ZMF100™ INSTALLATION GUIDE (May85c)

INTRODUCTION

The ZMF100™ is a modification "kit" which includes all of the parts and materials (except solder) needed to modify an "old" motherboard Z-100™ computer so that one, two or three sets (nine chips per set) of industry-standard 256K memory chips may be installed on the motherboard in place of 64K memory chips. No 64K chips may be installed. This permits up to 768K bytes of memory to be installed without using an S-100 bus card slot.

Included in the ZMF100™ "kit" are two small, pre-assembled printed circuit boards which plug-in in place of existing motherboard chips. The "replaced" chips then plug into sockets on the circuit boards.

Installation of the two circuit boards accomplishes most of the changes to the motherboard circuitry, however, a modification to the motherboard memory array is still required to connect pin-1 of all of the memory chip sockets together and to a short cable which plugs into one of the ZMF100™ circuit boards. This modification is necessary because 256K memory chips need two more address bits than 64K chips. The two new address bits are multiplexed together and connect to pin-1 of the 256K chips. Pin-1 is not used by the 64K memory chips.

MATERIALS SUPPLIED

The following items are supplied with the ZMF100™ package:

- ZMF100™ Installation Guide Booklet
- Small Circuit Board
- Large Circuit Board
- Wire Pack Containing:
  - One-Wire Cable (Connector on One End)
  - Two-Wire Cable (Connectors on Both Ends)
  - 16 inches of #26 Solid Bare Wire
  - 13 inches of Insulating Sleeving

HOW IT WORKS

The ZMF100™ circuit boards "fool" the existing high address decoder PAL (U173) and memory mapping PROM (U111) by altering their address bit connections so that they decode 256K memorybanks instead of 64K banks. Because of this, the "bank swapping" Memory Maps 1, 2, and 3 (used by some 8-bit operating systems such as Watzman CP/M®Plus) will no longer function as described in the Z-100™ documentation when the ZMF100™ is installed. Memory Map 0 (used by Z-DOS™, MS™DOS, CP/M®86 and CP/M®85) functions normally.

Memory Maps 1, 2, and 3 still function but the memory swaps take place on 256K banks instead of 64K banks. The 8-bit CPU will not see any difference but the 16-bit CPU will see the swap area addresses four times higher in memory than before.

The large circuit board includes a chip (U1) to multiplex the two extra address bits required by the 256K RAM chips.

With the ZMF100™ installed, memory installed on the S-100 bus can no longer be accessed. This is because all of the memory is now "on the motherboard" regardless of how many banks of 256K memory chips installed. A simple change (described in Appendix C on page 9) to the ZMF100™ small circuit board will allow access to some memory on the S-100 bus.

INSTALLATION

Installation of the ZMF100™ package consists of modifying the memory array and installing the ZMF100™ circuit boards. The installation procedure is relatively simple but there is an element of **risk of damage** to the computer involved. Before you start the installation, please read over the entire procedure. If you do not feel confident that you can perform the installation safely, please return your ZMF100™ package to your dealer for a refund.

The modification to the memory array consists of connecting all of the pin-1's of the sockets at locations U101-U109, U117-U125, and U137-U145 together and to the one-wire cable.

The recommended procedure for modifying the memory array is described under **MEMORY ARRAY MODIFICATION** and is, in our judgement, the safest method and produces the cleanest and most reliable installation. The procedure requires soldering and so is "permanent" but the changes can be easily and cleanly removed to return the motherboard to its original state. Removal of the motherboard is required but this simplifies the soldering and results in better connections. Alternate methods that do not require the removal of the motherboard are described in Appendix A on page 8.

Note that even with the memory array modified the 64K memory chips may be installed and the ZMF100™ circuit boards removed to restore the computer to "normal" operation. The memory array modification does not interfere with the operation of the 64K memory chips.

INITIAL DISASSEMBLY

To install the ZMF100™ you must first disassemble your computer. Initially, the procedure used depends on which model of computer that you have: All-In-One or Low-Profile. Follow the step-by-step procedure applicable to your model and keep in mind that you will have to reassemble the computer later.

ALL-IN-ONE INITIAL DISASSEMBLY

1. Unplug the Z-100™ line cord from the AC outlet.
2. Remove the cabinet top as shown in the Zenith manual.
3. Remove the rear screw of each cover latching slide.
4. Pivot each slide outward.
5. Remove the five screws which hold the drive/video subassembly to the to the base assembly.
6. Carefully lift the drive/video subassembly up and to the front of the computer about 4 or 5 inches and set it back down.
7. Unplug the signal/power cable from the video deflection board.
8. Unplug the disk controller cable from the H/Z207 board.
9. Unplug the power cable from each disk drive.
10. Remove the drive/video subassembly and set it aside.
11. Proceed to **FINAL DISASSEMBLY.**

LOW-PROFILE INITIAL DISASSEMBLY

1. Unplug the Z-100™ line cord from the AC outlet.
2. Remove the cabinet top as shown in the Zenith manual.
3. Remove the four screws and two locking pins that hold the drive subassembly to the base assembly.
4. Carefully lift the drive subassembly up and to the front of the computer about 2 inches and set it back down.
5. Unplug the disk controller cable from each disk drive.
6. Unplug the power cable from each disk drive.
7. Remove the drive subassembly and set it aside.
8. Remove the two remaining locking pins.
9. Proceed to **FINAL DISASSEMBLY.**

FINAL DISASSEMBLY

1. Remove the lower cabinet shell and set it aside.

2. Lift the keyboard up and move it forward to expose the keyboard connectors on the motherboard. Carefully unplug these connectors and set the keyboard aside.

3. Remove the three screws that hold the video logic board in place.

4. Swing the video logic board up and towards the back and leave it leaning on the cardfile.

5. Unplug the video logic board's 40-pin ribbon cables from the motherboard at P104 and P106.

6. Swing the video logic board to the left without unplugging any of the cables connected to it and leave it positioned out of the way.

7. Remove all the cards from the cardfile and set them aside.

8. Remove the two rear panel screws that hold the cardfile to the rear panel.

9. Remove the four screws from the motherboard that hold the cardfile in place.

10. Remove the cardfile and set it aside.

11. Remove the nine screws and three hex spacers that hold the motherboard in place. Remember where the spacers were installed!

12. Lift the front edge of the motherboard up slightly and pull it forward until the rear panel connectors clear the inside of the rear panel.

13. Twist the front of the motherboard to the left and lift the right edge upwards until it clears the right side of the computer's base assembly and the power supply connectors can be unplugged.

14. Unplug the power supply connectors at P101 and P102.

15. Remove the motherboard from the computer's base assembly and lay it with the component side upwards on your work surface.

16. Remove all of the 64K memory chips from the memory array (U101-U109, U117-U125, and U137-U145) and set them aside. Wrap the chips in aluminum foil or plug them into conductive foam to protect them against static electricity.

MEMORY ARRAY MODIFICATION

Locate the insulating sleeving and cut the following sleeves:

21 SHORT sleeves 3/8" long
3 MEDIUM sleeves 7/16" long
2 LONG sleeves 7/8" long

Position the motherboard so that the circuit side is upwards and the memory array is at the lower left corner. Using a felt-tip (or similar) pen, mark the motherboard next to the pin-1 pads to be connected. Install the solid bare wire and insulating sleeves as shown in Figure 1 (follows page 10).

Solder the wire to each pin-1 IC pad (now easily identifiable by the pen mark) in the memory array starting at U137 and ending at U109. Don't attempt to make a "mechanical" connection at the pads. Just solder the wire to the pad and route it to the next marked pin-1 pad. Do not cut the wire except at the last connection (U109).

At each connection, use enough solder to cover the wire and the pad. Too little solder may allow the wire to "pop" loose if the motherboard is flexed. Slip the insulating sleeves between connections as the wire is installed to prevent the wire from contacting any other pads.

After the wire has been installed, connect the stripped end of the one-wire cable to pin-1 of U109. Route the cable as shown in Figure 1.

Visually inspect each pin-1 connection to make sure that it is good. Trace the path of the wire and make sure that it does not contact any other pins or conductors.

Turn the motherboard over so that the component side faces upwards. If you have an ohmmeter or continuity checker, use it to verify that there is continuity between the connector on the end of the one-wire cable and pin-1 of every memory chip socket. Verify that there is no continuity between the cable connector and pin-8 or pin-16 of the socket at U109.

INTERMEDIATE TESTS (OPTIONAL)

If you are confident that your pin-1 wiring job is okay, you may wish to skip ahead to **CIRCUIT BOARD INSTALLATION.**

Reinstall the motherboard by reversing the procedure you used to remove it. Don't replace the card cage but do install enough screws to hold the motherboard in place. Install the three hex spacers that support the video logic board.

Reinstall 64K memory chips at U101-U109 and U117-U125. As you install the chips, make sure that the pin-1 end of the chip (identified by a "notch" or "dot" on the IC) is oriented

towards the pin-1 marking on the motherboard and that none of the IC pins "roll under" or bend out of the socket.

Reconnect the video logic board cables and remount the board using at least two screws. Reinstall the keyboard and the video monitor but not the disk drives. Reinstall enough screws to keep everything safely in place.

Connect the AC power cable and turn the computer on. After a few seconds, the Monitor program should show a "Device Error" message (there's no disk controller!) and display the hand prompt. If this doesn't happen, power down, disassemble the computer, and recheck everything. There must be a mistake so fix it now. See **IN CASE OF DIFFICULTY.**

If everything worked as expected, power down and disassemble the computer but do not disconnect the keyboard or remove the video logic board. Just lift the keyboard up, move it forward, and set it down and then remove the screws holding the video logic board in place and swing it up and towards the back of the computer and out of the way. Remove the 64K memory chips, as before.

ZMF100™ CIRCUIT BOARD INSTALLATION

1. Locate and remove the IC at location U173. Note the orientation of the chip.

2. Plug this IC into the socket labeled U173 on the small circuit board. Make sure that the pin-1 end of the IC (identified by a "notch" or "dot" on one end of the IC) is oriented towards the "dot" on the circuit board.

3. Position the small circuit board so that P173 side is towards the front of the computer.

4. Align the pins of P173 with the socket at location U173 on the motherboard. The IC should be oriented the same way that it was when it was installed in the socket on the motherboard. Push the pins of P173 firmly into the socket until the pins are fully inserted.

5. Locate and remove the IC at location U111. Note the orientation of the chip.

6. Plug this IC into the socket labeled U111 on the large circuit board. Make sure that pin-1 end of the IC is oriented towards the "dot" on the circuit board.

7. Locate and remove the IC at location U128. Note the orientation of the chip.

8. Plug this IC into the socket labeled U128 on the large circuit board. Make sure that pin-1 end of the IC is oriented towards the "dot" on the circuit board.

9. Position the large circuit board so that the P111/P128 side is towards the front of the computer.

10. Align the pins of P111 and P128 with the sockets at U111 and U128 on the motherboard. The chips should be oriented as they were when installed in the sockets on the motherboard. Push the pins of P111/P128 into the sockets until the pins are fully inserted.

11. Connect the two-wire cable supplied with the ZMF100™ from P1 on the small circuit board to P1 on the large circuit board. Orient the cable so that the wires of the cable are flat (i.e., no twist).

12. Connect the one-wire cable from the memory array to P2 on the large circuit board.

FINAL TESTS

Install the 256K memory chips. The first set installs at U101-U109, the second at U117-U125, and the third at U137-U145. As you install the chips, make sure that the pin-1 end of the chip (identified by a "notch" or "dot" on the IC) is oriented towards the pin-1 mark on the motherboard and that none of the IC pins "roll under" or bend out of the socket.

Reassemble the computer to the point of operability, as in **INTERMEDIATE TESTS**, and power up. The Monitor program should come up normally. Use the 'S' command to find out how much memory you have installed. If the command indicates less memory than you have installed, the cable between the two ZMF100™ boards is probably twisted. Fix it.

Run the Monitor program's memory test (it's under the TEST command). If the memory test works normally, reassemble the computer by reversing the disassembly procedure. This completes the installation.

IN CASE OF DIFFICULTY

Remove the ZMF100™ circuit boards and inspect them carefully. Look for IC pins that "rolled under" or were bent out when the chips were plugged into the sockets. Make sure all of the pins on P111, P128, and P173 are present and not bent over. Finally, look for assembly errors (unsoldered pins, missing components, etc.) on the ZMF100™ circuit boards.

If you get a memory error message when running the Monitor program memory test, check the chips installed at U101-U109 for "rolled under" or bent out pins. The Monitor program only tests the first 192K of memory, all of which is in the first set of 256K memory chips. If you do not find an improperly installed IC, recheck the pin-1 wiring. A connection may have come loose.

APPENDICES

A. ALTERNATE MEMORY MODIFICATIONS

The goal of these alternate methods of modifying the memory array is to avoid soldering directly to the motherboard and to avoid having to remove the motherboard from the computer. All simply provide a place other than the motherboard to make the pin-1 connections when wiring the pin-1's together.

Method 1: Obtain the required number of "solder tail" 16-pin IC sockets suitable for plugging into the existing memory sockets. Bend pin-1 of each socket out at right angles to the outside of the socket and then "plug" the sockets into the memory chip sockets. Solder to the bent socket pins.

Method 2: Bend pin-1 of each memory chip outward slightly so that when the chip is inserted into the motherboard socket, pin-1 ends up on the outside of the socket. Solder to the bent IC pins.

B. EXTENDED MEMORY TESTING

The memory test in the Monitor program only checks the first three 64K Banks (0, 1 and 2) of memory. The procedure given below can be used to test higher memory Banks if you have the v2.5 Monitor program and the DEBUG program from v2.x MS-DOS. Run the DEBUG program. Enter the program instructions listed below with the "A100" command line. Do not enter the text to the right of the instructions.

```
CLD                     Autoincrement Pointers
MOV DI,8000             Destination Offset
MOV SI,8000             Source Offset
MOV AX,F000             Source Segment
MOV DS,AX
MOV CX,8000             Byte Count
REPNZ MOVSB             Copy Monitor Program
MOV AX,CS               Restore DS
MOV DS,AX
MOV AX,3000             Bank 3 (Segment to Test)
MOV ES,AX
CALL A626               Perform Test
```

When the program runs, it first copies the Monitor program from high memory (PROM) into its own segment. It then sets ES equal to the base segment address of the memory bank to test and calls a subroutine (MIMT_HB) in the relocated Monitor program. This subroutine performs a byte moving inversion test on the 64K Bank pointed at by the ES register.

To run the program and test 64K Bank 3, start execution with the "G=100 11D A65D A662" command line.

As the test is run, audible clicks will be generated. There are 66 clicks during the testing of one 64K Bank and a little over two minutes of running time is required. When testing is complete or if an error occurs, the program will exit to a breakpoint. At the breakpoint, if IP=011D, there were no errors detected. If IP=A65D, there was an error in the data bits. If IP=A662, there was an error in the parity bit.

Change the operand of the MOV AX,3000 instruction to point to the start of the next available 64K Bank (see table below) and repeat the test. Repeat this procedure until all available 64K Banks have been tested.

256K Chips	64K Bank	Operand
U101-U109	0	Use Monitor TEST
	1	Use Monitor TEST
	2	Use Monitor TEST
	3 *	3000
U117-U125	4	4000
	5	5000
	6	6000
	7 *	7000
U137-U145	8	8000
	9	9000
	10	A000
	11 *	B000

* If last Bank installed, reboot after testing.

If a Bank fails the test, the problem is probably caused by a defective or improperly installed memory chip. Check for a memory chip installed backwards or with a "rolled under" or bent out pin.

Note: Don't attempt to test the Bank in which the test program resides! Normally, this will be Bank 0 and Bank 0 can be tested with the Monitor program memory test. However, if certain memory resident programs (such as a memory disk) are loaded, "free" memory may start in Bank 3 or higher.

C. ACCESS TO S-100 BUS MEMORY

Memory at or above 512K (address 8000:0000) installed on the S-100 bus may be accessed with the ZMF100" installed only if a jumper is changed on the small circuit board.

On the small circuit board, near the label "U173" on the component side, are three "pads" in a row. On the other side of the board, the middle pad is connected to an outside pad by a trace. To enable S-100 bus memory access, cut this trace and install a jumper between the middle pad and the previously unconnected outside pad.

REPAIR POLICY

The ZMF100™ circuit boards are quite simple and are unlikely to develop any problems. However, if either of your boards does require repair, please contact us for a return authorization and shipping instructions. If you write, please include a brief description of the problem. If you call, please do so between 1 and 4 PM Pacific time. Our number is (206) 246-9815 and our address is at the bottom of the page.

WARRANTY

FBE Research Company, Inc. warrants to the original purchaser of a ZMF100™ package that, for a period of 120 days from the date of purchase from FBE Research Company, Inc. or an Authorized Dealer, the ZMF100™ circuit boards described herein shall be free of defects in material and workmanship under normal conditions of use and service. During this period, if a defect should occur, the ZMF100™ boards may be returned to FBE Research Company, Inc. for repair or replacement, at our option. No statements regarding the ZMF100™ boards performance or suitability for use shall be considered part of this warranty. This warranty becomes null and void if the either ZMF100™ board is misused, neglected, altered, or otherwise abused. There are no other warranties express or implied.

LIABILITY

FBE Research Company, Inc. accepts no responsibility, obligation, or liability for damages including but not limited to loss of profits or benefits arising from or consequential to the installation, use or misuse of the ZMF100™ package.

TRADEMARKS

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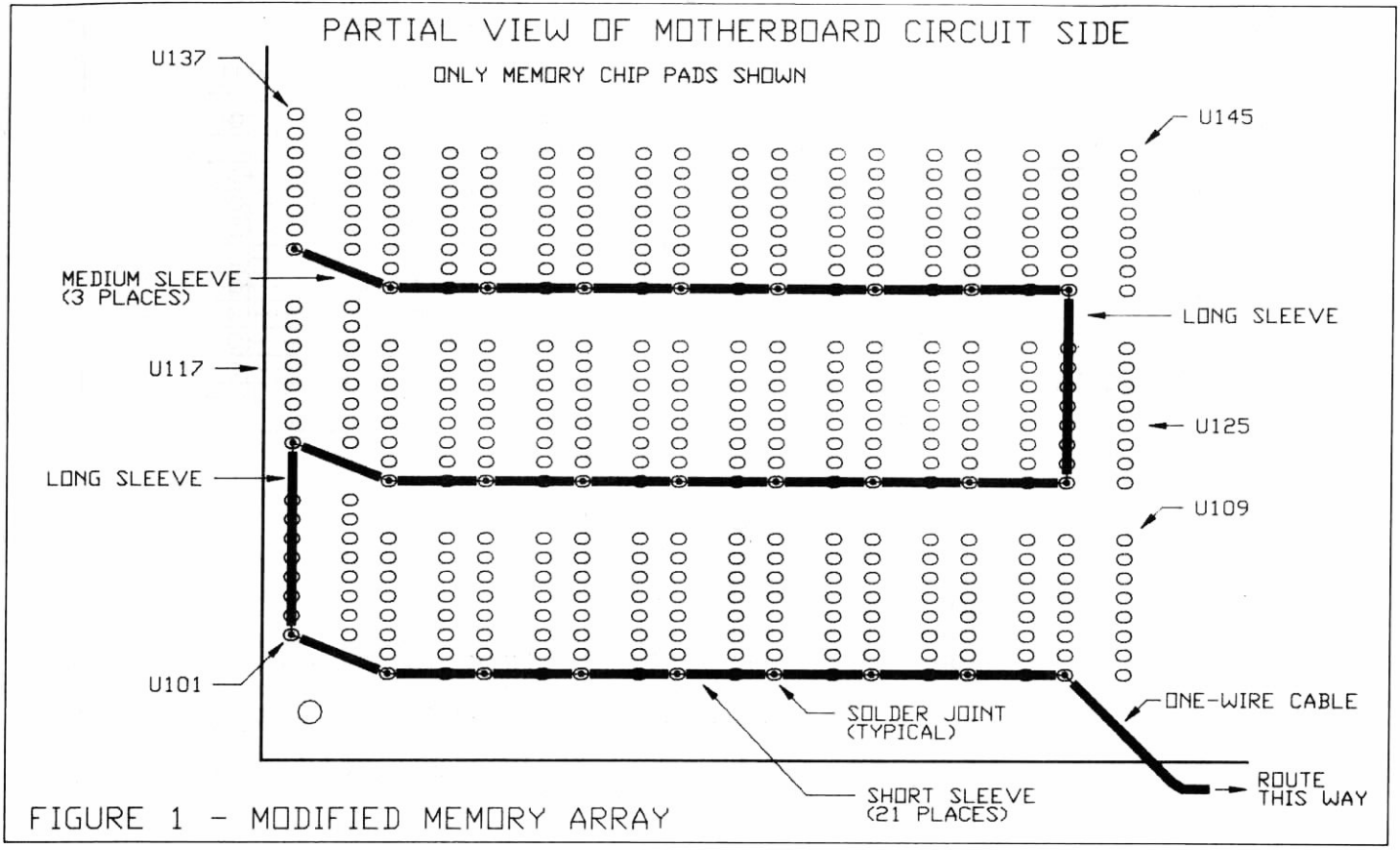
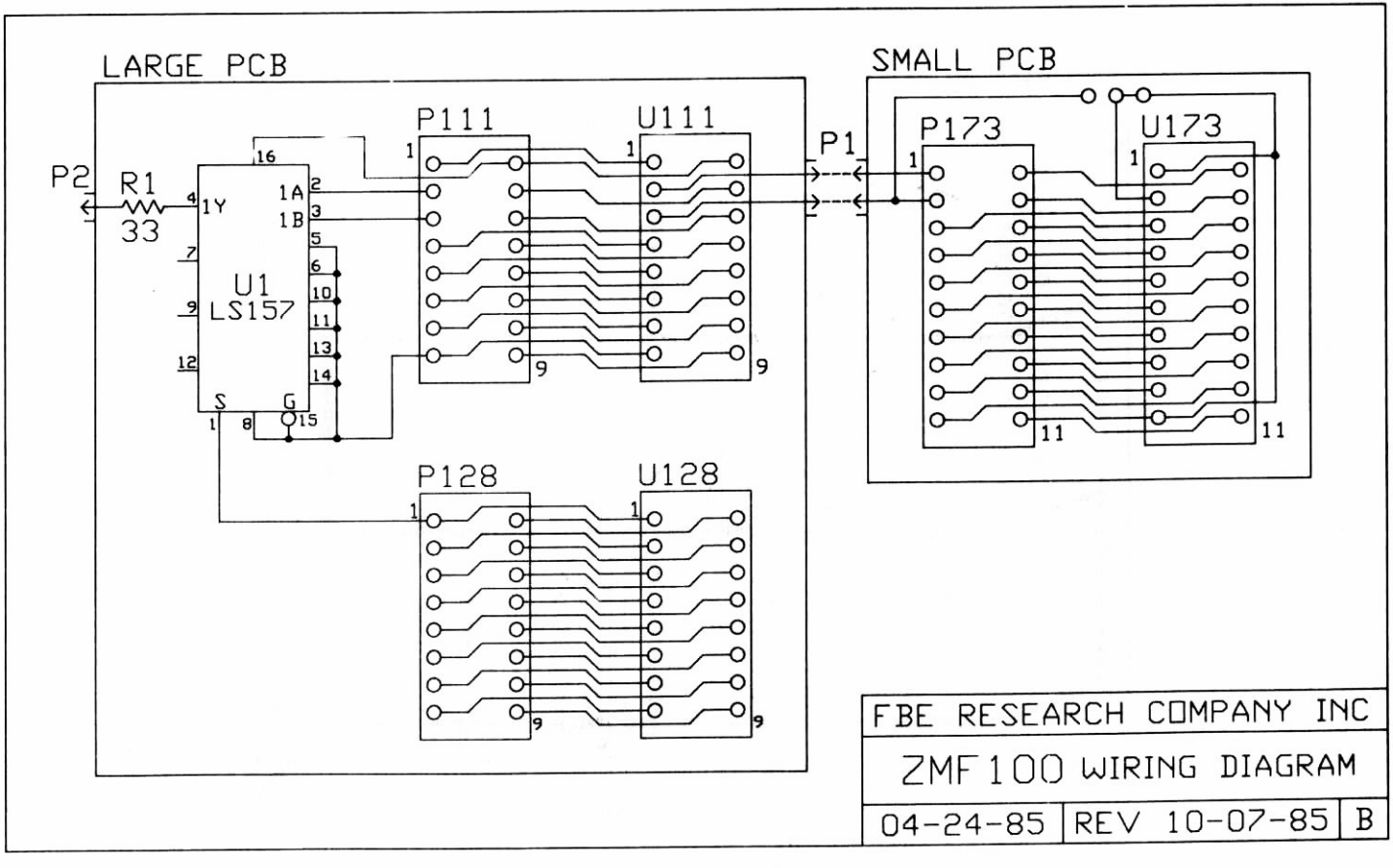


FIGURE 1 - MODIFIED MEMORY ARRAY



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ZMF100 WIRING DIAGRAM		
04-24-85	REV 10-07-85	B