

PROROM
ASSEMBLY and OPERATING MANUAL

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MOUNTAIN HARDWARE

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I. INTRODUCTION and GENERAL INFORMATION

1.1 INTRODUCTION

This manual provides the necessary information to assemble, test, and use Mountain Hardware's PROROM board. It is advisable to review the entire manual before beginning construction of the unit. Then be sure all parts have been included, as listed in section 2.2. Follow the assembly instruction given in the order shown.

If you run into any problems during assembly, feel free to call on us if you feel help is necessary. If the completed unit does not function properly, recheck your assembly carefully. Check for backward or wrong component placement. The trouble shooting section 3.5 may be of help in locating problems. If you have double checked the unit for proper assembly, then feel free to contact us for help.

Note: Appendix A-3 contains errata information that has been added to the manual.

1.2 GENERAL INFORMATION

1.2.1 PROROM Description

Mountain Hardware's PROROM board is a general purpose PROM (programmable read only memory) module compatible with the S-100 computer bus. The board has provisions for 7½ kilobytes of ultra-violet erasable proms (EPROMs). There are also sockets for 512 bytes of random access memory (RAM). The board has a built in programmer that will program any of the proms on the board. The programmer does not need any special software. Any number of bytes may be programmed at a time.

The PROROM board is supplied in several forms. Typically it includes one 6834 EPROM (512 bytes) and one 3539 RAM (256 bytes). A monitor routine is pre-programmed into the EPROM, which allows the user to perform basic functions with the host computer.

1.2.2 Replacement Parts

To order replacement parts, use a complete description to identify the component. The parts list in section 2.2 gives an adequate description of the parts used.

1.2.3 Repair Service

Mountain Hardware provides a repair service for its products, both in and out of warranty. Before returning a module to Mountain Hardware, first obtain authorization to do so. When the return is authorized:

1. Include a letter describing the problem completely.

2. Pack the unit and letter in a suitable shipping container.
3. Ship prepaid to: Mountain Hardware, P.O. Box 1133,
Ben Lomond, CA 95005.

Your module will be returned prepaid.

Upon receipt of the module at Mountain Hardware, it will be repaired promptly, usually within 4 days. No charge will be made for in warranty modules, if in our judgement the failure is not due to misuse or failure of purchaser to exercise care in assembly or operation. Out of warranty modules (or misused units) will be repaired for a minimal charge not to exceed 25 dollars. If the repairs exceed this amount, an estimate will be sent to the owner along with a request for instructions.

NOTE: We advise the owner to save all original packing materials in the event it is necessary to return the module.

1.2.4 Receiving Inspection

Upon receiving your PROROM board, check shipping container for visible outside damage, that may have occurred in transit. If damage is noticed, please report this information to us.

Then check the contents of your kit for the proper number of components, as compared to the list in section 2.2. Let us know of any parts shortages so that we may supply the needed components to you.

1.2.5 Warranty Information

The parts supplied with your PROROM board are warranted against defects in materials and workmanship for a period of six months from the date of purchase. See Appendix A-1 for complete statement of warranty.

II. ASSEMBLY INSTRUCTIONS

2.1 General Information

The following assembly instructions should be followed in the order given. All components are installed on the side of the pc board marked component side.

NOTE: The PROROM board contains memory devices that are MOS integrated circuits. These are the 6834 Proms and the 35391 (35392) RAMS. Avoid unnecessary handling, as these devices can be damaged by static electricity discharges. Wear cotton clothing, rather than synthetics, when handling them. When removing the Proms for erasure place them on aluminum foil, or in static protective foam.

NOTE: The PROROM module is a complicated unit. Please use great care in assembly to insure proper operation.

2.2 Component Orientation

2.2.1 Parts and Shipping Check List - By Package

PACKAGE #1 15 COMPONENTS

| <u>QTY.</u> | <u>DESIGNATION</u> | <u>DESCRIPTION</u> | | |
|-------------|--------------------|--------------------|------|-----------------------------|
| 1 | R9 | 560 | Kohm | ¼W Green-Blue-Yellow-Gold |
| 2 | R10,R17 | 9.1 | Kohm | ¼W White-Brown-Red-Gold |
| 1 | R11 | 27 | Kohm | ¼W Red-Violet-Orange-Gold |
| 1 | R12 | 36 | Kohm | ¼W Orange-Blue-Orange-Gold |
| 1 | R13 | 4.7 | Kohm | ¼W Yellow-Violet-Red-Gold |
| 1 | R14 | 6.8 | Kohm | ¼W Blue-Gray-Red-Gold |
| 1 | R15 | 470 | ohm | ¼W Yellow-Violet-Brown-Gold |
| 1 | R16 | 6.2 | Kohm | ¼W Blue-Red-Red-Gold |
| 2 | R18,R19 | 10 | Kohm | ¼W Brown-Black-Orange-Gold |
| 3 | CR1,CR2,CR3 | IN4148 Diode | | |
| 1 | CR4 | IN753 Zener Diode | | |

PACKAGE #2 13 COMPONENTS

| | | | | |
|---|-------------|---------------------|------|---------------------------|
| 7 | R1-R5,R7,R8 | 4.7 | Kohm | ¼W Yellow-Violet-Red-Gold |
| 1 | R6 | 1 | Kohm | ¼W Brown-Black-Red-Gold |
| 1 | R20 | 3.9 | Kohm | ¼W Orange-White-Red-Gold |
| 1 | R22 | 910 | ohm | ¼W White-Brown-Brown-Gold |
| 1 | R23 | 51 | ohm | ¼W Green-Brown-Black-Gold |
| 1 | CR5 | IN5262B Zener Diode | | |
| 1 | CR6 | IN3070 Diode | | |

PACKAGE #3 33 COMPONENTS

| <u>QTY</u> | <u>DESIGNATION</u> | <u>DESCRIPTION</u> |
|------------|----------------------------|-----------------------------------|
| 1 | R21 | .68 ohm 1W Blue-Gray-Silver-Gold |
| 1 | R24 | 200 ohm 1/2W Red-Black-Brown-Gold |
| 1 | Q1 | 2N2222 Transistor |
| 2 | Q2,Q3 | 2N5400 Transistor |
| 1 | Q4 | MJE172 Transistor |
| 1 | L1 | Pot Core Inductor |
| 1 | S1 | 8 Position Dip Switch |
| 1 | C1 | .01 uF cap (CK05 BX 103) |
| 13 | C2,9-11,14-16, 19,21-25 | .1 uF disc cap |
| 2 | C3,C4 | 22 uF 10v dip tantalum cap |
| 1 | C5 | 680 pF cap (CK05 BX 681) |
| 1 | C6 | 3 uF 100v Electrolytic cap |
| 4 | C7,8,17,18 | 10 uF 25v dip tantalum cap |
| 3 | C12,13,20 | 15 uF 15v dip tantalum cap |

PACKAGE #4 19 COMPONENTS

| | | |
|---|-------------|-----------------------------|
| 1 | U16 | 74154 |
| 3 | U19,U20,U22 | 74LS367 |
| 2 | U21, U23 | 74367 or 8097 |
| 1 | U24 | TL497CN |
| 1 | U25 | 555 |
| 1 | U26 | 74LS04 |
| 1 | U27 | 74LS32 |
| 1 | U28 | 8131 |
| 1 | U29 | 74123 |
| 1 | U30 | 74LS20 |
| 1 | U31 | 74LS00 |
| 1 | U32 | 74LS74 |
| 1 | VR1 | LM340T-12 or 7812 Regulator |
| 2 | VR2,VR4 | LM340T-5 or 7805 " |
| 1 | VR3 | LM320T-12 or 7912 " |

PACKAGE #5 25 COMPONENTS

| | | |
|---|--------------|------------------------------|
| 2 | 6107-14 | Heatsinks |
| 1 | 4-40 X 3/4 | Nylon Screw |
| 1 | 4-40 | Nylon Nut |
| 1 | 4-40 | Star Washer |
| 3 | 6-32 X 1/2 | Steel Screw |
| 2 | 6-32 X 3/8 | Steel Screw |
| 1 | 6-32 X 1/2 | Nylon Screw |
| 6 | 6-32 | Steel Nut |
| 6 | 6-32 | Star Washer |
| 1 | #6 regulator | insulating washer |
| 1 | | Capsule of heatsink compound |

MISCELLANEOUS COMPONENTS

| <u>QTY</u> | <u>DESIGNATION</u> | <u>DESCRIPTION</u> |
|------------|--------------------|-----------------------|
| 1 | | 680-.5220 heatsink |
| 1 | | PROROM pc board |
| <u>1</u> | U15 | S6834 EPROM |
| <u>1</u> | U17 | F35391 (35392) RAM |
| 1 | | Documentation Package |

IC SOCKETS

| | |
|----|----------------|
| 7 | 16 Pin sockets |
| 6 | 14 Pin sockets |
| 1 | 8 Pin sockets |
| 2 | 22 Pin sockets |
| 16 | 24 Pin sockets |

2.2.2 Parts List (Alphabetical Order)

| QTY | DESIGNATION | DESCRIPTION |
|-----|----------------------------|---|
| 1 | C1 | .01 uF Cap (CK05 BX 103) |
| 13 | C2,9-11,14-16, 19,21-25 | .1 uF disc Cap |
| 2 | C3,C4 | 22 uF 10v dipped tantalum cap |
| 1 | C5 | 680 pF Cap (CK05 BX 681) |
| 1 | C6 | 3 uF 100v Electrolytic cap |
| 4 | C7,8,17,18 | 10 uF 25v dipped tantalum cap |
| 3 | C12, 13,20 | 15 uF 15v " " " |
| 3 | CR1 - CR3 | 1N4148 diode |
| 1 | CR4 | 1N753 Zener diode |
| 1 | CR5 | 1N5262 B Zener diode |
| 1 | CR6 | 1N3070 diode |
| 1 | L1 | Pot Core Inductor |
| 1 | Q1 | 2N2222 Transistor |
| 2 | Q2,Q3 | 2N5400 " |
| 1 | Q4 | MJE-172 " |
| 8 | R1-R5,R7,R8,R13 | 4.7 Kohm $\frac{1}{4}W$ Yellow-Violet-Red-Gold |
| 1 | R6 | 1 Kohm $\frac{1}{4}W$ Brown-Black-Red-Gold |
| 1 | R9 | 560 Kohm $\frac{1}{4}W$ Green-Blue-Yellow-Gold |
| 2 | R10,R17 | 9.1 Kohm $\frac{1}{4}W$ White-Brown-Red-Gold |
| 1 | R11 | 27 Kohm $\frac{1}{4}W$ Red-Violet-Orange-Gold |
| 1 | R12 | 36 Kohm $\frac{1}{4}W$ Orange-Blue-Orange-Gold |
| 1 | R14 | 6.8 Kohm $\frac{1}{4}W$ Blue-Gray-Red-Gold |
| 1 | R15 | 470 ohm $\frac{1}{4}W$ Yellow-Violet-Brown-Gold |
| 1 | R16 | 6.2 Kohm $\frac{1}{4}W$ Blue-Red-Red-Gold |
| 2 | R18,R19 | 10 Kohm $\frac{1}{4}W$ Brown-Black-Orange-Gold |
| 1 | R20 | 3.9 Kohm $\frac{1}{4}W$ Orange-White-Red-Gold |
| 1 | R21 | .68 ohm 1W Blue-Gray-Silver-Gold |
| 1 | R22 | 910 ohm $\frac{1}{4}W$ White-Brown-Brown-Gold |
| 1 | R23 | 51 ohm $\frac{1}{4}W$ Green-Brown-Black-Gold |
| 1 | R24 | 200 ohm $\frac{1}{2}W$ Red-Black-Brown-Gold |
| 1 | S1 | 8 Position Dip Switch |
| 15 | U1-U15* | 6834 EPROM |
| 1 | U16 | 74154 4 to 16 DEMUX. |
| 2 | U17,U18* | 35391 or (35392) RAM |
| 3 | U19,U20,U22 | 74LS367 3-state buffer |
| 2 | U21,U23 | 74367 or 8097 3-state buffer |
| 1 | U24 | TL497CN Switching Regulator |
| 1 | U25 | 555 Timer |
| 1 | U26 | 74LS04 HEX Inverter |
| 1 | U27 | 74LS32 QUAD 2-IN OR |
| 1 | U28 | 8131 HEX Comparator |
| 1 | U29 | 74123 Dual Monostable |
| 1 | U30 | 74LS20 Dual 4-IN NAND |
| 1 | U31 | 74LS00 QUAD 2-IN NAND |
| 1 | U32 | 74LS74 Dual D Flip Flop |
| 1 | VR1 | LM340T-12 or 7812 |
| 2 | VR2,VR4 | LM340T-5 or 7805 |
| 1 | VR3 | LM320T-12 or 7912 |

parts list cont.

2.2.2 Parts List Continued:

| <u>Qty</u> | <u>DESCRIPTION</u> |
|------------|--------------------------------|
| 2 | 6107-14 Heatsinks |
| 1 | 680-.5220 |
| 1 | 4-40 x 3/4 Nylon Screw |
| 1 | 4-40 Nylon Nut |
| 1 | 4-40 Star Washer |
| 3 | 6-32 x 1/2 Steel Screw |
| 2 | 6-32 x 3/8 Steel Screw |
| 1 | 6-32 x 1/2 Nylon Screw |
| 6 | 6-32 Steel Nut |
| 6 | 6-32 Star Washers |
| 1 | #6 Regulator Insulating Washer |
| 1 | PROROM PC Board |
| 1 | PROROM Documentation Package |
| 1 | capsule of heatsink compound |
| 1 | 8 PIN IC Sockets |
| 6 | 14 PIN IC Sockets |
| 7 | 16 PIN IC Sockets |
| 2 | 22 PIN IC Sockets |
| 16 | 24 PIN IC Sockets |

* One 6834 and one 35391 (or 35392) is supplied with the basic PROROM module.

2.3 GENERAL ASSEMBLY

The parts list in section 2.2.1 is listed according to the shipping packages. The list in section 2.2.2 is in alphabetical order. Keep the parts with their respective packages until inserting into pc board. Use the assembly drawing 5.1 to aid in assembly, along with the silk screen lettering on the pc board.

NOTE: Square solder pads on the pc board are used to mark the orientation of some components. Square pads are used for:

1. Pin 1 of all IC's
2. Cathode end of diodes (dark band on the case of the diode)
3. The positive (+) terminal of polarized capacitors

Be sure to follow this standard throughout construction of the unit.

2.4 SOCKET INSTALLATION

Place the pc board in front of you with the component side up and the 100 gold fingers toward you. Install the 32 sockets with pin 1 facing down and to the left. Place all the sockets in their holes and then place a stiff piece of cardboard over the sockets so that the board may be flipped over. Carefully turn the board over and check to see that all the pins are through their holes. Then solder two diagonally opposite pins on each socket. Remove the cardboard and check to see that each socket is firmly seated. If not, reheat the soldered pins and press the socket into place. Then solder the remaining pins.

NOTE: See Appendix A-2 for proper soldering techniques.

NOTE: The 16 pin hole pattern marked S1 at the top right does not use a socket. It is reserved for the 16 pin dip switch.

2.5 HEATSINK AND REGULATOR INSTALLATION

NOTE: Refer to component placement (figure 5.1) and silk screen lettering on pc board for aid in assembly.

Place the large black heatsink over the large bare area in the top center of the board. Orient the heatsink such that the 2 sets of holes for the regulator leads are visible thru the triangular holes of the heatsink. Secure the heatsink with 2 sets of 6-32x $\frac{1}{2}$ hardware, inserting the screws from the bottom and placing lock washers and nuts on from the top. Take one of the two 5 volt regulators (340-5 or 7805) and bend the leads to match the holes in the triangular hole on the right side of the heatsink. Smear a small amount of heatsink compound on the back of the regulator and insert the regulator into position. Secure it with a 6-32x $\frac{1}{2}$ "

screw inserted from the bottom. Install star washer and nut.

Take the -12 volt regulator (320-12 or 7912) and bend the leads to fit the left hand set of holes in the large heatsink. The back of this regulator needs to be electrically insulated from the heatsink. A mica insulating washer is provided to be placed between the regulator and the heatsink. Trim the mica washer with sizzors as needed to clear the fins of the heatsink, but still covering the back of the regulator. Smear a little heatsink compound on both sides of the washer. Insert the regulator on top of the washer, with the three leads inserted into their proper holes. Secure the heatsink with the NYLON 6-32x $\frac{1}{2}$ screw, inserted from the bottom. Use a star washer and nut on top. Solder the six regulator leads from the back side. Take the two smaller heatsinks and smear a thin layer of heatsink compound on their mounting surface. Place the two heatsinks as shown in figure 5.1. Bend the leads of the two remaining regulators. Smear a thin layer of heatsink compound on their mounting surface. Place the +12 volt regulator (340-12 or 7812) in the left position. Place the +5 volt regulator (340-5 or 7805) in the right hand position. Be sure to double check the placement of the regulators because damage to the board may occur if any of the regulators are interchanged. Secure the regulator/heatsink assembly with 6-32x $\frac{3}{8}$ screws inserted from the bottom, placing star washers and nuts on top. Solder the leads.

2.6 COMPONENT INSTALLATION: Package #1

The components in package #1 are mounted in a vertical position. The spacing between the leads is .15 inches. Take these components and bend their leads as shown in figure 5.1 in the right hand legend. All of these components are mounted on the right hand side of the pc board near the center. Insert them in their proper location as shown in the assembly drawing (figure 5.1). Note that one side of all the diodes is marked with a dark band. This end goes into the square pad on the pc board. Insert each component and bend the leads outward. When all the components in the package are installed, carefully solder each lead and cut off excess.

2.7 COMPONENT INSTALLATION: Package #2

Package #2 contains components that are mounted with lead spacings of $\frac{1}{2}$ inch. They are mounted horizontally as drawn in the legend of figure 5.1. All of these components mount in the right hand upper half of the pc board. Insert the components and bend the leads outward. After all twelve components are inserted, carefully solder each lead and cut off excess.

2.8 COMPONENT INSTALLATION: Package #3

Package #3 contains a variety of components and figure 5.1 has drawings in the legend to help differentiate between components. Insert the components as listed in the package #3 parts list. Bend the leads of the two $\frac{1}{2}$ watt resistors (R21 and R24). Insert them as shown on assembly drawing. Insert the transistors as shown in the drawing. The "D" or "Q" outline shows proper orientation. Bend the center lead toward the flat side of the "D", on Q2 and Q3.

Q4 (MJE172) mounts above R21. The bottom side (metal side) of Q4 faces toward the top of the board (away from the 100 gold plated fingers). This transistor mounts in an upright vertical position. No heatsinking is necessary.

L1 is a core inductor that mounts as shown in the assembly drawing. Cut the leads to about 3/4 inch and scrape 1/4 inch of the enamel off each lead with a sharp knife. Insert the leads into the proper holes on the board. This pot core inductor mounts with the 4-40 nylon screw, lockwasher, and nylon nut. DO NOT TIGHTEN MORE THAN 1/4 TURN PAST FINGER TIGHT. This will prevent cracking of the ceramic pot core. Insert the screw from the top side of the board, and cut off the excess length of screw that extends beyond the nut with diagonal cutters. Solder the inductor's leads and cut off the excess wire.

S1 is an 8 position dip switch that mounts in the top right hand corner of the board. Insert the switch with the switch numbers at the top. Solder two diagonally opposite pins, and check to see that the mounting is flush with the board. If so solder the remaining pins.

For mounting the capacitors use the package #3 parts list (section 2.2.1) and the assembly drawing (figure 5.1). For polarized capacitors, insert the positive (+) end of the capacitor in the square solder pad on the pc board. Double check positioning, as tantalum capacitors will over heat and destroy themselves if inserted backwards. Insert all the capacitors, bend the leads outward, solder, and cut off excess leads.

2.9 PRELIMINARY CHECKOUT

Before inserting the integrated circuits a preliminary checkout is advised.

1. Check to see that all components are in their proper position with the leads soldered.
2. Check for solder bridges or solder splashes that will cause undesired shorts.
3. Check to see that all vertically mounted components are vertical, and not shorting against an adjacent component.
4. Clean off excess amounts of flux with Q-tips and alcohol, or other suitable cleaner.

Plug the board into your S-100 computer, and turn the computer on. If a DC volt meter is available, measure the voltage on each of the four regulators. The output pin on each of the regulators is the right hand pin as shown on figure 5.1. This output pin should measure the desired regulator output voltage when measured to ground.

If these voltages are all present, turn off the computer and install U24 (TL497CN). This is the dc to dc converter circuitry that generates the large negative voltage to program the proms. Normally a high pitched whistle may be heard, which is the inductor L1 vibrating. Measure the voltage to ground on the negative side of C6 (the large 3 uF capacitor). The voltage should be -55 ± 3 VDC.

NOTE: The PROMS may be damaged if this voltage is more negative than -60 VDC.

If this test checks out, turn off the computer and proceed to the next section.

WARNING: DO NOT REMOVE BOARDS FROM YOUR COMPUTER WITH POWER APPLIED.

2.10 IC INSTALLATION

Install all the IC's with pin 1 in the lower left hand corner, as shown on the assembly drawing (figure 5.1).

NOTE: If your kit includes the Monitor prom (6834 programmed with an executive monitor program), insert it in U15. If your kit included one RAM (35391 or 35392) insert it in U17's position.

NOTE: With all the IC's in the board the dc to dc converter (that produces the -55v) will only operate when you are programming the proms. Be sure to check this voltage as outlined in section 2.9 before installing all the IC's.

III. TESTING and OPERATING INFORMATION

3.1 ADDRESS DECODING

The PROROM board may be addressed to any 8K block whose starting address is a multiple of 8K. Three switches on the dip switch set up this address location. A13, A14, and A15 are used to determine if the board is being addressed. If the proper switch is set to A13-1 that address line must be high for the board to be addressed.

The following is a list of switch settings for the given address, listed in hex.

| Switch Position - | 3 | 4 | 5 |
|-------------------|-----|-----|-----|
| Address Line - | A13 | A14 | A15 |
| 0000 - 1FFF | 0 | 0 | 0 |
| 2000 - 3FFF | 1 | 0 | 0 |
| 4000 - 5FFF | 0 | 1 | 0 |
| 6000 - 7FFF | 1 | 1 | 0 |
| 8000 - 9FFF | 0 | 0 | 1 |
| A000 - BFFF | 1 | 0 | 1 |
| C000 - DFFF | 0 | 1 | 1 |
| E000 - FFFF | 1 | 1 | 1 |

NOTE: a "1" is an "open" on the dip switch.

For use with the executive monitor program in the prom (if supplied) the address switches should be set up for A000 - BFFF.

The 6834 proms are 512x8 bytes or ½K bytes. Therefore there are 15 proms to make 7½K bytes. U1 occupies the first 512 bytes and U15 the last. Therefore the address of each prom can be determined. U17 and U18 are 35391 (35392) RAMS which are 256x8 bytes each. They occupy the top ½K bytes of the 8K that the board can address. U18 occupies the top 256 bytes. For example if the switches are set to A13-1, A14-0, and A15-1, then U17 occupies address BE00 - BEFF. U15 occupies BC00 - BDFE.

Another feature of the PROROM board is the 4K/8K addressing mode. If you only intend to use 4K or less prom, then one half of the PROROM board may be "turned off", to allow those addresses to be used for another peripheral (a 4K RAM memory module, for example). Either the upper or lower 4K block, of the total 8K possible space, may be turned off. This is accomplished by switches 6 & 7 on the dip switch.

| SWITCH POSITION | SWITCH CLOSED | SWITCH OPEN |
|-----------------|--|--|
| 6 | 4K (selects the board for 4K block) | 8K (selects the addressing for full 8K active) |
| 7 | L-4 (selects the lower 4K of the board active) | H-4/8 (selects the board for either the upper 4K active or for full 8K active) |

NOTE: For normal (don't care) addressing of the full 8K, set switches 6 & 7 open.

NOTE: The on-board RAM is only active during full 8K operation or upper 4K active operation.

3.2 WAIT STATE SELECTION

The PROROM board has provisions for including wait states. Memory chips with access times greater than 550 ns to be used with the PROROM board.

0 wait states - Memories faster than 550 ns

1 wait states - Memories with access times from 550-1050 ns.

2 wait states - Memories with access times from 1050-1550 ns.

Positions 1 and 2 on the dip switch S1 determines the wait state selected.

| SWITCH POSITION | SWITCH CLOSED | SWITCH OPEN |
|-----------------|---|--|
| 1 | 0 WS (select for no wait states) | 1/2 WS (select for 1 or 2 wait states) |
| 2 | 0/1 WS (select for 1 or no wait states) | 2 WS (select for 2 wait states) |

NOTE: When selecting wait states, both switches 1 and 2 must be set to the proper position.

NOTE: The access time for the 6834 proms is 575 ns maximum. Typically they are less than 500 ns. For slower proms wait states may need to be added.

3.3 PROM PROTECT CIRCUITRY

Circuitry is provided to protect the proms from accidental programming, by means of switch 8 on the dip switch. When the switch is closed (in the SAVE) position, nothing will happen if the computer writes to a prom. When you intend to write to a prom, double check to see that your addresses are correct, and also the new data is correct. Then place switch 8 in the open position (WR). Any of the 15 sockets for proms is capable of programming a 6834 prom. Immediately after the programming is complete, place the switch back in the SAVE position.

NOTE: The SAVE switch does not affect the operation of the on-board RAM.

NOTE: Switch 8 on the dip switch must be in the WR position (open) in order to program a prom.

3.4 OPERATING SUGGESTIONS

3.4.1 Set up switches as described in the previous sections. Below is a table for easy reference:

| SWITCH POSITION | SWITCH CLOSED | SWITCH OPEN |
|-----------------|--|---|
| 1 | OWS - set for no wait states | 1/2 WS - set for 1 or 2 wait states |
| 2 | O/1 WS - set for 1 or no wait states | 2 WS - set for 2 wait states |
| 3 | A13-0 - set for A13 line desired low | A13-1 - set for A13 line desired high |
| 4 | A14-0 - set for A14 line desired low | A14-1 - set for A14 line desired high |
| 5 | A15-0 - set for A15 line desired low | A15-1 - set for A15 line desired high |
| 6 | 4K - set for only 4K block active | 8K - set for full 8K block active |
| 7 | L-4 - set for lower 4K block active | H-4/8 - set for upper 4K active or full 8K active |
| 8 | SAVE - set to protect proms from programming | WR - set to enable prom programming |

3.4.2 Using the PROROM board.

If you are using the supplied prom with the pre-programmed monitor, place the prom in the U15 position. A RAM must be present in the U17 position in order for the monitor to perform properly. (See section IV for a software description of the monitor program). Set up the PROROM board for a starting address of A000. If another prom is available place it in a vacant socket. (Only use two proms in the board initially until proper board operation is verified).

Examine the extra proms contents and verify that it is 00(HEX) (which should be if it has been erased with ultra-violet light). If so try writing to a location on the unused prom. This may be done with the supplied monitor or by writing a program in RAM which writes to a location in the prom. The front panel deposit switch will not successfully program the proms due to timing relationships needed from the CPU. Check the programmed byte and see that it was done properly. If not recheck your programming method, and then refer to the trouble shooting section in this manual.

Next verify operation of the on-board RAM. This may be written to and read from the front panel, or by software.

The 6834 prom when erased contains NOP's to an 8080. Therefore, when writing software you may leave some space for NOP's for possible insertions later. With the PROROM board you can program one byte at a time if desired, or your software can transfer any size block from memory to the proms. The hardware makes the programming operation seem like you are writing to RAM. For large block transfers the monitor prom supplied has a transfer routine, ideal for programming the proms. Before programming a large block of proms, we recommend that you verify that the proms are fully erased. Also once programmed, verify that it is correct (See software section IV for details).

Since you can program any number of bytes at a time, short programs can be placed in part of a prom, and then additions to it can be made at a later time.

Programming one prom takes between two and three minutes. Each byte is slightly more than one quarter of a second.

The proms like all integrated circuits are mechanically delicate. When removing the proms we recommend an IC puller. A small screw driver may be used. Carefully pry one end up a little, and then the other. Avoid bending the pins on the IC. Slowly work the device out until removed. We recommend that IC carriers be used if the proms are to be removed and inserted often. When inserting proms, slowly rock it in place until firmly seated.

The on board RAM allows for some unique programming. The RAM area may be used for a scratch pad area or stack space, and not tie up spots in larger RAM modules in the system. For dedicated systems only a small amount of RAM is usually needed, therefore the PROROM board prevents the user from needing any other RAM cards.

The 6834 proms may be erased using a high intensity ultra-violet light. A short wave emission near 2537 Angstroms is recommended. Ultra-Violet Products, Inc. manufactures a line of UV lights. Prices for commercially available units run from \$25 on up. They are available from rock and gem shops, and many computer stores are carrying the lights. The January 1977 issue of Byte has a construction article on an inexpensive UV light. *Art 6/1977 p. 68 40 watt bulb.*

When erasing the proms, carefully remove them from their sockets and place them on aluminum foil or in static proof foam. Place the UV light 1 inch above the proms. The length of time for erasing depends on the type of light, but is usually around 15 minutes. If practical for your application, the proms may be erased while in the board (be careful not to erase the monitor in U15).

The uses for a prom board are quite wide. The most often used application is for holding bootstrap programs. Several will usually fit on one prom, and the monitor may be used to jump to these routines. For large boards like PROROM, Basic or other large programs may be stored and either run while in the prom, or transferred to RAM for execution.

A method to aid in hardware development is to store short little routines in prom to check out new hardware boards. These programs often have to be run over and over, and if in prom they are not destroyed if power is turned off.

3.5 THEORY AND TROUBLE SHOOTING

The circuitry used in the PROROM module is relatively straight-forward. With the aid of the schematic (section 5.0) most computer enthusiasts should have little trouble understanding the operation or trouble shooting PROROM, should a problem occur. A description of the circuitry, followed by a trouble shooting guide, is presented.

Address decoding for the PROROM board is done by U28 (8131) and 5 switches on S1. Decoding for a particular prom or RAM is the job of U16 (74154), a 4 to 16 demultiplexer. Data enters and leaves through buffers, which are controlled by a group of gates which determine if the operation is a read or a write.

The read operation is fairly simple. The micro-processor outputs the message of a read command ($\overline{\text{DBIN}}$, $\overline{\text{SMEMR}}$, $\overline{\text{SINP}}$, $\overline{\text{SOUT}}$). These are decoded and open the output gates. Address information is input to the proms, who in turn output the desired data. U32 (74LS74) is the wait state circuitry that is set up by the switches, and is clocked by $\phi 1$, $\phi 2$, and PSYNC.

A write to the prom is slightly more complicated. The command ($\overline{\text{MWRITE}}$, $\overline{\text{SIN}}$, $\overline{\text{SOUT}}$), is decoded along with the proper address information and U29 (74123) is triggered. This turns on an astable multivibrator U25-555, with an 8 ms period. The astable multivibrator, gated with the one-shot, switches transistors Q1, Q2, and Q3 which applies a negative voltage to the proms. This programs the prom with the data being applied from the data bus. The astable pulses the programming voltage until the one shot runs out of time. The one-shot holds the ready line low to allow this to happen, while the CPU is stopped.

Two one-shots (triggered from the same inputs) are used. One of these is longer than the other, which allows the prom to recover from the programming before programming the next byte. The prom-protect switch doesn't allow these one-shots to fire.

A dc to dc converter is used to generate the -55 VDC. The heart of this is a switching regulator, integrated circuit U24 (TL497CN). L1 is the switching inductor that produces the negative backward emf voltage, that is filtered by C6. This circuitry has a feedback path that keeps a constant output voltage with changing load.

Trouble shooting (once past checking the regulator voltages as outlined in section 2.9) is greatly aided by an oscilloscope. An extender card for your computer main frame is also recommended.

A good way to see problems is to write a short software program that outputs or inputs repeatedly to the board. Then with a scope the timing relationships can be easily viewed since they are constantly repeated.

Familiarity with digital circuits and the S-100 bus structure is required for in depth trouble shooting. Feel free to consult with us in the event of problems with your unit.

Before attempting any detailed trouble shooting, recheck the assembly of the board. Most problems are concerned with improper parts placement or faulty construction techniques.

NOTE: When PROROM is in the "SAVE" mode the EPROMs can not be accidentally altered. When in the "WRITE" mode and using the monitor program, the monitor will not allow you to accidentally (or otherwise) modify the monitor program. BUT, when in the "WRITE" mode and using other software, the monitor could be destroyed if something goes amiss. Therefore we recommend that once your PROROM module is working, save the monitor on paper tape, cassette tape, another prom, or someplace in case the monitor is accidentally destroyed. Also it is advisable to get in the habit of putting PROROM back in the "SAVE" mode immediately after programming a prom.

IV. SOFTWARE

4.1 LOS ALTOS MICRO-MONITOR (Version 2)

The Los Altos Micro-Monitor (version 2) provides a communications link between the user and a microcomputer using an 8080 or Z-80 CPU. It is intended to occupy 512 bytes of read-only memory between locations BCOO and BDFF, inclusive, and will not interfere with other software such as the Assembler/Editor and "BASIC" interpreter programs currently available to the hobbyist. The monitor requires 128 Bytes of RAM memory from BE00 through BE7F for its stack area and work space. In addition, a suitable I/O interface is required, and must be addressed to channel 0 for status and channel 1 for data. The I/O device itself may be a teletype machine, or video display with a line width of at least 32 characters and an ASCII-encoded keyboard.

The Los Altos Micro-Monitor can perform the following functions:

1. Examine one byte at a time at any address.
2. Display the contents of any segment of memory as a pair of hexadecimal digits per byte. Eight bytes plus the address are displayed on each line.
3. Enter machine-language programs or data from a keyboard, two hexadecimal digits per byte.
4. Jump to a user-supplied program or routine at any address.
5. Transfer a block of data from one part of memory to another (block move). This feature can be used to program PROMs, and will verify at the same time, or it can be used to test new PROMs.

In addition, the monitor contains user-callable subroutines to display the contents of one byte of memory in hexadecimal or ASCII and to perform I/O operations on a teletype or other keyboard and printer or display.

The monitor is intended for use with a serial I/O interface addressed to ports 0 and 1. The I/O subroutines in ROM expect to use status Bit 7 (the leftmost, or high-order, Bit) for the TBE (Transmitter Buffer Empty) flag and Bit 6 for the RDA (Receiver Data Available) flag. In both cases a "High" (1) means ready status and a "Low" (0) means busy or not ready. If your I/O interface meets these specifications, simply examine location BCOO (274,000 in OCTAL) and select run mode to bring up the monitor. The Processor Tech. 3P+S I/O interface will meet the specifications when built according to the instructions and set up for Processor Tech's own software.

But-if you use different status bits or active low flags - Fear Not! For you can still use the monitor, by inserting a 3-byte patch into RAM memory as follows:

Location BE00 (276,000 in OCTAL) is the status bit polarity switch. Bit 7 (leftmost) is for output and bit 0 (rightmost) is for input. A "1" means active high and a "0" means active low.

Location BE01 is the status bit mask for input.

Location BE02 is the status bit mask for output - in this byte, only one bit can be a "1".

For Example:

For a MITS SIO board Rev. 0, deposit 81 22 20 starting at BE00.

For a MITS SIO board Rev. 1, deposit 00 81 80 starting at BE00. Then start the monitor at location BCOC instead of at location BCOO. (BCOO-BCOB contains code to move 81 CO 80 - the default I/O status masks - into locations BE00-BE02).

There is no reason why a parallel interface couldn't be used instead of a serial interface, as long as it provides the correct "Data Available" and "Buffer Empty" handshake signals.

When the monitor is run for the first time, one or two characters of garbage may appear on your display. Press CR (Carriage Return or Control-M) and a ? should be displayed. If nothing happens, the monitor is probably using the wrong status bits or polarity. If the monitor outputs characters continuously, the status bit mask for input should have both the RDA and TBE bits in use, otherwise the receiver may pick up what was just transmitted and re-echo it. This problem was experienced using a 3P+S I/O board and an ASR-33 connected for current loop operation.

The monitor is in command mode when a question mark (?) is displayed. This prompt tells you it is awaiting a command. Each Function to be performed by the monitor is identified by a 1-character alphabetic command. A command is followed by one, two or three address parameters. An address parameter consists of four hexadecimal digits; the first two are the "High" part of the address and the last two are the "Low" part of the address. The lowest address is 0000 and the highest is FFFF.

If while entering an address you make a mistake, or decide you have typed the wrong command, you can enter the @ symbol (shifted P on a teletype keyboard) at any time to return to command mode. Then, you can re-type the command with the correct address. Spaces can be inserted in between addresses. An invalid character typed while entering an address is not "Echoed" and is ignored by the monitor.

In some cases a parameter is optional; that is, you can simply press the carriage return key (CR) instead to bypass that parameter. Optional parameters will be shown here like this: (EEEE) but you don't actually enter the parenthesis.

The monitor maintains a special 2-byte address value in RAM; this value is called the current open address. It is used as a default value in place of optional address parameters. When the monitor is initialized, the current open address is the monitor's normal re-start address. The current open address is used and/or modified by the J and M commands, but is not affected by the D and T commands or by entry of the @ symbol.

After the address parameters have been entered as required for the particular command, the monitor waits for you to press CR (Carriage Return) to begin the command function, or to type the @ symbol to abort and return to command mode. The purpose of this maneuver is to give you a chance to sight-verify the parameters.

Now, here are the commands:

D BBBB (EEEE) (CR) Displays the contents of all memory locations between beginning address BBBB and ending address EEEE, inclusive. Each line displayed will show up to 8 bytes of memory plus the address of the first byte on the line, in hexadecimal.

D BBBB (CR) Displays the contents of 8 consecutive bytes of memory beginning at address BBBB.

In either of the above cases, after the display is finished, it is necessary to type @ to return to command mode; or, either of two other actions may be taken:

- 1) Press CR and the next 8 bytes will be displayed.
- 2) Type in a new ending address followed by a CR, and all memory locations between the old ending address + 1 and the new ending address, inclusive, will be displayed.

If the ending address is less than or equal to the beginning address, only one byte will be displayed; but then you can still press CR to get more. The display memory command has no effect on the current open address.

J BBBB (CR) Results in a jump to location BBBB to turn control over to a user-supplied program. The current open address is replaced by BBBB.

J (CR) Results in a jump to wherever the current open address points to.

A CR and LF are outputted immediately after CR is pressed. It is up to the user to make sure that a valid program exists the location to be given control. A jump inside the monitor or its stack area, or to any area containing garbage, will have unpredictable results and if the PROM board is not protected, the monitor PROM could be altered and would then have to be erased and re-programmed.

The user program may employ the monitor's own stack (116 bytes are available). The user program may go back to the monitor in command mode by issuing a RET (Return) instruction or by a jump to location BCOC. The latter will reinitialize the monitor's stack pointer.

M (CR) Is used to examine and/or modify memory one byte at a time, beginning at the current open address.

M BBBB (CR) The beginning address BBBB becomes the current open address, where memory may be examined and/or modified one byte at a time.

Operation is as follows:

Whenever CR is pressed, the current open address is displayed along with the contents of the byte at that address, as in this example:

```
?M BE80 (CR)
BE80 00
```

At this point, any of three actions may be taken:

- 1) Press @ to return to command mode. The current open address retains its value - BE80 in the above example.
- 2) Press CR to examine the next consecutive address. The current open address is incremented, a new line is started on the output device and the address and its contents are displayed. To continue the previous example:

```
BE80 00 (CR)
BE81 00 (Now the current open address is BE81)
```

It is possible to continue examining as long as desired by repeatedly pressing CR, or to press @ to go back to command mode, or to take the third action.

- 3) Key in binary data, two hexadecimal digits for each byte in memory. The current open address is incremented after each byte is stored. For example:

```
BE81 00 CD (Machine Typed BE81 00, operator typed CD)
Now BE81 contains CD instead of 00 and the
current open address is BE82.
```

Any amount of data may be entered, two hexadecimal digits for each consecutive byte, and the current open address is incremented and updated each time. Valid hexadecimal digits (0, 1, 2, ..., 9 or A, B, ..., F) are echoed to the display; invalid characters are ignored and are not stored in memory. The space bar (SP) and carriage return (CR) keys may be used any time to format the display as desired, without affecting data in memory. On a teletype machine it is necessary to manually enter CR to keep from overprinting the last character on the line. Here is another example. At the start, assume that locations BE80-BE8F contain zeroes.


```

?M BE80 (CR)
BE80 00 CD 37 02 C9 (CR)
BE84 00@
?D BE80 (CR)
BE80 CD 37 02 C9 00 00 00 00@
?M (CR)
BE84 00      And so on.

```

The three actions previously described may be repeated as long as required, in any combination. The @ symbol may be entered at any time to go directly back into command mode (the @ symbol is echoed but is not stored in memory). Note also that any attempt to modify the monitor itself will result in an immediate and automatic return to command mode; in which case the data byte just entered is not stored and the current open address is not incremented. However, addresses within the monitor may be examined.

T BBBB EEEE SSSS (CR) Transfers a block of consecutive data bytes from one part of memory to another part. As few as 2 bytes, or as many as memory capacity permits, can be moved. All three addresses must be entered correctly before the transfer can begin.

BBBB is the beginning address of the receiving field.

EEEE is the ending address of the receiving field, and must be greater than BBBB. The receiving field cannot overlap any part of the monitor or the stack area.

SSSS is the beginning address of the source field. which may be anywhere in memory.

The transfer command moves data one byte at a time from the source field to the receiving field, beginning with the lowest source byte address and continuing upwards until the receiving field is full. The transfer (Block Move) can be used to program PROMs, or to clear memory, as the receiving and source fields may overlap. The receiving field may be above or below the source field. For Example:

```

?M BE80 00 01 02 04 08 10 20 40 80 @
?T 0000 0007 BE80      (Moves the contents of BE80-BE87, 8
                        bytes, to 0000-0007)
?D 0000
0000 01 02 04 08 10 20 40 80
?
?M 0100 FF 00 @      (These two commands will set to zero
?T 0101 01FF 0100    memory bytes 0100 through 01FF,inclusive).
?

```

NOTE: The CR issued at the end of the transfer command will not be echoed until after the command has completed. Furthermore, the transfer command does not affect the current open address.

The transfer command will verify each byte in the result field to make sure it agrees with the source field. This is done one byte at a time; right after each byte is moved, the result byte is compared with the source byte. If there are no discrepancies, the monitor will go directly back into command mode and display a ? after the transfer is completed. If an error is found, the result address where the error occurred, along with the contents of the defective result byte, are displayed. The transfer is then continued at the next byte. It is possible to easily modify the program so the user has the option to either type CR to continue the transfer at the next byte, or @ to abort and go back to command mode. Locations BCF3-BDF5 in the monitor should contain zeroes (NO-OPS). Alter these locations to contain CD 9E BD. You can use the M command (Examine/Modify Function), but don't make a mistake or your program will be damaged.

The transfer command may also be used to test a PROM to see if it contains any data. To do this, create a field of 512 bytes of binary zeroes (as shown above), and then use it to "program" the PROM by using the transfer (T) command. Since it also verifies, it will tell you if a new prom is defective or if an old one still contains data. For example (assuming there is RAM memory at 0000 and the PROM under test is at A000):

```
?M 0000 F3 00@   (Create a field
?T 0001 01FF 0000   of 512 NULLS)
?T A000 A1FF 0000   (Test the PROM)
A014 C3           (If locations A014 and A015 already con-
A015 27           data, you might get this display).
?                 (Transfer complete, return to command mode).
```

NOTE: Leave the prom protect switch in the "SAVE" position, since you don't want to actually program the prom. You will just be using the verify routine to see if the Prom contains the data desired. This allows the operation to run at full 8080 speed.

The monitor will not display any error message. If it persists in going back into command mode when it isn't intended, it could be for one of the following reasons:

1. An invalid command was typed.
2. A jump was made to the beginning of the monitor, at BC00 or BC14. This will happen if J (CR) is entered right after the monitor is initialized.
3. An inadvertent attempt was made to modify the monitor program itself or its stack area.
4. In the transfer command (T), an improper address range was specified or the receiving field overlays part or all of the monitor or its stack area.

This monitor has a self-preservation instinct. Otherwise if the ROM board were unprotected the ROM monitor could be used to destroy itself. If the keyboard Hex Loader attempts to violate the monitor no error message is issued; the monitor will return automatically to command mode and will not allow you to modify any part of it or the stack.

A word about restarts: If the system crashes and all RAM data is destroyed - or if the monitor is being started for the first time after system power-up - start at BC00 if the default I/O status masks are wanted, or at BC0C if I/O status masks, etc. are patched in RAM. If a user-supplied program goes into an endless loop - or for another reason - it is necessary to re-start but the monitor RAM is O.K., then re-start at BC12. BC12 is the normal re-start address; starting at BC12 will not affect the current open address.

The Los Altos Micro-Monitor contains a number of useful subroutines which may be called from user-supplied programs. As a rule these subroutines save (or don't use) registers B, C, D, E, H and L. The accumulator is not saved. Except where otherwise specified, all subroutines end with an orderly RET (Return) to the caller.

Following are the names of the subroutines, their addresses in HEX, and what they do:

E107 ADDRIN BCFF Same as ADRIN1, but CR is ignored. Entry of an address is required instead of optional. The @ symbol may still be entered to return to the monitor command mode.

E118 ADRIN1 BD10 Gets an optional address value in H-L, in hexadecimal from the keyboard. This routine calls INPHEX. Upon return the caller should test the zero flag. If the zero flag is off (0), H-L contains a valid address. If the zero flag is on (1), that means the user pressed the CR key instead of entering an address, and H-L will remain undisturbed. The user can also type @ to return to command mode.

E125 INPHEX BD1D Inputs 2 hexadecimal digits from the keyboard and assembles a single byte of data (or address) in the accumulator. The @ symbol and valid HEX digits 0-9 and A-F are echoed; @ returns to monitor command mode and re-initializes the stack pointer. CR and SP are valid, but only at the first digit position. All other characters are invalid and are ignored and are not echoed to the display.

Upon return from INPHEX the caller should test the zero flag. If the zero flag is off, the accumulator contains valid data entered as two HEX digits. If the zero flag is on, the user pressed the CR key instead. This feature allows optional entry of data. If the data is required - and CR is not to be allowed - source code similar to this can be used:

```

INDATA CALL INPHEX
          JZ  INDATA
          Etc.

```

- E176* ADCOMP BD6E Address compare routine which compares the address value in D-E with the address value in H-L. Result is indicated by the carry and zero flags. The carry flag is set to 1 if H-L is greater than D-E.
- E17C* ADROUT BE74 Starts a new line on the output device and displays the address value contained in REGS. D-E. One space is left after the address.
- E187* OUTSP BE7F Skips one character position on the output device. A space (SP) is outputted.
- E18D* OUTHEX BD85 Outputs 2 hexadecimal digits to your display device. The pair of HEX digits represents the contents of the accumulator.
- E1A6* WAIT BD9E Inputs CR or @ symbol from the keyboard. All other characters are ignored. CR returns to the caller; @ returns to the monitor and re-initializes the stack pointer.
- E1B8* INASCI BDB0 Gets one character from the keyboard and returns it in the accumulator. The parity bit, which is bit 7 - the high-order, or leftmost bit - is zeroed out. Some terminals use bit 7 as a parity bit or leave it on all the time. Normally, this routine should be used for all keyboard input.
- E1BE* INCH BDB6 Gets one character from the keyboard and returns it in the accumulator. All 8 bits are returned without alteration. This input routine is the one to use when reading a binary paper tape.
- E1C8* OUTNEW BDD3 Starts a new line on the output device. A CR is issued, followed by a LF (Line Feed).
- E1D5* OUTCH BDE0 This routine sends the character in REG. B (All 8 bits) to the display device. Control characters such as LF and CR will perform their normal functions for the display being used. At exit, both the accumulator and REG. B will contain the character that was outputted.

This monitor was written by Charlie Pack, 25470 Elena Road, Los Altos Hills, CA 94022. His intention is to stand behind this software, so if you have problems with it - or want to make suggestions (which are welcome) feel free to contact him or Mountain Hardware about it. Charlie Pack's phone number is (415) 941-0495, evenings between 7 and 10 PM are preferred.

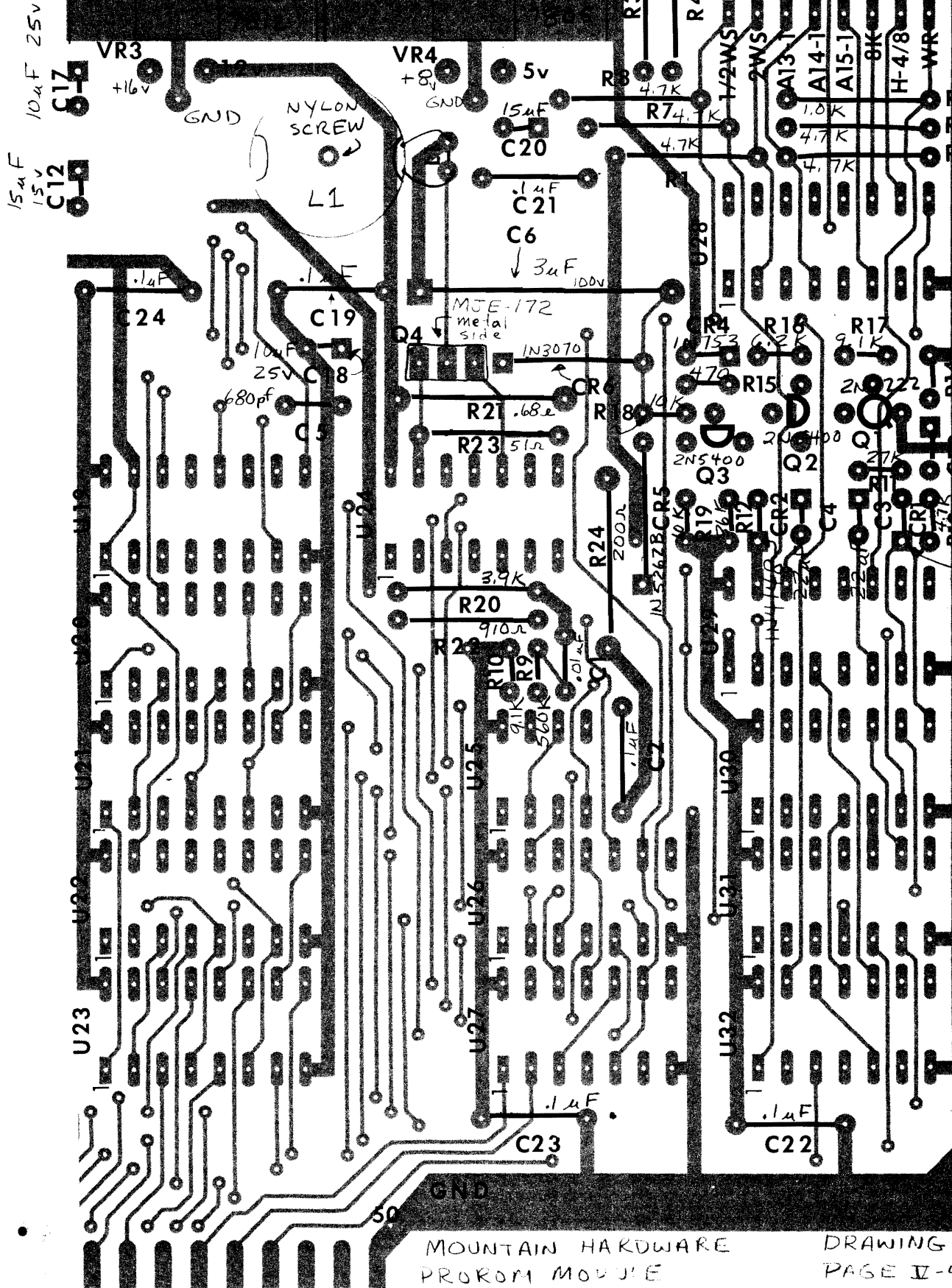
Copies of the source listing are available from Mountain Hardware for a copying charge of \$3.50.

V. DRAWINGS

- 5.0 PROROM Schematic Drawing
- 5.1 PROROM Assembly Drawing
- 5.1a Expanded Assembly Drawing

Heatsink

small Heatsink



EXPANDED ASSEMBLY DRAWING

A. APPENDICIS

A.1 Statement of Warranty

Mountain Hardware warrants its products in the following manner:

Any part that fails because of defects in workmanship or materials will be replaced at no charge, if the part is returned postpaid to Mountain Hardware within six months of the date of purchase.

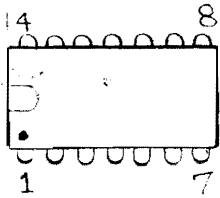
Any malfunctioning module returned post paid to Mountain Hardware within the six month warranty period will be repaired and returned, if in the judgement of Mountain Hardware the module was assembled with care (in the case of kits) and not electrically or mechanically abused.

This warranty is made in lieu of all other warranties expressed or implied, and is limited in any case to the replacement or repair of the unit involved.

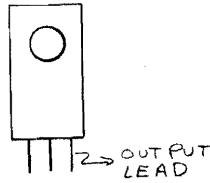
A.2 Soldering Techniques

The most needed skills to soldering is patience and care. Use plenty of both when assembling any kit.

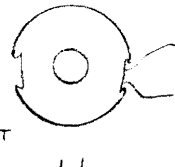
- a. Use a small, good soldering iron. The wattage should be 30 watts or less. Larger irons can burn the pc boards, and cause traces to lift. Soldering guns are too hot and large for this application. The tip on the iron should be small and clean. Wipe the tip on a damp sponge before each use.
- b. Use 60-40 rosen core solder ONLY. The diameter of the solder should be small, around 20 to 30 thousandths of an inch. DO NOT use externally applied flux, or acid core solder.
- c. When soldering, wipe the tip first. Lightly set the iron on both the lead and the pad to be soldered. After a second, apply solder to the lead and the pad, near the iron. The solder should melt freely. Apply enough solder to surround the entire lead, allowing a little extra to flow with the hole. Remove the solder and let the iron bubble out some of the resin on the solder. Then remove the iron. The entire process should take less than 3 seconds. The soldered joint should be neat and shiny. When soldering on large metalized areas, a longer time may be required to solder the joint.
- d. The solder mask varnish is intended to prevent solder bridges and splashes. Excessive heat in soldering may cause this varnish to blister. If this happens try to reduce the length of time the iron is on the pad when soldering.



- IC



REGULATOR
AND
Q4 2N6407
TRANSISTOR



LI
INDUCTOR



.1Z
25V
DISC
CAPACITOR

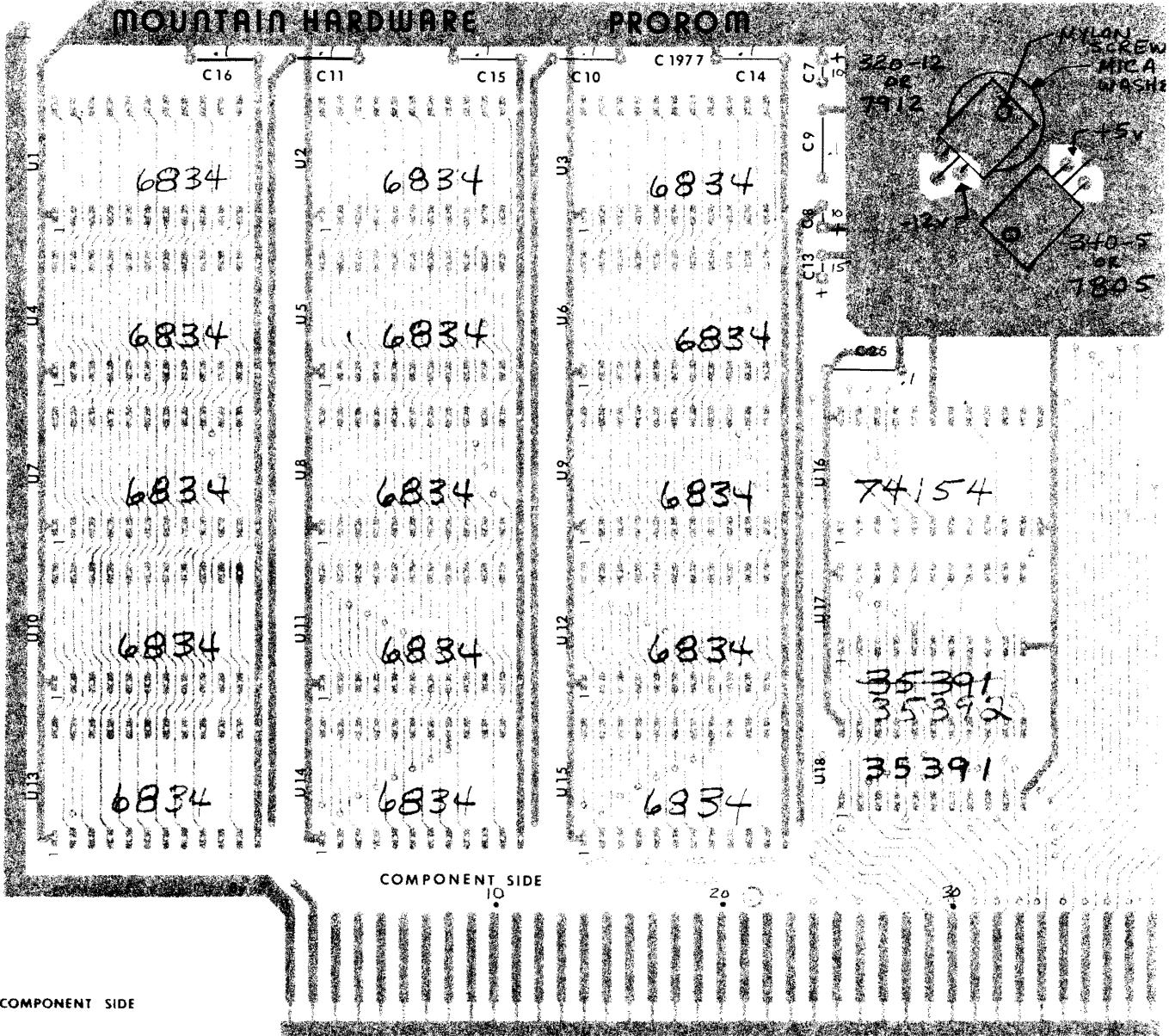


DIPPED
TANTL.
CAPACITOR



CKOS
TYPE
CAP.

LARGE HEATSINK

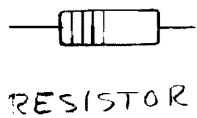


5.312

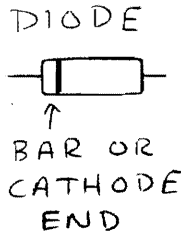
10.000

PC DESIGNER:
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LOS ALTOS, CA 94022
(415) 941-0379

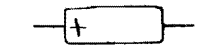
FIG. 5.1



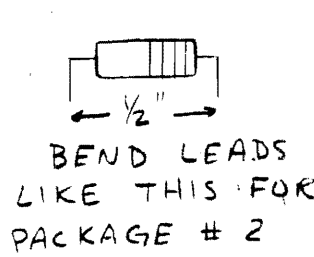
RESISTOR



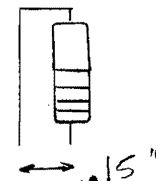
DIODE
↑
BAR OR
CATHODE
END



LARGE
TUBULAR
CAPACITOR



BEND LEADS
LIKE THIS FOR
PACKAGE # 2



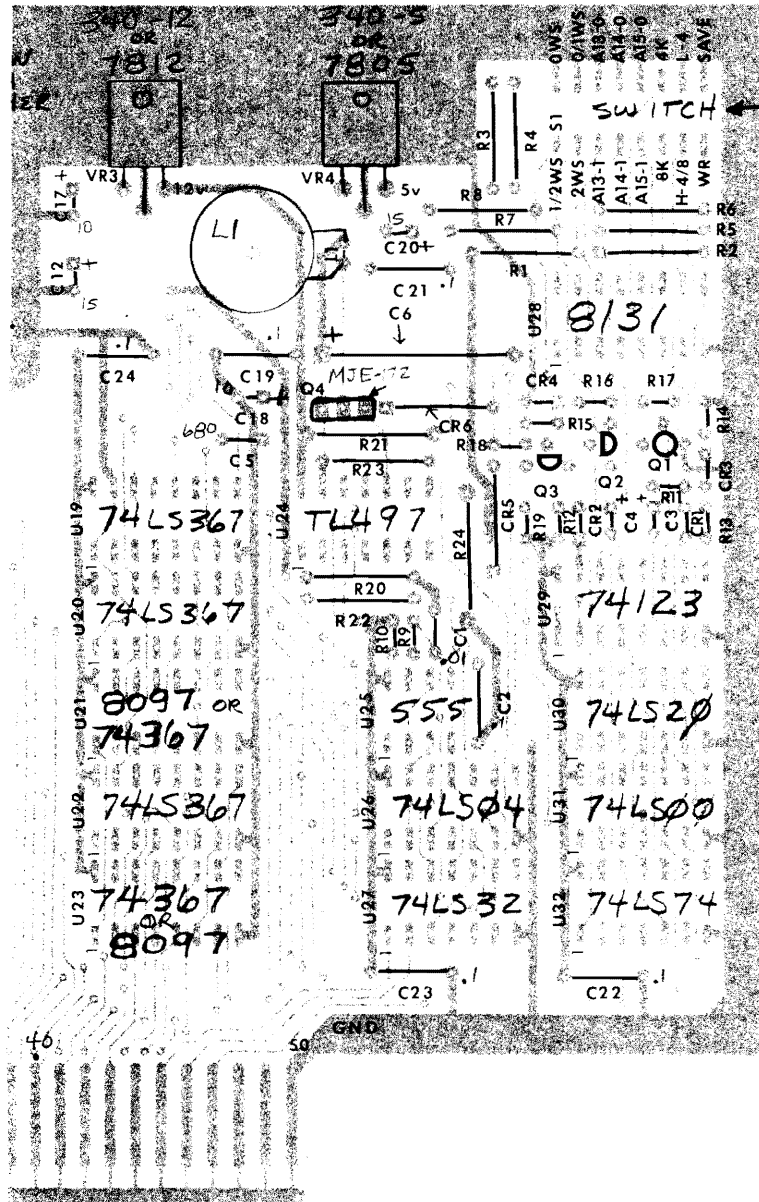
BEND LEADS
LIKE THIS
FOR PACKAGE
1

NOTES:

1. PIN 1 OF ALL IC'S IS IN LOWER LEFT HAND CORNER
2. THE NON-METAL SIDE (TOP) OF Q4 FACES THE 100 PIN EDGE CONNECTOR
3. SQUARE COMPONENT PADS ON THE BOARD DENOTES
 - a. PIN 1 OF IC'S
 - b. + LEAD OF CAP
 - c. CATHODE (BAR END) OF DIODES
4. SEE FIGURE 5.1 a FOR DETAILED BLOWUP OF RIGHT HAND SIDE OF BOARD

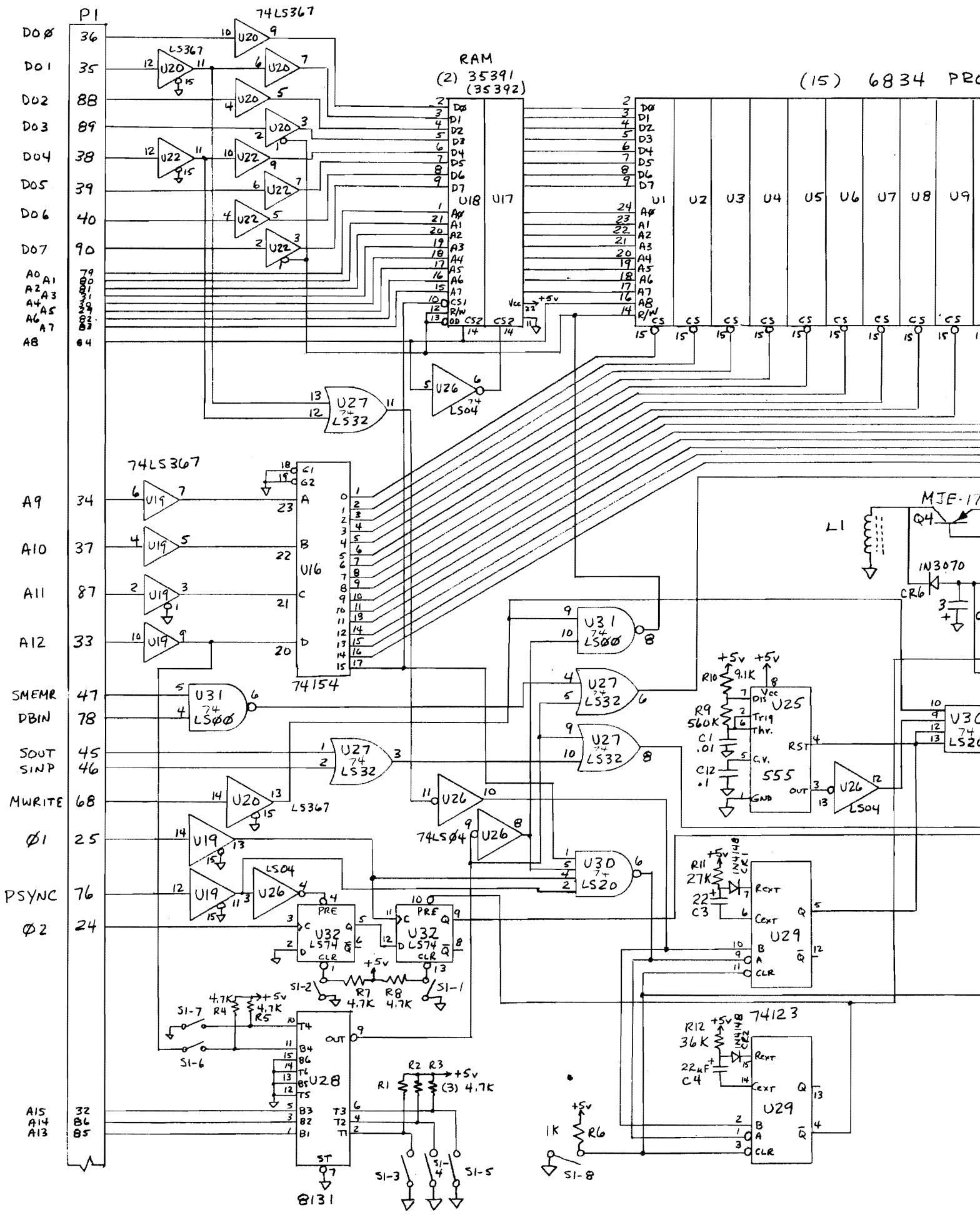
SMALL HEATSINK SMALL HEATSINK

DO NOT USE SOCKET FOR SWITCH

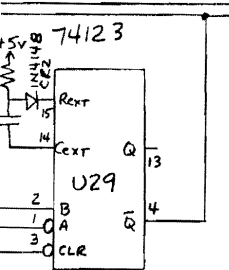
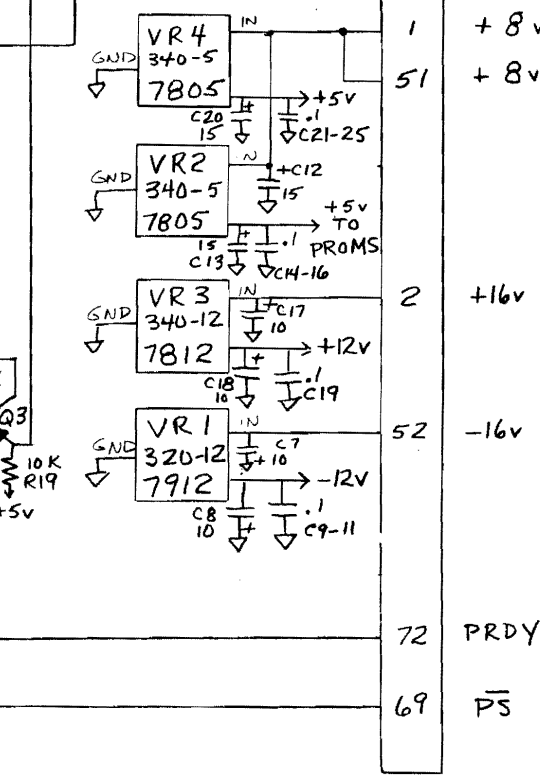
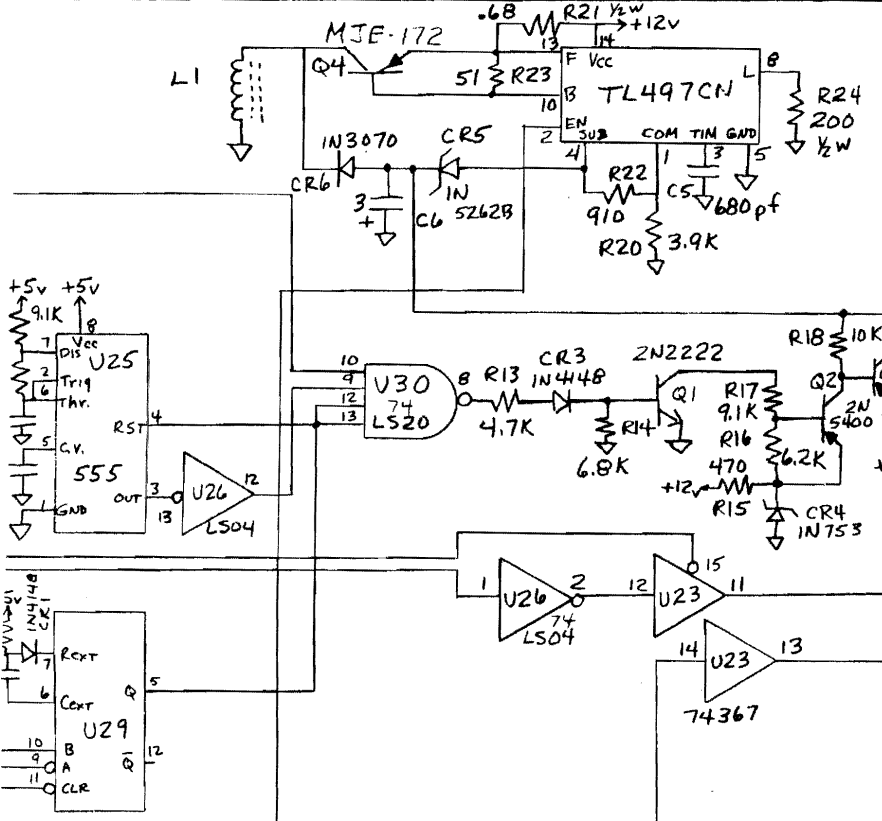
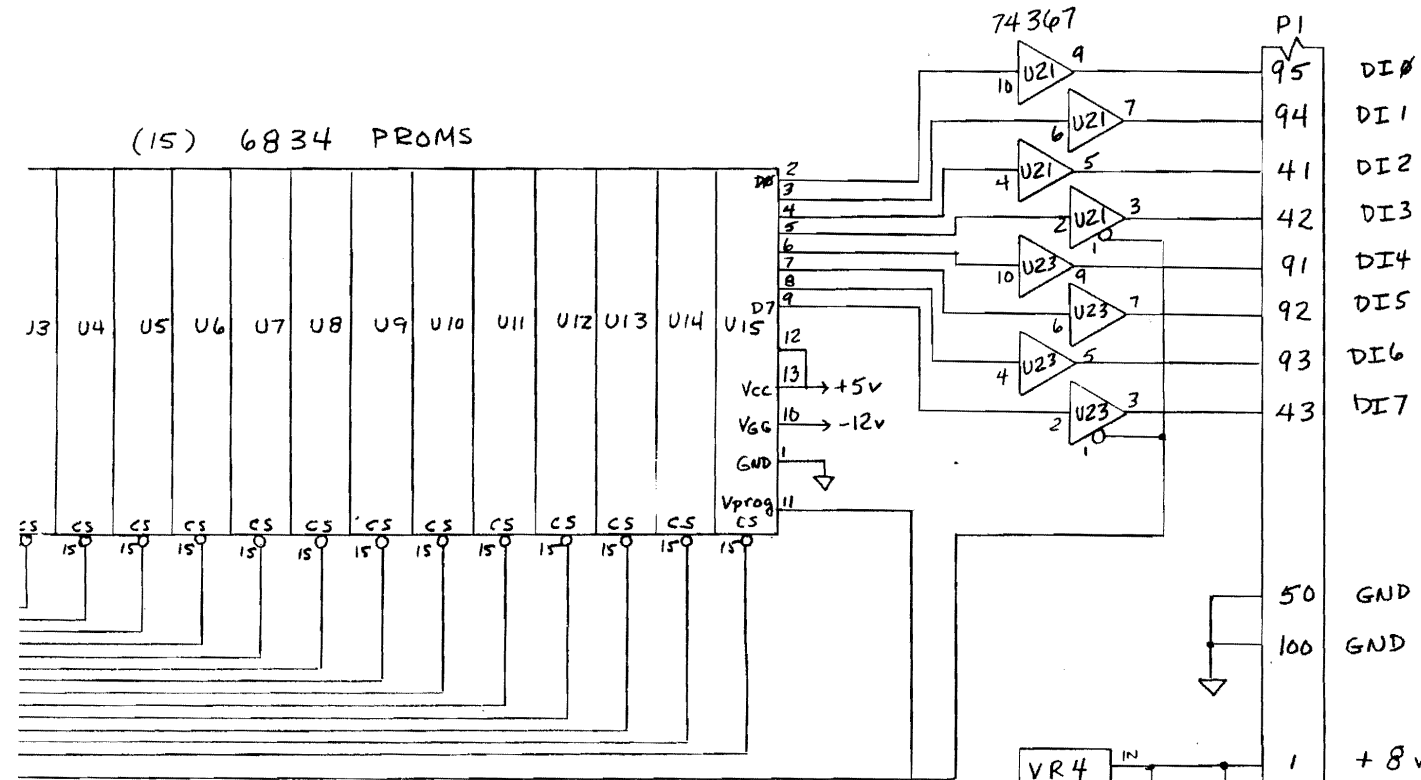


DRAWING 5.1

| | | |
|-------------------|-----------------|--------------------------------|
| MOUNTAIN HARDWARE | | |
| B | 1/10/77 D.M. | PRO ROM ASSEMBLY DRAWING |



(15) 6834 PROMS



MOUNTAIN HARDWARE
 B • 1/10/77 D.M.
 PROROM SCHEMATIC

DRAWING 5.0
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