

HRD+ RAMDISK

CONSTRUCTION
GUIDE

BY

BUD MILLS & RON GRIES

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11/20/87

The CONSUMER assumes full risk and liability for direct or consequential damages arising from attempted construction of the HRD+ Ramdisk.

EXCLUSION OF WARRANTIES: The HORIZON RAMDISK circuit board is provided on an AS IS basis. No warranty any kind is assumed by Horizon Computer, Limited. The user assumes full responsibility for quality of all parts associated with construction of the HRD+ RAMDISK. BUD MILLS SERVICES does not recommend or endorse the quality of parts sold by any other party. In any case, BUD MILLS SERVICES shall be liable only for the cost of the circuit board, associated manuals, disk based software, or parts, only if purchased from BUD MILLS SERVICES.

Fully constructed HRD+ RAMDISKS are available with a 90 day limited warrenty for an additional cost covering

parts and labor. Contact BUD MILLS SERVICES for current list of Dealers or Builders.

Prior familiarity with construction of digital circuits is assumed. Read all construction suggestions and notes provided with the eight figures before proceeding. The following eight pages show progressive stages in completion of the HRD+ RAMDISK. If you encounter a problem or have a question at any step DO NOT PROCEED UNTIL THE PROBLEM IS RESOLVED. If you have any questions contact: Bud Mills at (419) 385-5946.

Although static can be a problem with CMOS devices (i.e. the 6264LS-15's) we have not seen a single case of IC damage under ordinary handling procedures; nor have we seen problems do to excessive heat. While you may decide to take precautions against excessive static and heat transfer, remember that it is equally important THAT ALL SOLDER CONNECTIONS ARE OF GOOD INTEGRITY.

Use a low wattage (about 25 watts) SOLDERING PENCIL and fine 60:40 tin/lead solder. DO NOT USE a soldering gun or acid core solder! Make sure that sufficient solder is supplied to all connections with good wet-out, but that there are no solder bridges between connections. Upon completion of all soldering, remove flux from the solder side of the board with a commercial flux remover.

When inserting IC's bend the pins to fit the socket by placing the IC on it's side on a flat surface. Bend the pins against the surface by moving the body of the IC. Make sure all pins are properly aligned with the socket holes and that all pins actually go into the socket holes upon insertion.

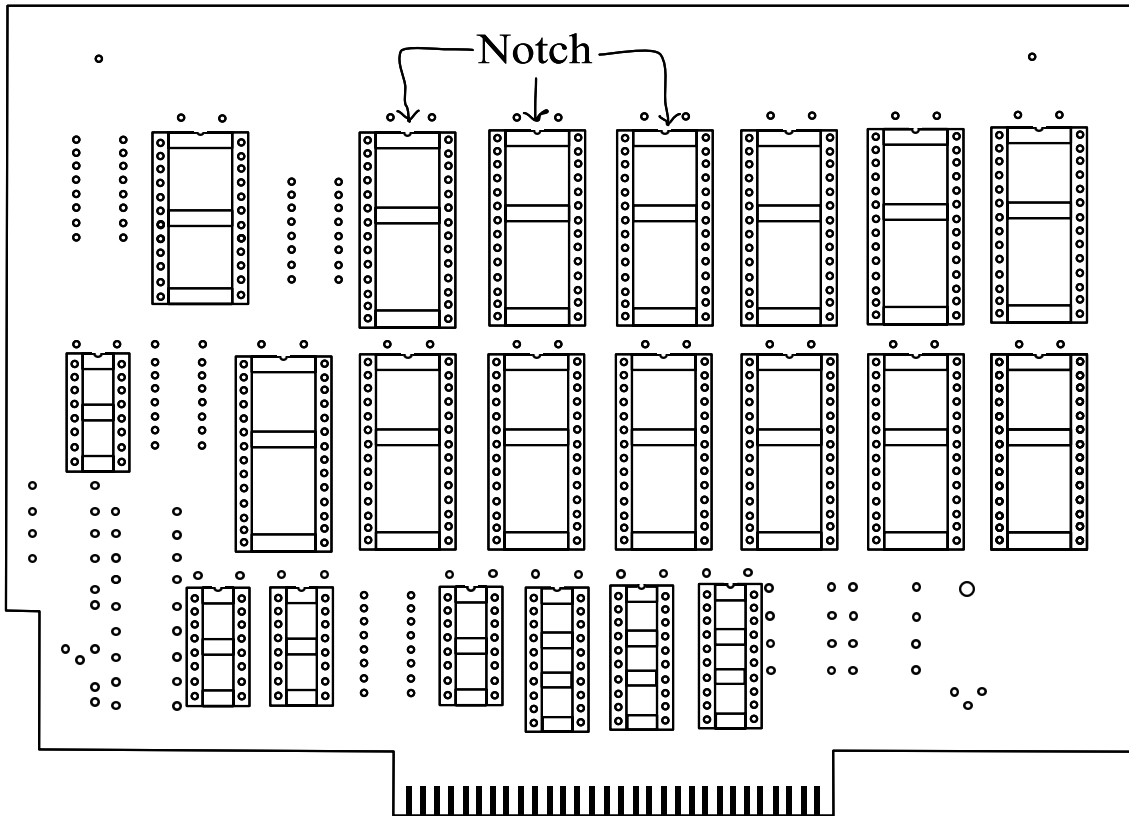


FIGURE 1

The sockets required are: 13 28-pin, 3 20-pin, and 5 16-pin.

Referring to Figure 1, place all sockets on the board. The sockets are inserted on the side of the board on which all parts are labeled. The sockets you use may be notched on one end. If so, orient the notches as shown. If your sockets are not notched, orient them with the pin 1 mark in the upper left corner. Note that sockets are not used for the JACK. Before inserting the switch socket in place, insert a 2 inch piece of jumper into Pin Hole #8. The other end will eventually connect to pin 4 of U20B. Place a piece of cardboard or other stiff material over the sockets to hold them in place, and turn the board upside down for soldering. When soldering the corner pins of each socket, apply a little pressure to the board to insure that the socket is all the way in. Do not apply excessive amounts of solder.

Upon completion of soldering, carefully inspect your work to insure that there are no solder bridges between pads.

A 16 pin socket may optionally be used for the DIP switch, labeled "switch" on the PC board.

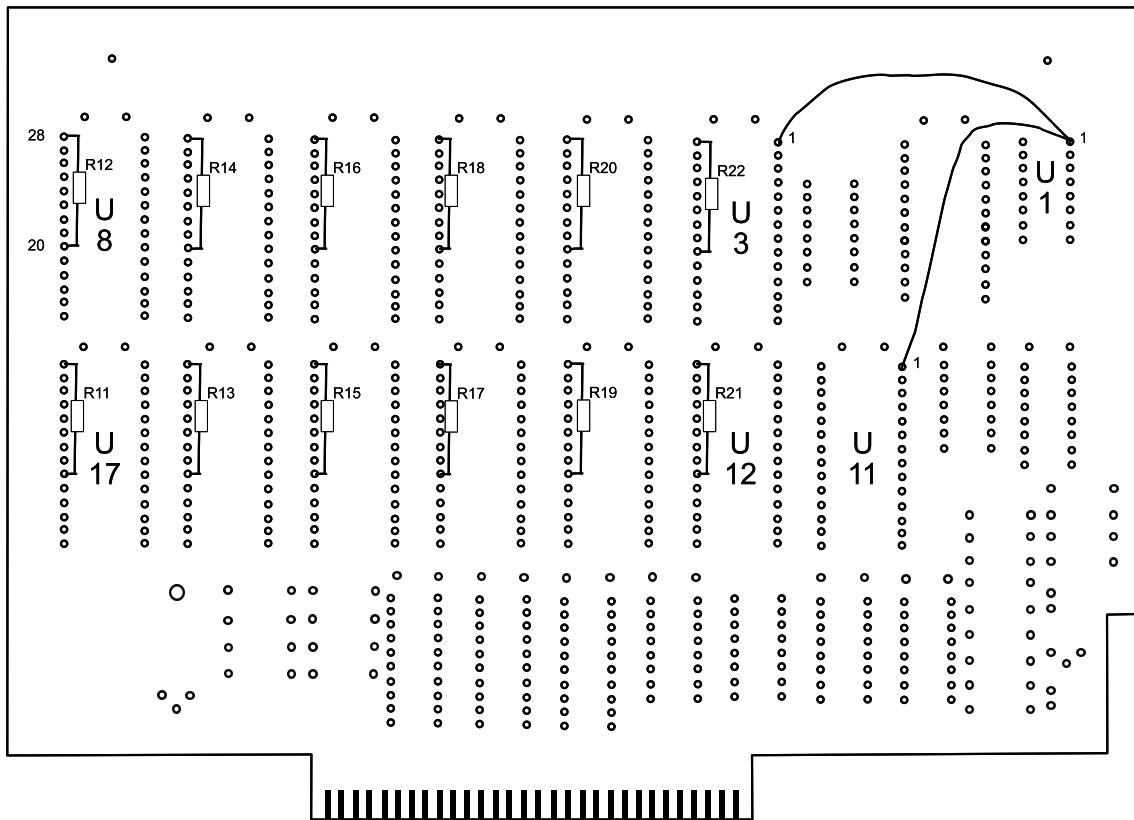


FIGURE 2

On the back (solder) side of the Horizon board install resistors R11 thru R21 (1K ohm 1/8 Watt) between pins 20 and pin 28 of each socket U3 thru U8 and U12 thru U17. Connect jumper wires from hole 1 of U1 to pin 1 of U3 and also to pin 1 of U11.

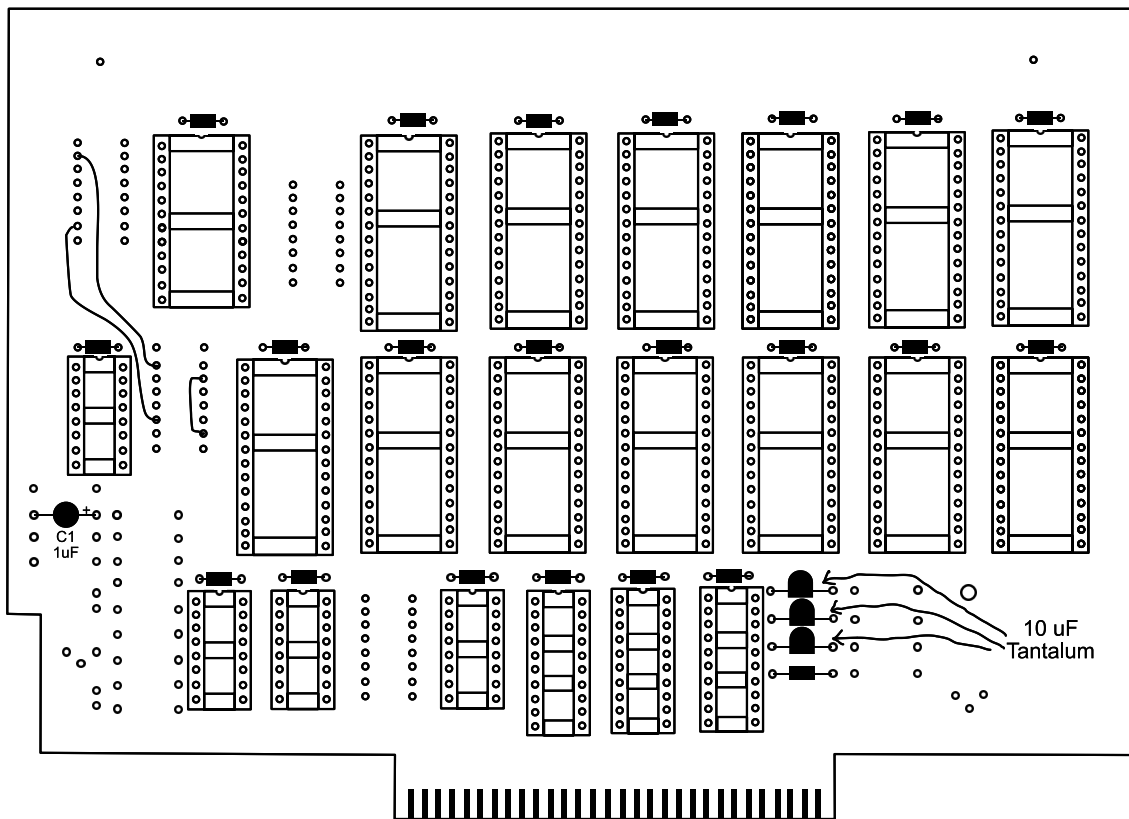


FIGURE 3

Install the .1 uF bypass capacitors as shown in Figure 3. Glass capacitors are shown, but any .1 uF capacitors may be used. Make sure the components you use are not diodes – diodes have a blue or black band on one end and the bypass capacitors do not. These capacitors have no polarity and may be oriented in either direction. As shown in Figure 2, there are 22 bypass capacitors. C5 is also a bypass capacitor. Install C1, a 1 uF capacitor. Observe polarity positive (+) lead points toward the center of the board.

Mount the 10 uF tantalum capacitors C2, C3, and C4 as shown in Figure 2. These capacitors are polar and must be oriented as shown. The positive (+) lead of these capacitors will be marked on the capacitor body. Make sure you orient each capacitor with the positive lead to the right as shown in Figure 2.

Install Jumpers:

U1 hole 2 to U10 hole 1
 U1 hole 7 to U10 hole 3
 U10 hole 9 to U10 hole 13

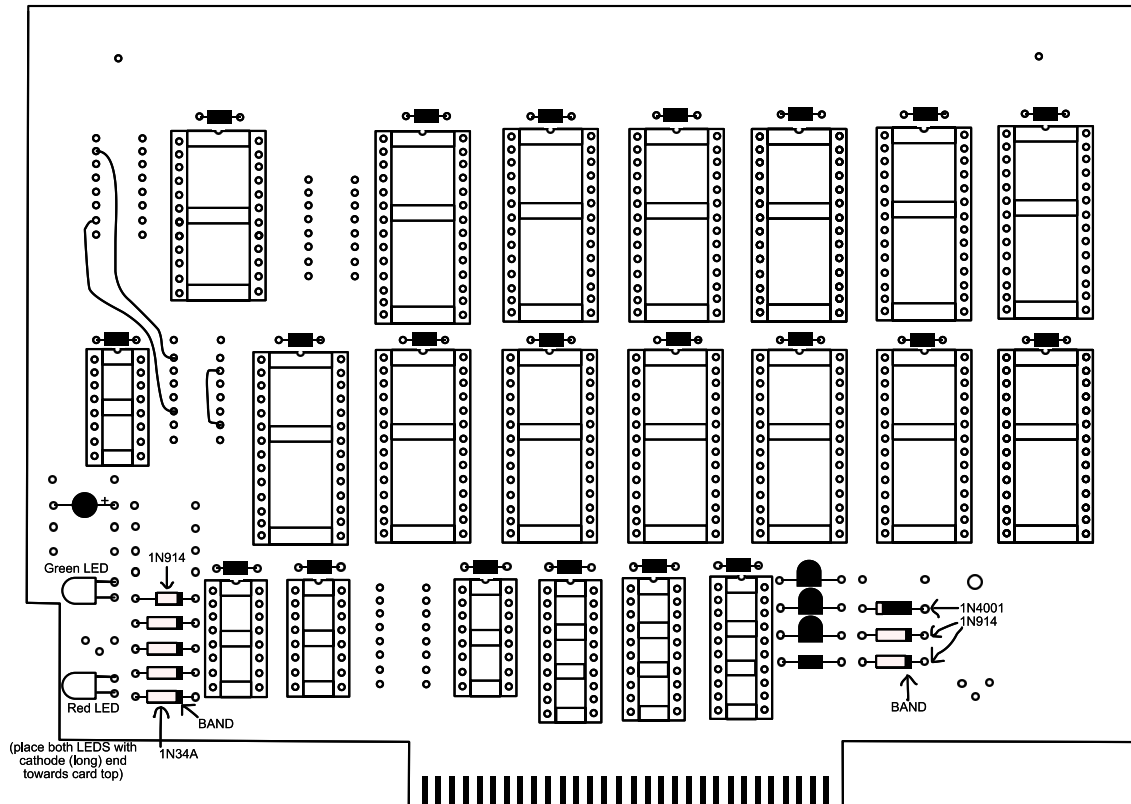


FIGURE 4

Refer to Figure 3 for diode placement. Three diode types are shown: CR3, CR9, and CR10 are 1N914 silicon diodes; CR4, CR3, CR6, and CR7 are 1N34A germanium diodes; and CR8 is a 1N4004 rectifier diode. Although similar in appearance, the 1N914 silicon diodes are smaller than the 1N34A germanium diodes.

Diodes are polar. In the $\rightarrow|$ notation the arrow points toward the cathode (-). Silicon and germanium diodes have a black or blue band on one end to indicate the cathode (-) lead. The rectifier diode will likely be black with a silver cathode band. Make sure the components you are working with are banded (glass bypass capacitors look similar but are not banded), and make sure you orient each diode with the cathode band in the direction shown in Figure 3.

Next install the 2 Light Emitting Diodes (LED's). CR1 must be green or yellow. CR2 may be any color of LED. LED's have polarity, and the cathode (-) of those you are using will be indicated by a flat side on the LED body or the shorter of the two leads. Orient the LED's as shown in the inset. CR2 should be installed so that the lens points toward the front of the card but does not extend beyond the card edge.

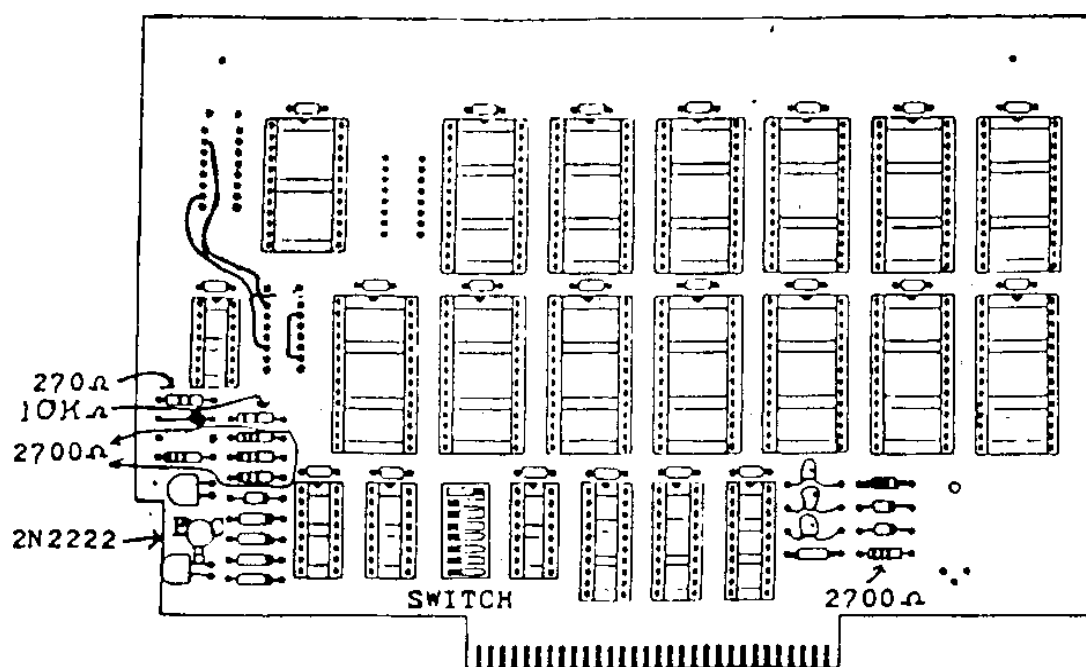


FIGURE 5

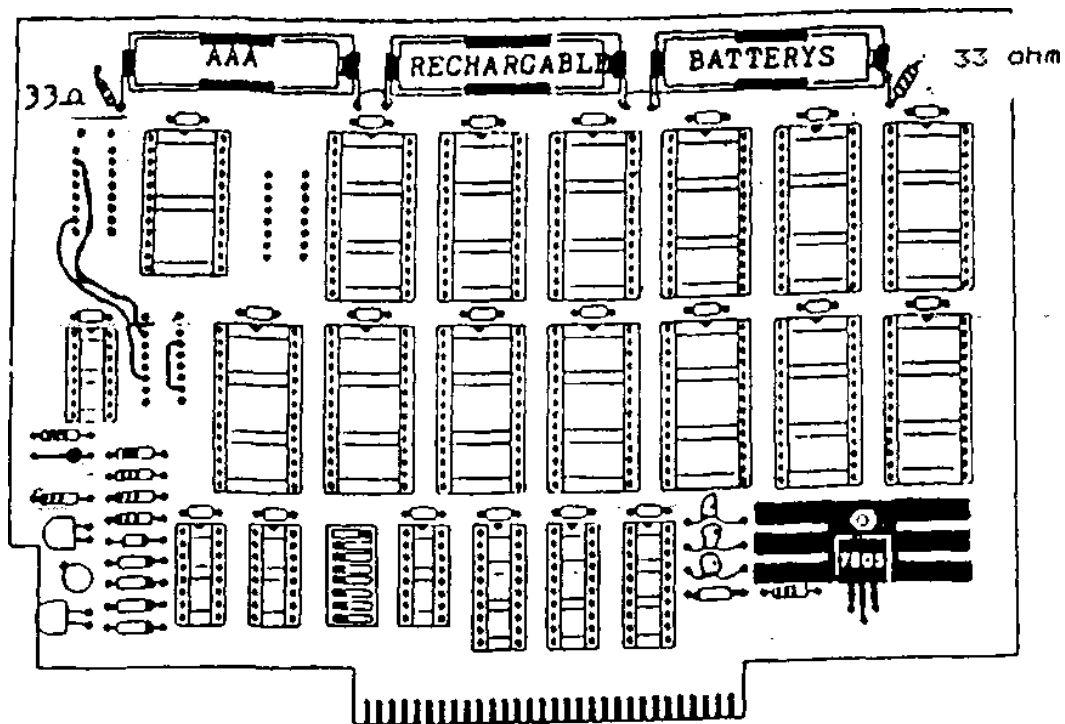
Mount resistors R2 - R8 and R10 as shown. Although resistors have no polarity, you may orient them so that the color codes can be read - from left to right. Resistor values and corresponding color codes are as follows:

R2	270	Red Violet Brown	R6	2.7K	Red	Violet	Red
R3		Not Used	R7	2.7K	Red	Violet	Red
R4	2.7K	Red Violet Red	R8	2.7K	Red	Violet	Red
R5	10K	Brown Black Orange	R10	2.7K	Red	Violet	Red

R11-R42 1K Black Red Silver

Install the 2N2222 transistor Q1. From the top starting with the tab and going counter clockwise the three pins of Q1 are emitter, base, and collector (E B and C). Solder the leads so that the case stands about 1/4" above the surface of the board.

Install the 8-position DIP switch in 16 pin socket as shown. Place switch 1 in the ON or CLOSED position as shown.



Lightly sand the underside of each battery holder to promote adhesion. Bend the solder tabs on each battery holder so they are parallel with the surface of the board. Observing correct polarity, with batteries in place, use five minute epoxy to cement the holders to the board surface. Leave space between the holders as shown. When the cement has set, use short lengths of wire to connect the center holder with the two end holders.

Solder a 33 ohm resistor, R1 (orange orange black) to the board and the negative end of the left battery holder.

Solder a 33 ohm resistor, R9 (orange orange black) to the board and the positive end of the right battery holder.

Solder the 7805 voltage regulator in place making sure that the hole in the tab lines up with the hole in the board. Install a heat sink on top of the tab with a 6-32 1/4 machine screw and nut.

If the results at any step are not as described STOP AND CORRECT THE PROBLEM BEFORE PROCEEDING.

With no ICs inserted, place the card Expansion Box and switch on the power. The CR1 LED light and the CR2 LED should not light. CR1 LED cannot be seen from the front of the PEB, you must look down from the top.

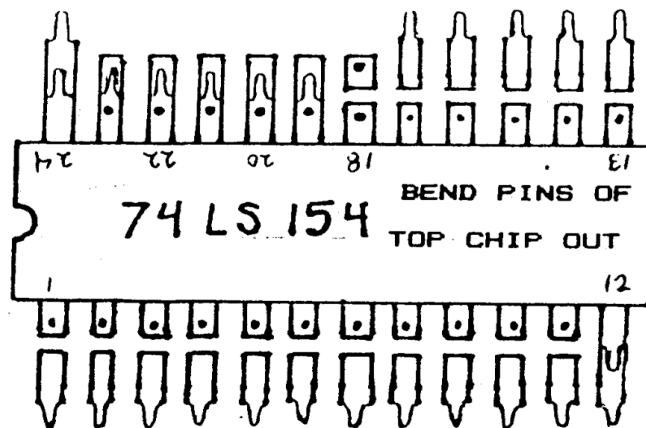
FIGURE 7

Take two 74LS154 IC's and stack them. Bend the pins of the top chip in slightly to grip the bottom chip. Solder pins 12, 19, 20, 21, 22, 23, and 24.

The remaining top chip pins should be bent outward (for attaching wires).

On the bottom chip, Pins 18,19,20,21,22, and 23 MUST NOT be plugged in to the U2 socket. Either cut them off or bend them outward to attach wires later. SEE SKETCH

CUT PINS OFF SO THEY CAN NOT
ENTER SOCKET (PINS
18,19,20,21,22,23)



LEGEND

- * CHIP PIN SOLDERED TO LOWER CHIP
- * CHIP PIN CUT OFF OR BENT OUT AND A WIRE CONNECTED
- * CHIP PIN CUT OFF TO PREVENT CONTACT WITH ANY LOWER PIN

SIDE VIEW

U2B (2ND LAYER)

U2A (BOTTOM)

Insert U2 in socket and connect jumper wires to U1 and U10 socket holes as shown below.

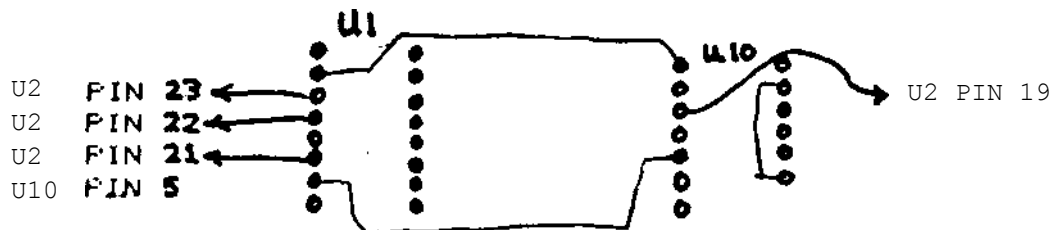


FIGURE 8A

Prepare (2) 74LS259's as shown in sketch.

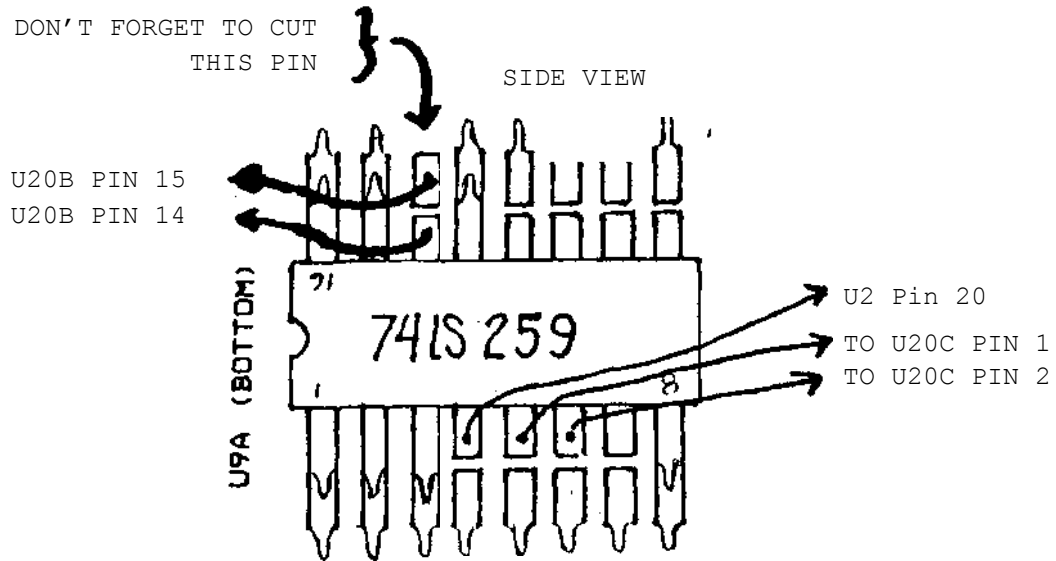
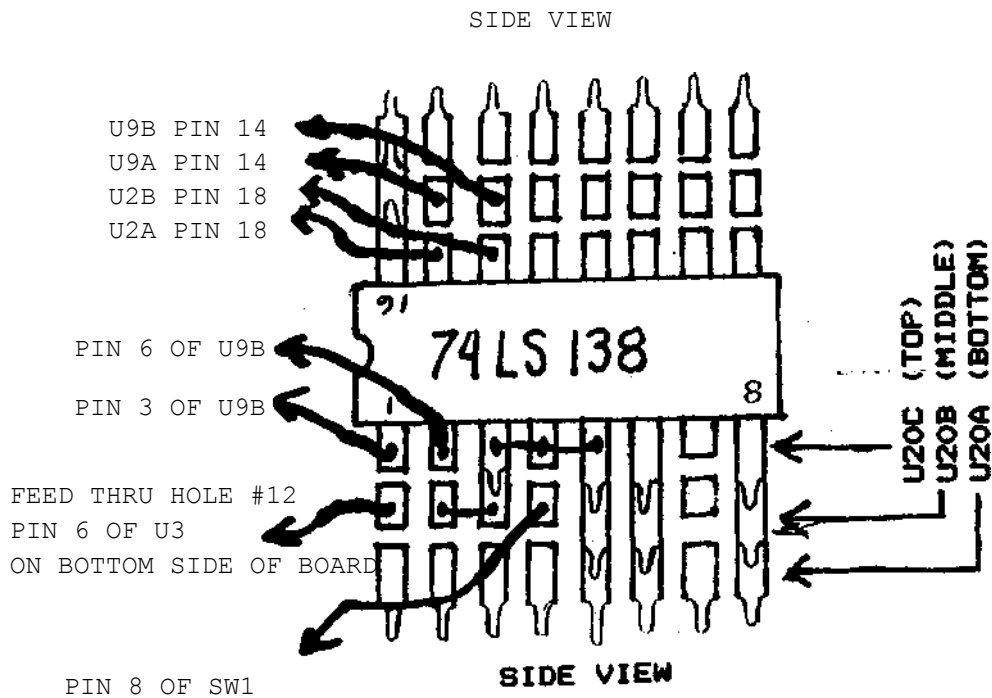


FIGURE 8B

Prepare (3) 74LS138's in a similar manner

SEE SKETCH



Insert the assembled chips in their respective sockets and connect the wires as shown.

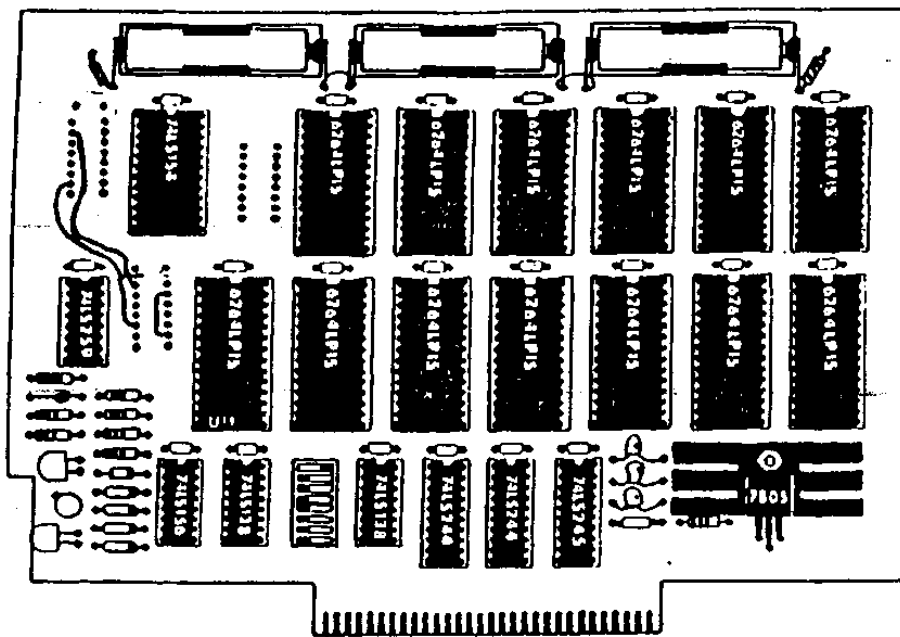


FIGURE 9

1) Insert all IC's except the thirteen MEMORY CHIPS and connect all jumpers. Make sure the notch of each IC points toward the battery holder and that the labels on the IC backs are oriented as shown in Figure 6. Install U11, the 6264LP-15 nearest the left side of the board. TO AVOID MEMORY DAMAGE, NEVER PLACE THE CARD IN THE PE-BOX WITHOUT ITS BATTERIES! Run the MEGTEST program as described in the MEGTEST Instructions selecting the U11 test. As the program runs, the CR2 LED should turn on and off. If the program stops or has errors check that the DIP switch setting and the CRU address MEG TEST is testing match. If the DIP switch setting is correct check the germanium diodes. We have found that the germanium diodes CR4-CR7 are often the problem. The diodes can be replaced with Radio Shack Cat. No. 276-1123.

2) Insert the 62256LP12 per the following chart. Re-run the MEGTEST program. This time selecting the MEG CARD option.
No bad chips should be found.

IMPORTANT: If you are building your card at less than 384K then you MUST insert the Memory Chips in the following sockets.

First 96K:	U17	U8	U16	
192K:	U7	U15	U6	
288K:	U14	U5	U13	(the twelve sockets will each have
384K:	U4	U12	U13	one memory chip inserted)

4) Load the RAM Operating System. As final verification that the card is working properly, you can run the Disk Manager-2 comprehensive test on each drive that you have (rest of lines missing from this page)

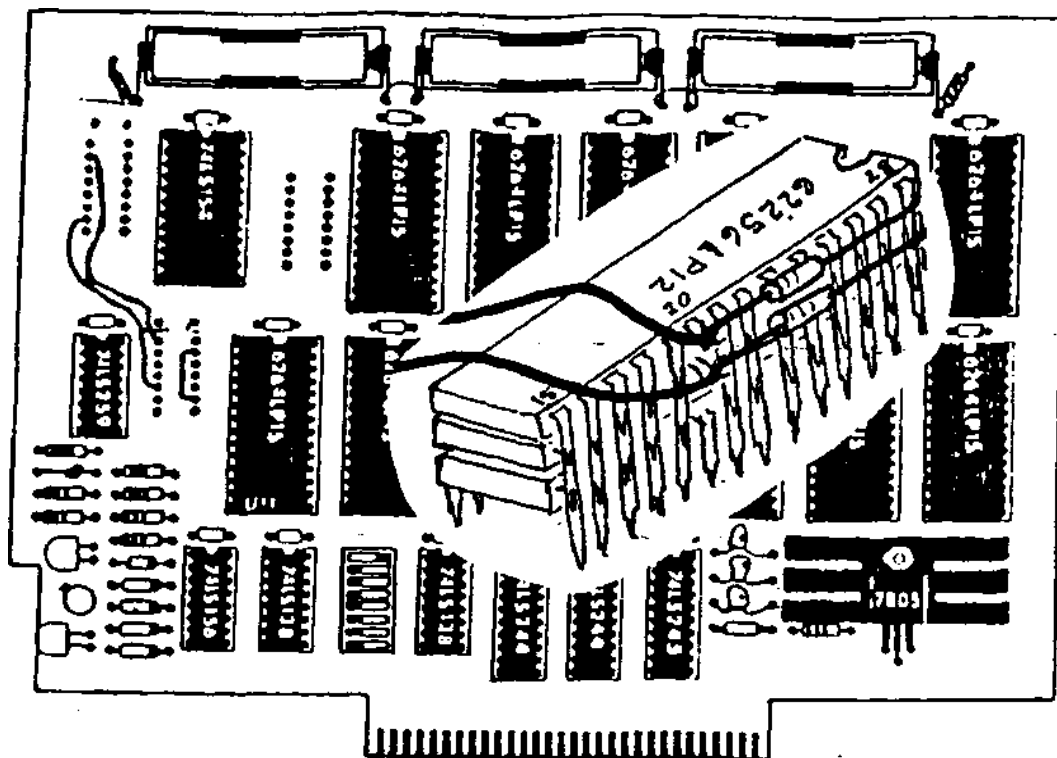


FIGURE 10

After testing the remaining chips proceed to stack and solder the memory chips for U3 thru U8, U12 and U13, three chips high. Do not solder pin 20 on any chip. Looking at at IC from the top with notch up, pin 20 is the sixth from the bottom on the right side. Bend the remaining pins inward so they make firm contact when placed over the bottom IC. Making sure notches are matched, place top IC (pin 20 bent out) over the bottom IC. Repeat for the third level. Stack chips U14 thru U17 two high. Bend pin 20 outward on each of the upper chips and connect a 1K ohm resistor between pin 28 and pin 20 of each of the UPPER chips (both the second and third levels). All pins on the bottom chip should be clean, straight, and free of excess solder for proper fit in the sockets. Keep the ends of the bottom IC pins free of solder and scrape off flux before reinsertion. THE INTEGRITY OF EACH SOLDER JOINT IS VERY IMPORTANT. After soldering and carefully inspecting as IC pair, re-heat each joint to INSURE GOOD WET-OUT OF BOTH PINS. Attach a wire to each bent out pin 20, this wire should be long enough to reach pin 1 thru pin 17 of the U2B (TOP 74LS154)

Chip Select CONTROL LEAD ASSIGNMENTS

The "order" of assignment is critical to proper operation of the HRD + RAMDISK, above 384K. The first 12 chip select leads to pin 20 of each memory socket are hardwired in the board directly to U2A. The next four appear at the "JACK" holes #13, 14 15 16. (This will take you up to 512K). The next 16 leads are connected directly to U2B pin 1 thru pin 11, and pin 13 thru pin 17 (in ASCENDING 1,2,3 order). The physical location of the 62256 memory chips is limited only to sockets (J3 thru U8 and U12 thru U17 and should not exceed three high unless you want to sacrifice the adjacent slot in your PEB or if you are expanding beyond one meg.

After you have connected the last control lead proceed to re-run the MEGTEST, all chips should test good. Proceed to install the ROS and configure your disk.

Parts list for RAMDISK

part description	# Required
reg. 7805	1
IC's	
74LS138	4
74LS154	2
74LS156	1
74LS244	3
74LS245	1
74LS259	1
6264LP15	1
62256LP12	3 6 12 16 or 32
Sockets 16pin	5
20	3
24	1
28	13
Trans 2N2222	1
Diodes 1N914	3
1N4004	1
1N34A	4
LED (green)	1
LED (red)	1
Dip Switch	1
Nicad AAA Batteries	3
AAA holder	3
Res 10k	1
2.7k	7
1k	32
270	1
33	2
Cap 1 mf	1
Cap 10mf tantalum	3
Cap.1mf bypass	22
Heat sink	1
Jumper wire	
62256LP12	3 for 96k
	6 for 192k
	12 for 384k
	16 for 512k
	32 for 1MEG

APPENDIX 1 MEGTEST INSTRUCTIONS

Insert the System Disk into Drive one.

Memory chips can fail, and so can any of the other components of your RAMDISK. In order to facilitate a test of your RAMDISK memory, a TI BASIC program called MEGTEST has been included on the System Master diskette. MEGTEST wipes out the ENTIRE contents of the RAMDISK including the operating system, so make sure you copy important files to a floppy diskette before running MEGTEST. After running MEGTEST, the operating system must be reloaded.

Troubleshooting with MEGTEST will identify the chip # for the bottom layer of chips, jack # for the next four chips and also the pin number of the second U2 so you can trace or "pull" the control lead to physically identify the chip in trouble if you have any. The Extended Basic "Load" program DSK1.LOAD provides a menu selection to load MEGTEST. The MEGTEST MENU asks:

```
[U] for U11 TEST
[M] MEMORY TEST
[L] LOOP TEST
```

When "U" is Selected the U11 chip is tested. When "M" is Selected the program asks how many chips are installed. Enter the number of 32K memory chips.

It then proceeds to fill the ENTIRE memory on the card with a series ... of eighteen special numbers and subsequently test each of the 32K chips on your card to see if they retain the values written. If you have a single-sided RAMDISK, 3 chips will be tested for each fill number - 6 for a double-sided; 12 for DSDD; 16 for 512K; 32 for one MEG.

The [L] loop test is only used to positively identify a bad chip using a Digital Voltmeter or Digital Probe. The chip under test will be pulsed on and off to allow a test measurement (HI & LO) to verify the physical location of the chip under test. MEGTEST does identify the "JACK" number or the U2B Pin that controls the chip with errors.

You may find one or more bad memory chips. Alternatively, you may find that for certain numbers several chips appear bad. An even more rigorous test is the Disk Manager II comprehensive test. Test 6 of the series has been able to locate problems on double-sided cards that no other test detects. All such problems have been due to poor solder connections on piggy-backed IC's. If you find errors, that you cannot correct, contact us regarding repair of your card.

Note: To use DM2 you will have to configure the card, renumber the drives to two(2) and three(3) (DM2 won't read above four (4) drives) and test each drive individually.

APPENDIX 2 IN CASE OF DIFFICULTY

Problems and "bugs" of various kinds have been found with many computer products, and the HRD+ RAMDISK will probably be no different in this regard. However, because the operating system for the card is in RAM, we can correct software problems by sending you a new disk.

You can help us to improve your RAMDISK by letting us know about the kinds of problems you experience in a way that will help us identify and correct the problem.

Whenever you experience a problem in using your RAMDISK, there are several questions you should try to answer. The first is:

Is the Problem Repeatable?

Using the same piece of software or the same disk, can you make the problem happen consistently. (While random problems are difficult to diagnose, we would still like to know about them.) If the problem is repeatable, try making it happen after powering-down your system and, waiting several minutes. Also try it immediately after re-loading the operating system (this will not affect the contents of your disk). Any information you can provide to pin down the factors which cause the problem will be of help.

Is the Problem Specific to the RAMDISK?

If you make a sector copy of the RAMDISK contents to a floppy, set the RAMDISK number at 6, and try the problem situation again using a floppy drive in place of the RAMDISK, does the problem occur? If so, it may not be related to the RAMDISK. In the process of RAMDISK software development there have been many times we thought there were problems with the RAMDISK only to discover the true source of the problem was elsewhere in the system.

Is the Problem Hardware Related?

Use the MEGTEST to check the HRD+ RAMDISK

If you do not find errors, the problem is likely to be in the software which controls the RAMDISK. When you have verified that the problem is repeatable, that it is specific to the RAMDISK, and that your hardware tests OK, please notify us of your problem so that it can be corrected.

No Access to Floppy Drives

If your system appears normal on power-up, but locks up when you try to access your floppy drives, re-load the operating system as follows: Power-down and wait two minutes. Remove the card and turn DIP switch 1 to the OFF or OPEN position. Turn switch 3 to the ON or CLOSED position to set the CRU base address at >1200. This will allow the disk controller card to be accessed before the RAMDISK. Re-install the card and load the operating system as usual. Power-down again and wait two minutes. Then remove the card and re-set the DIP switches as desired.

APPENDIX 2 (Continued)

System Lock-Up on Power-Up

Occasionally (especially if you choose to experiment with writing your own routines for the card) you may find that when you turn on your computer, you get a blank screen and that the computer is "locked-up".

If you find that this happens only when the RAMDISK is plugged into the PE-Box, bad data has found its way into the RAMDISK operating system memory, and the operating system must be re-loaded. (Power down and WAIT TWO MINUTES before removing the RAMDISK card.)

Before the operating system can be re-loaded, the card must be made "invisible" to the system. If you have Mini Memory or DEBUG on a SUPER-CART module, simply turn on the card (using the CRU command and entering a 1 for the appropriate base address). When you see the LED light, set the contents of CPU memory address >4000 to 0 (it should be >AA01 initially).

Alternatively, you can follow this procedure with Editor/Assembler.

- 1) Power-down the console and PE-Box;
- 2) Turn on the console FIRST, then the PE-Box;
- 3) Enter E/A
- 4) Select Option 5
- 5) Make sure system disk is in Drive 1 and type in DSK1.CFG
- 6) Re-load the RAMDISK operating system.

If this program fails to work the only other alternative is to power-down the system, remove the RAMDISK, and take out one of the three NI-CAD batteries. Allow the card to stand for at least 15 to 30 minutes so the memory contents are lost. Then re-insert the battery and place the card back in the PE-Box. (RUNNING THE CARD WITHOUT ALL THREE NI-CAD BATTERIES IN PLACE MAY CAUSE DAMAGE TO THE MEMORY CHIPS!)

Your system should now power-up normally. Re-load the operating system as usual.

Should you need further assistance, you may write to or call one of the two individuals below (sorry, but our extremely low margins will not allow us to accept collect calls.)

Ron Gries (419) 874-1414

Bud Mills (419) 385-5946

Notes by Chris Kobayashi (24 February 2016):

If you replace the 7805 with a switching equivalent (for example, the MINMAX 7805), the board as constructed will not work, because the voltage regulator ground connection is isolated from ground by a resistor. The resistor at R10 and diode at CR10 should be removed, and a jumper wire placed between the left-hand hole (as you are looking at the component side of the board) of R10 and the right-hand side of CR10 (immediately above it). This will connect the voltage regulator to chassis ground and allow the card to function properly.

