn the board over and solder the switches in place.

I-29 Put S17-S22 (SPDT spring loaded center off on-off-on) in the board. Turn the board over and solder the switches in place.

I-30 Clean off the flux on the underside of the board with flux cleaner.

II. Inspection and Testing

II-1 Use a bright light and magnifying glass to inspect all the traces on the underside of the board. If any slivers are found, cut and scrape them with an Xacto knife. Use the solder wick and soldering iron to remove any solder bridges found. Cover the solder bridge with flux and then place a clean piece of solder wick on top of the bridge. Place the soldering iron on top of the solder wick. Remove the iron and wick. Check to see if the bridge has been completely removed. If not, repeat the process until the bridge has been removed. Clean the flux off the board with flux cleaner.

NOTE

AT THIS TIME NO IC'S HAVE BEEN INSTALLED ON THE BOARD DO NOT INSTALL IC'S ON THE BOARD UNTIL CALLED FOR IN THE CHECKOUT PROCEDURE.

II-2 Place the multimeter in the R x 1 scale. Place one probe on the gold finger for pin one. Place the other probe on all the other fingers sequentially to check for shorts. Repeat this procedure for each pin. There should only be two sets of pins that are shorted; 1 to 51 and 50 to 100. If there are any other pair of pins that are shorted, use a strong light and magnifying glass to locate the solder bridge or sliver causing the short. When the short has been located, correct it as outlined in II-1.

CAUTION

DO NOT INSTALL OR REMOVE ANY BOARD IN COMPUTER WITH POWER ON. DAMAGE TO BOARDS AND COMPUTER MAY RESULT.

II-3 Ensure computer is OFF. Plug the FPB-1 into the motherboard. Check that FPB-1 is correctly plugged in and the board is fullyseated in the connector. Turn computer power ON and check outputs of both regulators on FPB-1. If any regulator does not have an output voltage of 4.8 to 5.2 volts, turn computer power OFF and replace defective regulator. Repeat II-3 until both regulator voltages are good. If voltages are good, turn computer power OFF and remove FPB-1 from motherboard.

II-4 Install all IC's on FPB-1. Check parts placement drawing (see figure 1) for proper location and correct polarity of IC's.

CAUTION

ENSURE ALL IC'S ARE INSTALLED CORRECTLY. INCORRECT POLARIZATION OF IC WILL RESULT IN DAMAGE TO IC AND CAUSE SUBSEQUENT TROUBLES TO APPEAR ON BOARD.

II-5 Install jumper located just above the edge connector. For 8080A processor boards, jumper 1 to 2. For Z-80 boards that provide M1 state on the Data #5 line, jumper 1 to 2. For Z-80 boards that do not provide M1 status on the Data #5 line, jumper 2 to 3.

III. Assembly of Cover for FPB-1

III-1 If you are replacing the IMSAI CP-1 front panel assembly, it is possible to use all the plexiglas, standoffs, nuts and screws that you presently have. The only replacement parts needed are the photo mask and white paper mask with cutouts. These are available from your WAMECO dealer for a nominal charge. This part kit is the FPBC-1.

III-2 If you are not replacing an IMSAI front panel assembly, it will be necessary for you to construct a cover for your front panel board. The exterior dimensions of the cover will be dictated by the case that you are going to use to house your computer. The cover will consist of four different layers (see figure 5). Since the exterior dimensions of the cover will vary with your case size, it will be easier for you to purchase the plexiglas locally cut to size, than for us to

sell you an oversized sheet for you to cut down. You will need two pieces. Both are 1/8" thick, one clear one red. You will also need to purchase the FPBC-1 which is described in III-1.

NOTE

IT IS POSSIBLE THAT THE HEATSINKS USED ON THE FPB-1 MAY CAUSE A CLEARANCE PORBLEM WITH THE CP-A PLEXIGLAS. IF THIS OCCURS, FILE DOWN THE TOPS OF THE HEATSINKS UNTIL CLEARANCE IS OBTAINED OR PLACE A WASHER BEHIND THE RED PLEXIGLAS ON EACH SCREW.

III-3 If you are making your own case you should place a support (or two braces) behind the FPB-1. This support should be firmly fastened to the case. It will absorb the stress placed on the FPB-1 when the switches are operated. The width of the support will be dictated by the inside dimensions of your case. The height should be 3 to 3½". The support can be screwed or riveted to your case. It is recommended that you fabricate the support, assemble the cover assembly as shown in figure 5, plug the front panel board into your motherboard and then position your motherboard to align the front panel to your liking. After this has been done, mark the position of your motherboard and supports on the case and secure them by whichever method seems most feasible to you. We recommend that you have ½" standoffs under your motherboard so it will not short out on the case.

IV. Electrical Connection of FPB-1

IV-1 There are two electrical connections to be made on the FPB-1. One set of connections are made by plugging the board into the motherboard. The second set is made by plugging a 16 pin double ended dip jumper from the FPB-1 to the CPU board. If you are using an IMSAI computer, use the dip jumper you already have. If you are building your own computer, you can use an AP dip jumper #924116-12-R.

NOTE

CHECK THE SCHEMATIC OF BOTH THE FPB-1 AND YOUR CPU BOARD WHEN PLUGGING IN THE DIP JUMPER TO ENSURE THAT YOU MATCH UP DO THRU D7.

V. General

V-1 This WAMECO product is guaranteed for a period of ninety (90) days from date of purchase from your dealer against defects in manufacturing. Upon receipt of the defective board by WAMECO, INCORPORATED, pre-paid freight or mailing, the defective board will be cheerfully replaced and the shipping charges incurred by you will be repaid- The guarantee is limited to replacement of the board with an equivalent board, even though the board may be defective through negligence in manufacturing or through other fault.

V-2 For reference, front and rear views of the FPB-1 traces are furnished (see figures 6A and 6B).

V-3 We sincerely hope that the FPB-1 will give you long and satisfactory service. If you have any problems with the FPB-1, or if you just want to comment on the board, please write to us.

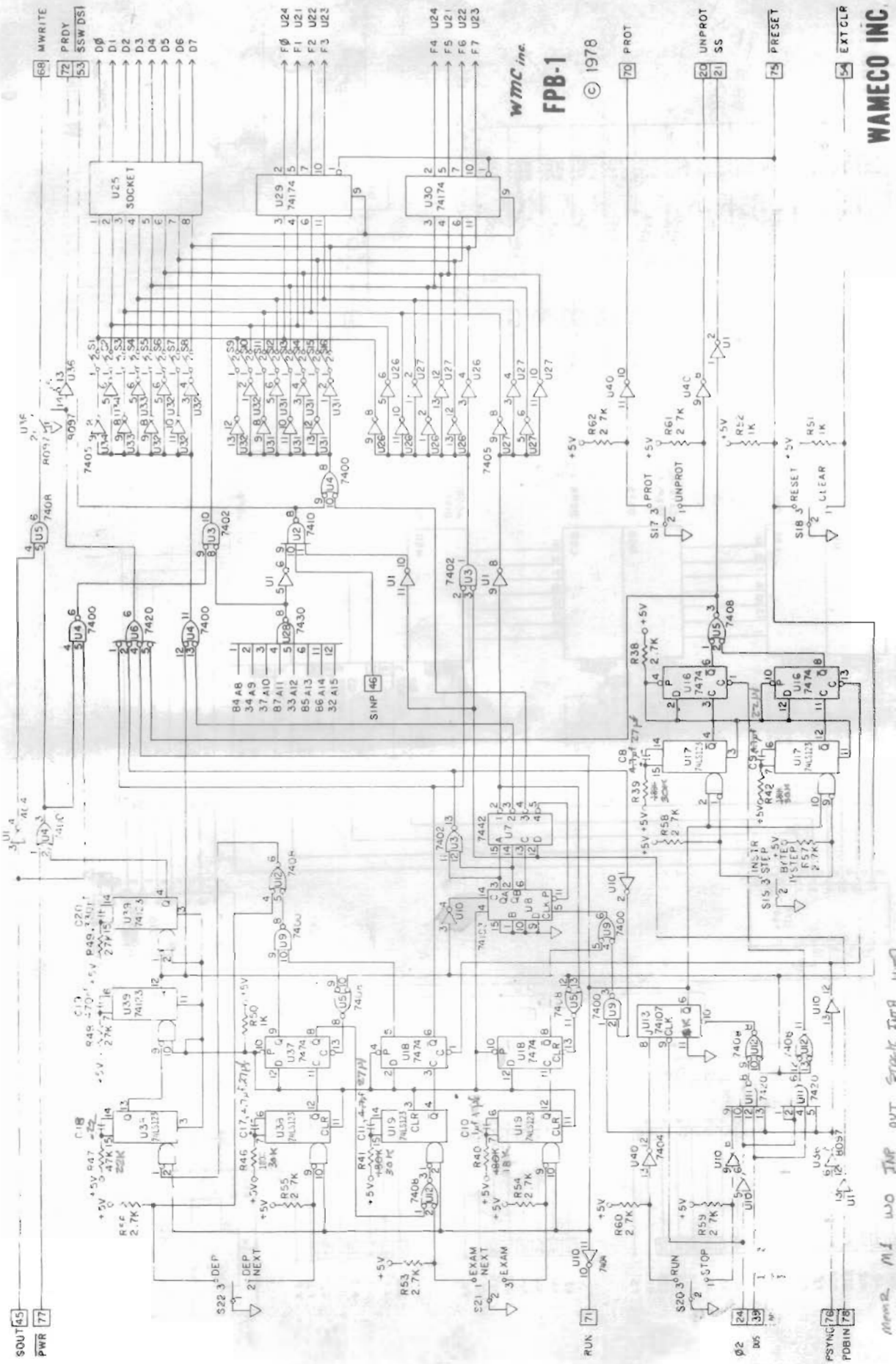


Figure 4. Schematic of FPB-1 (page 1).

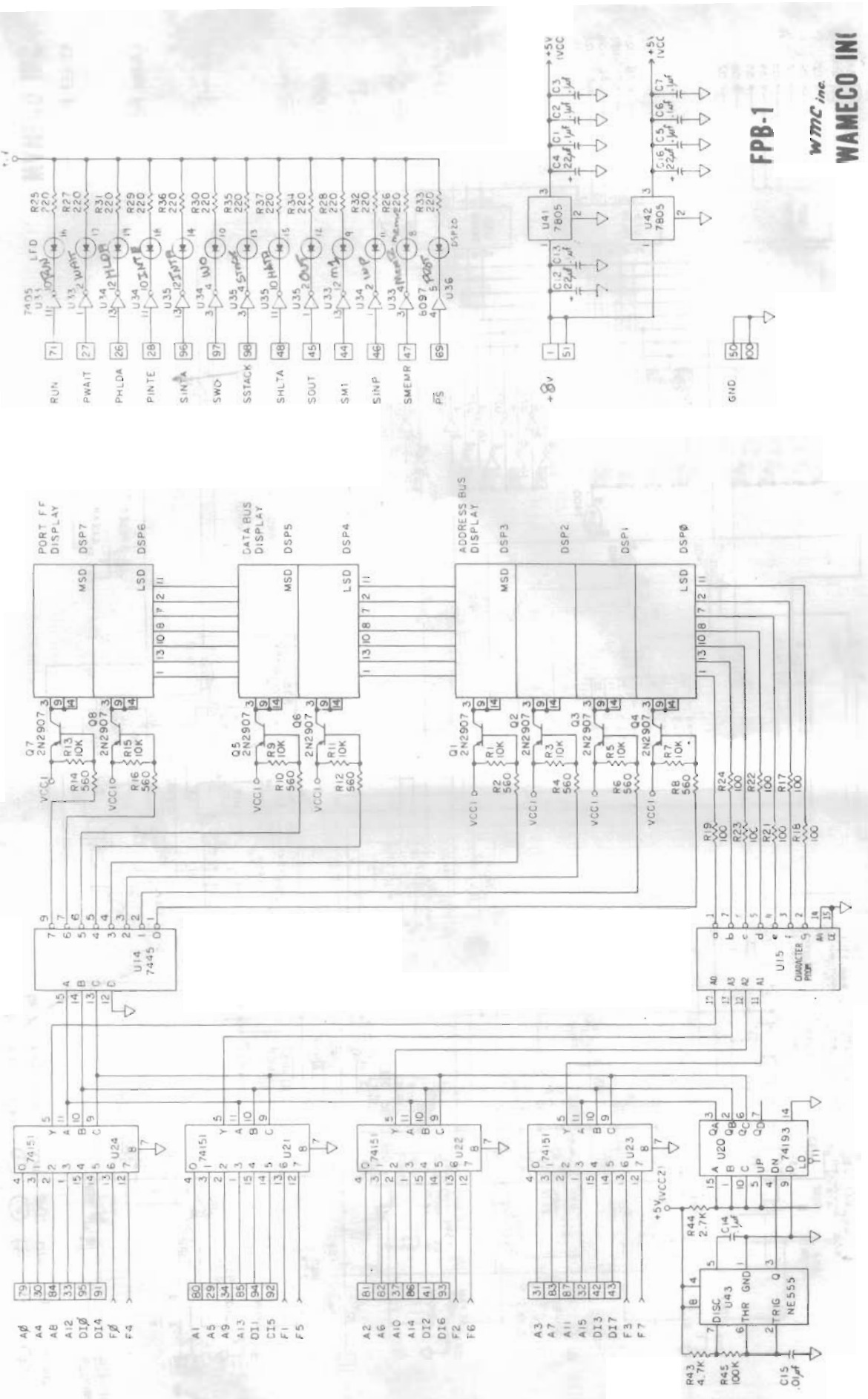


Figure 4. Schematic of FPB-1 (page 2).

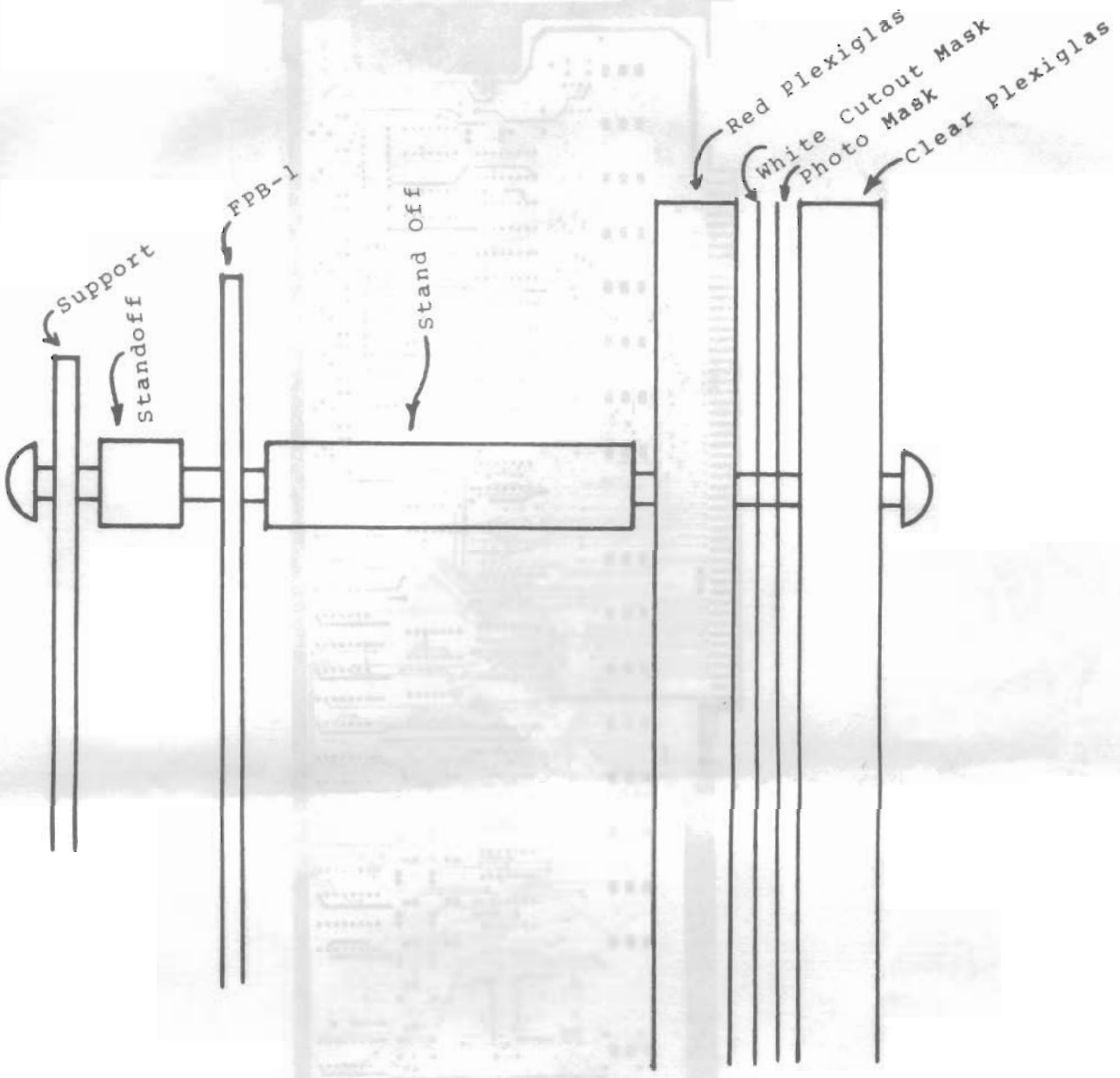


Figure 5. FPR-1 COVER ASSEMBLY

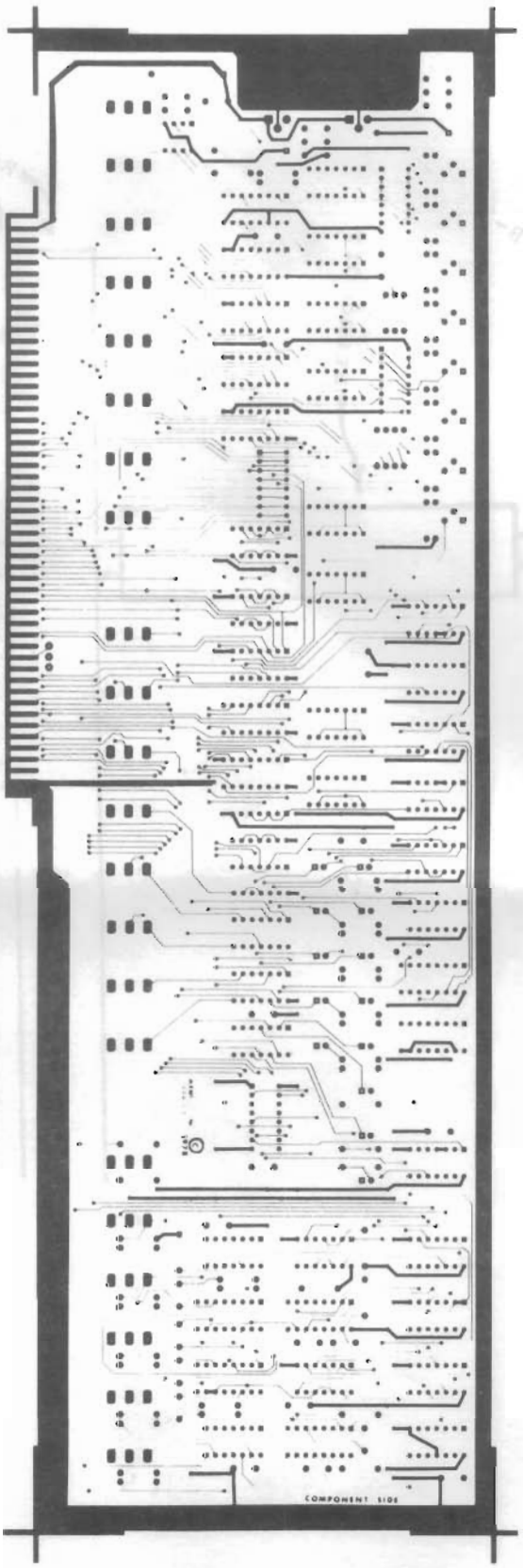


Figure 6A. Component Side of FPB-1

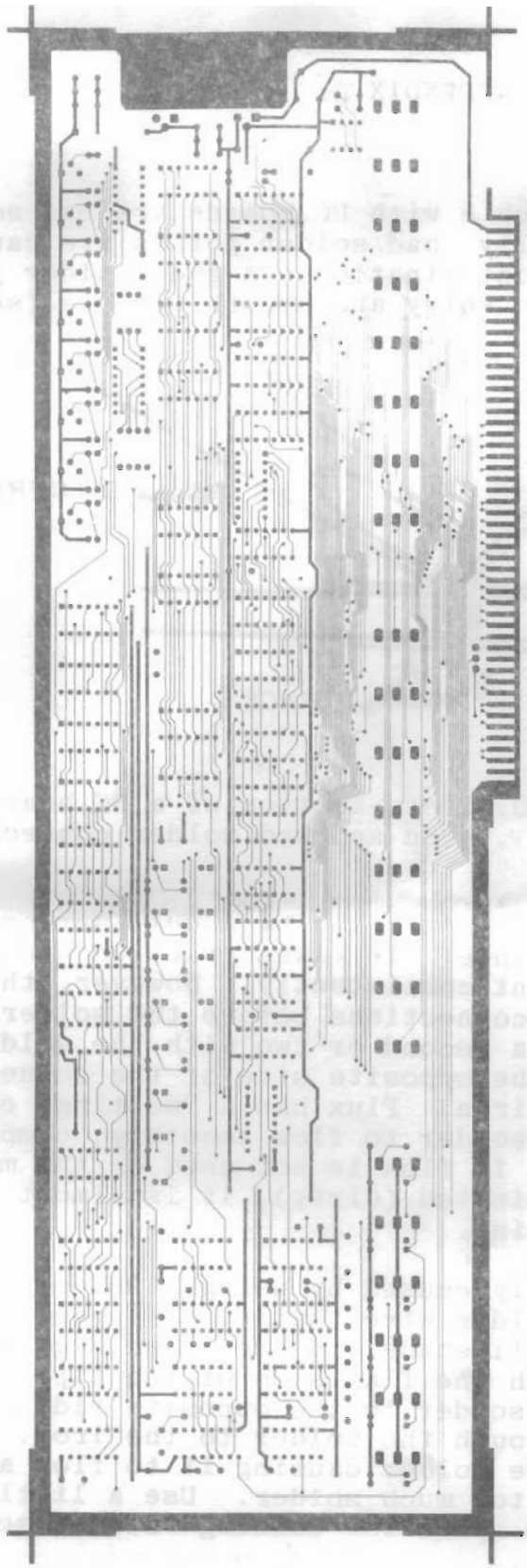


Figure 6B. Reverse Side of FPB-1

APPENDIX B

Soldering PC Boards

Two common causes of trouble with PC boards are bad solder joints or solder bridges. Usually, bad solder joints are caused by either a cold solder joint or contamination. A good solder joint is characterized by a bright shiny and smooth surface (see Figure 10).

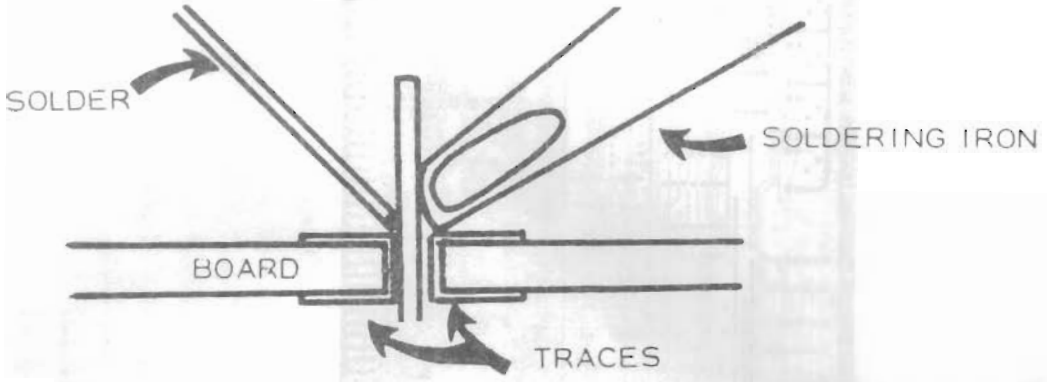


Figure 10. Cross-section of a PC board showing good and bad solder connections

A cold solder joint is characterized by a dull surface and usually a lumpy or balled appearance. It takes practice and patience to obtain a good solder joint consistently. However, the first step is to apply flux to all connections before the solder. Second, heat the connection for a second or two with the soldering iron. Third, apply solder to the opposite side of the connection. Don't touch the solder to the iron. Flux has a "wetting" effect on solder which causes the solder to flow smoothly, completely filling the connection. If flux is not used or the metal around the connection is contaminated (dirty), it is almost impossible to have a good solder joint.

Solder bridges are usually caused by using a soldering iron tip that's too large, solder wire that's too large or trying to rush the job. Use a small spade tip iron (see Figure 11). Touch the connection with the flat side of the tip. After the flux bubbles, touch the solder to the opposite side of the connection. Again, don't touch the solder to the iron. The connection is hot enough to melt the solder causing it to flow around the connection. Do not use too much solder. Use a little and watch it flow. Solder is like spice for cooking--don't use too much.

Applying heat for extended periods will cause either or both of the following: the trace or pad will lift from the board or the board material will turn brown. Remove the iron before this happens. One hobbyist counts the bubbles that pop in the solder. He found seven to nine bubbles insured a good solder flow without overheating.

S-100 (WAMECO) BUS DESCRIPTION

Pin #	Mnemonic	Enabled State	Description
1	+8 Volts	NA	Unregulated +8 Volts DC. This voltage should not be less that +8 or greater than +11 volts..
2	+16 Volts	NA	Unregulated +16 Volts DC. This voltage should not be less than +16 or greater than +20 Volts.
3	XRDY	Low	Causes CPU to enter WAIT state when enabled.
4	$\overline{\text{VI0}}$	Low	Vectored Interrupt priority 0.
5	$\overline{\text{VI1}}$	Low	Vectored Interrupt priority 1.
6	$\overline{\text{VI2}}$	Low	Vectored Interrupt priority 2.
7	$\overline{\text{VI3}}$	Low	Vectored Interrupt priority 3.
8	$\overline{\text{VI4}}$	Low	Vectored Interrupt priority 4.
9	$\overline{\text{VI5}}$	Low	Vectored Interrupt priority 5.
10	$\overline{\text{VI6}}$	Low	Vectored Interrupt priority 6.
11	$\overline{\text{VI7}}$	Low	Vectored Interrupt priority 7.
12	---	NA	Not used
13	---	NA	Not used
14	----	NA	Not used
15	---	NA	Not used
16	---	NA	Not used
17	---	NA	Not used
18	STAT DISABLE	Low	The eight line buffers on the CPU board enter the high impedance state when enabled
19	C/C DISABLE	Low	The six command/control line buffers on the CPU board enter the high impedance state when enabled.
20	UNPROTECT	High	Combined with address in an AND gate on a memory board which causes the PROTECT flip-flop to be cleared.
21	SS	High	Indicates the CPU is single stepping.

22	$\overline{\text{ADDR DSBL}}$	Low	The 16 address line buffers on the CPU board enter the high impedance state when enabled.
23	$\overline{\text{DO DSBL}}$	Low	The eight data-out lines on the CPU board enter the High impedance state when enabled.
24	Ø2	High	Buffered TTL CPU phase 2 clock.
25	Ø1	High	Buffered TTL CPU phase 1 clock.
26	PHLDA	High	CPU board "Hold Acknowledge" to Hold-H input.
27	PWAIT	High	CPU output showing a WAIT state is occuring.
28	PINTE	High	CPU output showing that Interrupts are enabled.
29	A5	High	Address Bit 5
30	A4	High	Address Bit 4
31	A3	High	Address Bit 3
32	A15	High	Address Bit 15
33	A12	High	Address Bit 12
34	A9	High	Address Bit 9
35	DO1	High	CPU Data Out Bit 1
36	DO0	High	CPU Data Out Bit 0
37	A10	High	Address Bit 10
38	DO4	High	CPU Data Out Bit 4
39	DO5	High	CPU Data Out Bit 5
40	DO6	High	CPU Data Out Bit 6
41	D12	High	Data In Bit 2 to CPU
42	D13	High	Data In Bit 3 to CPU
43	D17	High	Data In Bit 7 to CPU
44	SM1	High	CPU output indicating it is performing Fetch Instruction.
45	SOUT	High	CPU output showing it is in an output cycle.
46	SINP	High	CPU output showing it is in an input cycle.
47	SMEMR	High	CPU status signal indicating the current cycle is a Memory Read cycle.
48	SHLTA	High	CPU status signal indicating the CPU is halted.
49	CLOCK (2MHz)	Low	A buffered 2 MHz clock for general use.
50	GND	NA	Ground (common)
51	+8 Volts	NA	Same as pin 1
52	-16 Volts	NA	Unregulated -16 Volts DC This voltage should not be greater than -16 or less than -20 Volts.
53	$\overline{\text{SSW DSB}}$	Low	Sense Switch Disable disables CPU board data

			input buffers so that CPU can read sense switches.
54	$\overline{\text{EXT CLR}}$	Low	Front Panel generated I/O clear signal.
55	---	NA	Not used
56	---	NA	Not used
57	---	NA	Not used
58	---	NA	Not used
59	---	NA	Not used
60	---	NA	Not used
61	---	NA	Not used
62	---	NA	Not used
63	---	NA	Not used
64	---	NA	Not used
65	---	NA	Not used
66	---	NA	Not used
67	PHANTOM	NA	Used for Memory Bank Selection.
68	MWRITE	High	CPU output showing Data Out Bus Data is to be written into the memory selected by the address lines.
69	$\overline{\text{PS}}$	Low	Shows Protect Status of selected memory.
70	PROTECT	High	Combined with address in an AND gate on a memory board which causes the PROTECT flip-flop to be set.
71	RUN	High	Front panel indication that CPU run instruction has been input.
72	PRDY	Low	Causes the CPU to enter the WAIT state when enabled
73	$\overline{\text{PINT}}$	Low	If interrupts have been enabled causes the CPU to enter the Interrupt Acknowledge condition at the conclusion of the current instruction.
74	PHOLD	Low	CPU input which causes a HOLD status to occur. DMA transfer request signal is PHOLD.
75	$\overline{\text{PRESET}}$	Low	CPU board system reset signal.
76	PSYNC	High	Cpu output showing the start of a new machine cycle. This signal is used on the CPU board to enable the loading of the System Status Latch.
77	PWR	Low	Indication that data on the Data Out Bus is to be

			written either to a memory or an I/O device.
78	PDBIN	Low	Indication to the selected Memory or I/O device that the CPU expects data on the Data In Bus.
79	A0	High	Address Bit 0
80	A1	High	Address Bit 1
81	A2	High	Address Bit 2
82	A6	High	Address Bit 6
83	A7	High	Address Bit 7
84	A8	High	Address Bit 8
85	A13	High	Address Bit 13
86	A14	High	Address Bit 14
87	A11	High	Address Bit 11
88	DO2	High	CPU Data Out Bit 2
89	DO3	High	CPU Data Out Bit 3
90	DO7	High	CPU Data Out Bit 7
91	DI4	High	Data In Bit 4 to CPU
92	DI5	High	Data In Bit 5 to CPU
93	DI6	High	Data In Bit 6 to CPU
94	DI1	High	Data In Bit 1 to CPU
95	DI0	High	Data In Bit 0 to CPU
96	SINTA	High	CPU Interrupt Acknowledge Signal
97	SWO	Low	CPU output indicating the current cycle involves writing to a memory or I/O device.
98	SSTACK	High	CPU output indicating the address bus contains the stack address and the current cycle will have a stack operation.
99	$\overline{\text{POC}}$	Low	Power On Clear reset signal
100	GND	NA	Groung (common)

Pin	MNEMONIC	Term.
1	+5V	
2	+15V	
3	XRDY	X
4	VIØ	X
5	VI1	X
6	VI2	X
7	VI3	X
8	VI4	X
9	VI5	X
10	VI6	X
11	VI7	X
12		
13		
14		
15		
16		
17		
18	STAT DISABLE	X
19	CIC DISABLE	X
20	UNPROTECT	X
21	SS	X
22	ADDR DSBL	X
23	DO DSBL	X
24	Ø2	X
25	Ø1	X
26	PHLDA	X
27	PWAIT	
28	PINTE	
29	A5	
30	A4	
31	A3	
32	A15	
33	A12	
34	A9	
35	DO1	X
36	DOØ	X
37	A10	
38	DO4	X
39	DO5	X
40	DO6	X
41	DI2	X
42	DI3	X
43	DI7	X
44	SMI	
45	SOUT	
46	SINP	
47	SMEMR	
48	SHLTA	
49	CLOCK (2MHz)	
50	GND	

Pin	MNEMONIC	Alter. pin desig.	Term.
51	+5V	A	
52	-15V	B	
53	SSW DSB	C	
54	EXT CLR	D	X
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	PHANTOM	U	
68	MWRITE	V	X
69	PS	W	
70	PROTECT	X	X
71	RUN	Y	X
72	PRDY	Z	X
73	PINT	a	X
74	PHOLD	b	X
75	PRESET	c	X
76	PSYNC	d	X
77	PWR	e	X
78	PDBIN	f	X
79	AØ	h	
80	A1	j	
81	A2	k	
82	A6	l	
83	A7	m	
84	A8	n	
85	A13	p	
86	A14	r	
87	A11	s	
88	DO2	t	X
89	DO3	u	X
90	DO7	v	X
91	DI4	w	X
92	DI5	x	X
93	DI6	y	X
94	DI1	z	X
95	DIØ	AA	X
96	SINTA	AB	
97	SWO	AC	
98	SSTACK	AD	
99	POC	AE	
100	GND	AF	

Switch	Names	Function
S1-S16	Data Switches	All data and address information input from the front panel uses these switches. The LSB is S1, the MSB is S16. The address uses all 16 switches. The data deposited from the front panel by S22 uses S1-S8, input port FF uses S9-S16. All information is inputed in binary format.
S17	Protect/Unprotect	In the PROTECT (up) position, memory contents cannot be altered. In the UNPROTECT (down) position, memory contents can be written into (altered).
S-18	Reset/Clear	The RESET (up) position sets the Program Counter (PC) to address 0000H. No memory contents are changed. In the CLEAR (down) position gives a CLEAR command to all the external I/O cards.
S19	Instruction Step/ Byte Step	The INSTRUCTION STEP (up) position allows the computer to step through the next command in the program. This allows the operator to debug a program because the program will step through its execution exactly as it would operate in RUN mode. The only problems that INSTRUCTION STEP will not locate are timing or time dependent glitches. The BYTE STEP (down) position allows the computer to step through the program one BYTE at a time. This allows the operator to verify that the correct instructions were input.
S20	RUN/STOP	The RUN (up) position allows the computer to start or resume running the program. The STOP (down) position stops the computer at the next instruction. The computer will not resume running until RUN is selected.

Table II. FPB-1 control and data switches

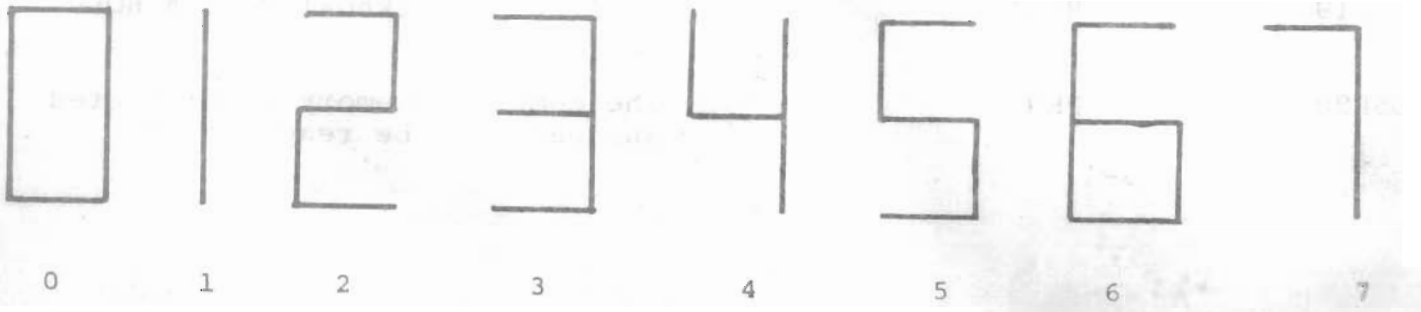
Switch	Name	Function
S21	Examine/Examine Next	The EXAMINE (up) position allows the operator to examine the contents of the Memory location selected by S1-S16. EXAMINE NEXT (down) position allows the operator to inspect the next location in memory after the one that is presently being displayed.
S22	Deposit/Deposit Next	The DEPOSIT (up) position allows the operator to write into a memory location using S8-S16, if the memory was not being protected by the PROTECT switch. The DEPOSIT NEXT (down) position allows the operator to write into the next memory location after the one that is presently selected.

Table II. FPB-1 Control and Data Switches

LED	Name	Function
DSPO-DSP3	Address	The memory location address presently being examined or written into is displayed in hexadecimal form (see Table IV) for displays.
DSP4,DSP5	Memory Data	The data of the memory location being examined is displayed in hexadecimal form.
DSP6,DSP7	I/O Data	The data being outputed to port FF is displayed in hexadecimal format.
DSP8	MEMR	Memory read is taking place
DSP9	M1	The first machine cycle (instruction fetch) of an instruction is taking place.
DSP10	WO	A WRITE into memory of an OUTPUT is taking place.
DSP11	INP	Data will be input onto the data bus using the device designated by the address bus.
DSP12	OUT	Data will be output onto the data bus to the output device designated by the address bus.
DSP13	STACK	The address bus contains the Stack Pointer address.
DSP14	INTA	The CPU has acknowledged an interrupt request, an interrupt has occured or and instruction to disable the interrupt has been input.
DSP15	HLTA	The CPU has acknowledged this execution of a HALT instruction. The CPU is currently implementing program execution.
DSP16	RUN/STOP	
DSP17	WAIT	The CPU has acknowledged a STOP command from the front panel or a wait-state is implemented by the CPU to coordinate with some other device or board.

Table III. FPB-1 displays

LED	Name	Function
DSP18	INTE	An interrupt has been enabled.
DSP19	HLDA	The CPU has acknowledged a HOLD command.
DSP20	PROT	The computer memory is protected and can only be read out of.



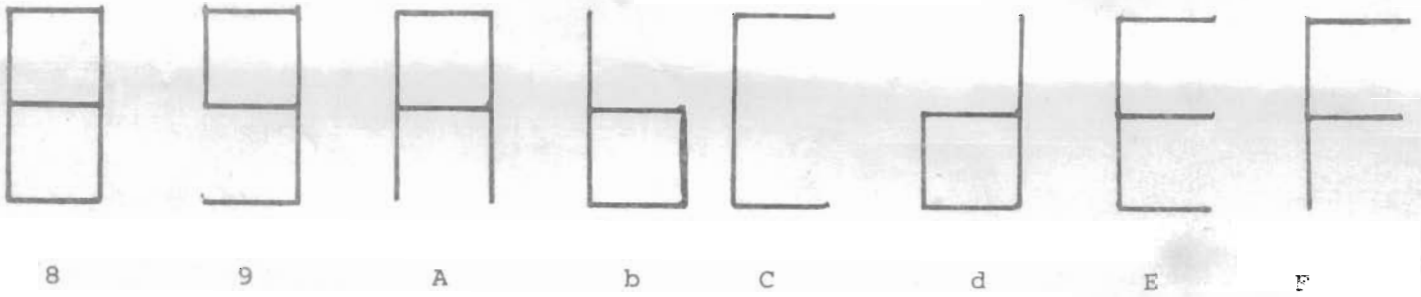


Table IV. 7 Segment Hexidecimal Display Format