

MEM-3400

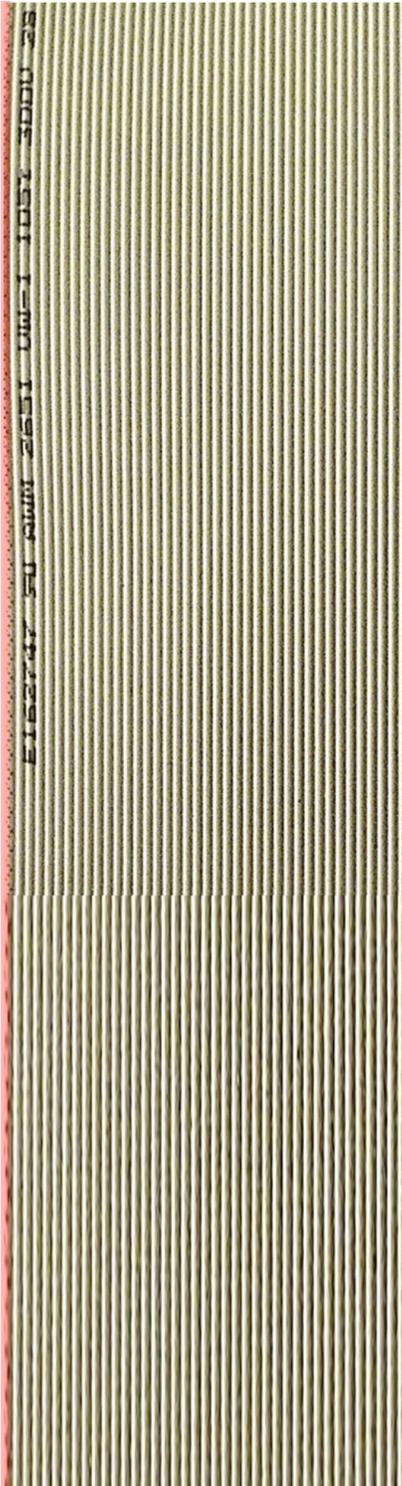
NON-VOLATILE RAM FOR ET-3400



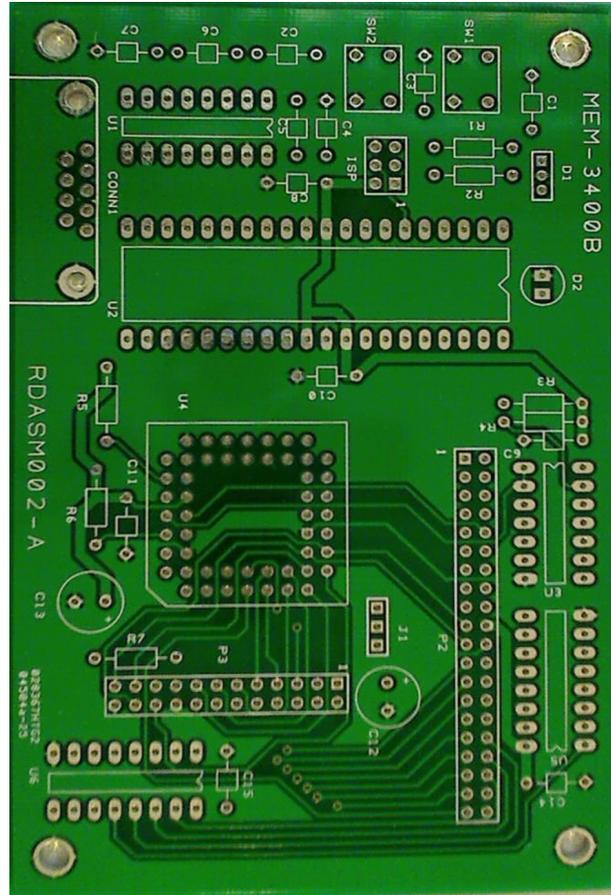
MEM-3400 Parts Checklist

Please go through the next 3 pages of check list and verify that all the correct parts have been received.

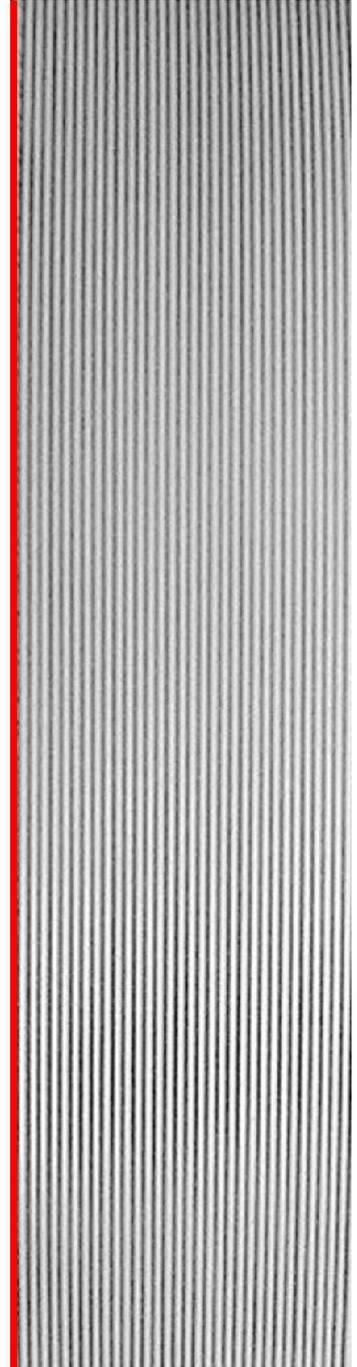
Request for replacement of missing parts will not be honored 7 days after delivery !



1x Quant.40 conductor ribbon cable.



1x Quant.MEM-3400 PCB

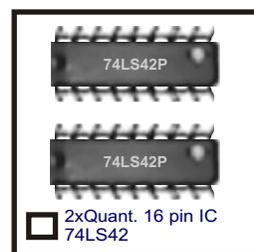
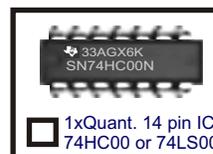
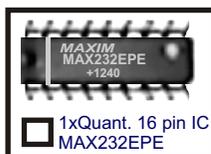


1x Quant.conductor ribbon cable.

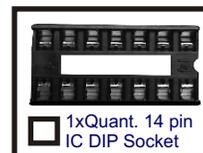
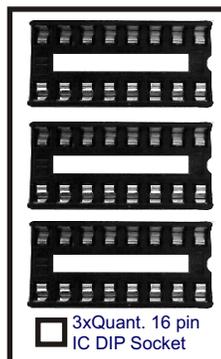
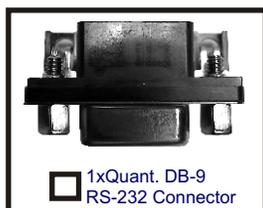
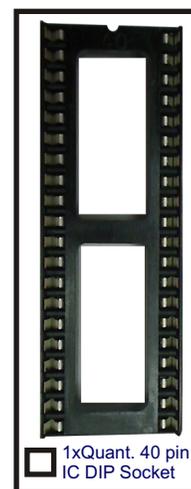
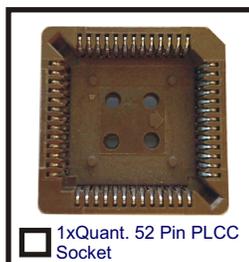
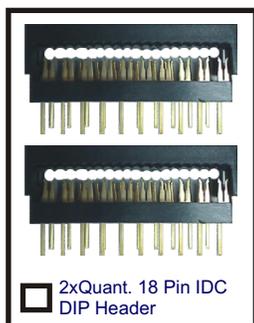
MEM-3400 Parts Checklist (continued)

MEM-3400 Parts Shipped in foam

IC Chips



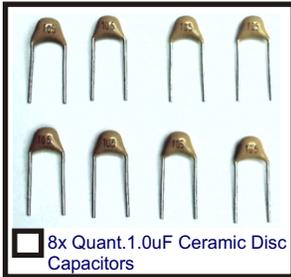
Sockets



MEM-3400 Parts Checklist (continued)

MEM-3400 Parts Shipped in Bags

Discrete



8x Quant. 1.0uF Ceramic Disc Capacitors



3x Quant. 0.1uF Ceramic Disc Capacitors



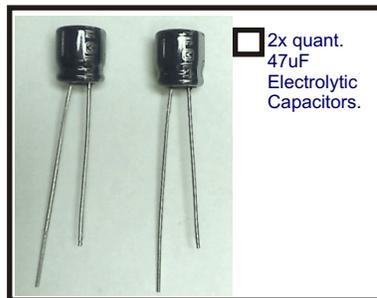
2x Quant. 1.0nF Ceramic Disc Capacitors



3x quant. 470 Ohm Resistors
Yellow, Purple, Brown



4x quant. 10k Ohm Resistors
Brown, Black, Orange



2x quant.
47uF
Electrolytic
Capacitors.

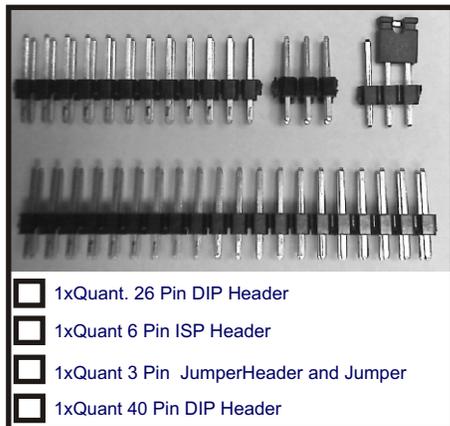


1xQuant. tri lead LED

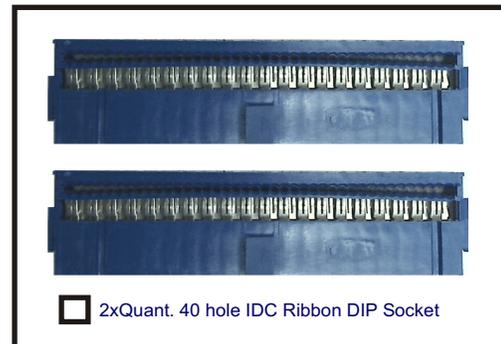


1xQuant. Dual lead LED
(Housing Color May vary)

Mechanical



1xQuant. 26 Pin DIP Header
 1xQuant 6 Pin ISP Header
 1xQuant 3 Pin Jumper Header and Jumper
 1xQuant 40 Pin DIP Header



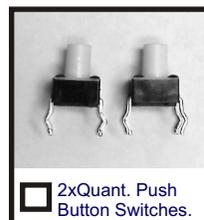
2xQuant. 40 hole IDC Ribbon DIP Socket



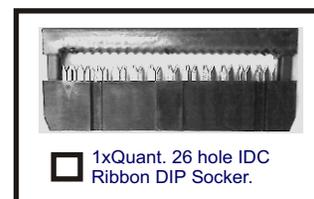
4xQuant. Nylon Standoffs
 4xQuant. 4-40 screws



2xQuant. additional
4-40 screws.
(For DB-9 mod.)



2xQuant. Push
Button Switches.



1xQuant. 26 hole IDC
Ribbon DIP Socket.

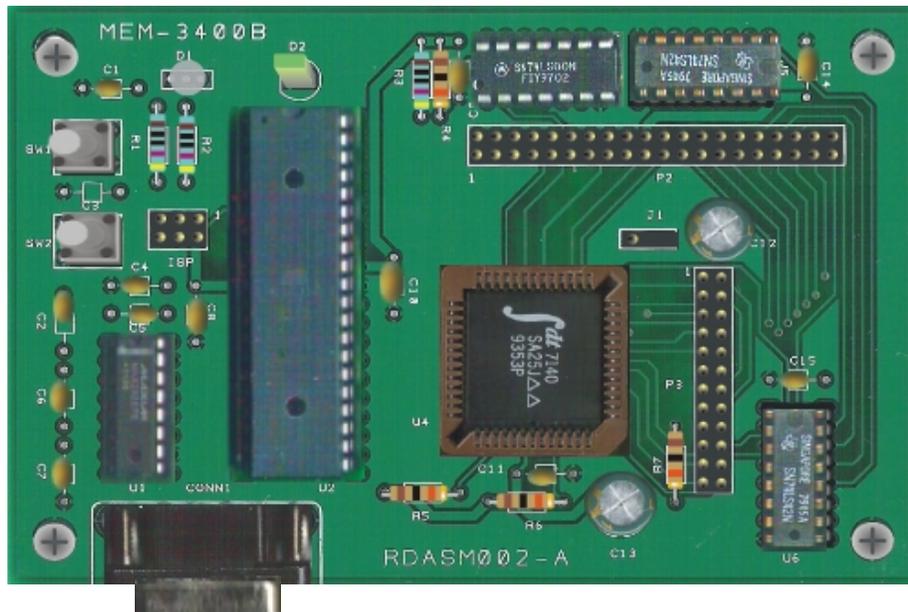
PART 1

Overview MEM-3400

MEM-3400

MEM-3400 allows your Heathkit 3400 trainer to save your code to non-volatile RAM.

(Photo corrected/enhanced image)



4.9 x 3.0 inches

Uses Atmel MEG324PA MCU and dual-port RAM

- * Can be used as stand-alone storage**
- * USB to RS-232 cable will file transfer code to PC**
- * Assembler can be used to generate code**

(See following pages)

Still one of the best ways to learn CPU Architecture

The decades old Heathkit Microprocessor Course and ET-3400 Heathkit trainer is still one of the best ways to learn foundational concepts of CPU functions and architectures. The secret is Heathkit courses use spoon-fed step-by-step instructions for beginners.

Once a good foundation is laid the beginner is then encouraged to join the modern MCU world of design with processors such as Freescale HC08. These old Heathkit gems are still the best stepping stone for beginners.

The reason for the effectiveness of these old Heathkit courses lies in the fact that modern CPU/MCU manufacturers just can't afford to develop painstaking step by step courseware for novice beginners in this fast paced world.



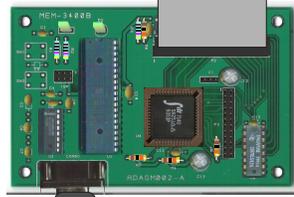
MEM-3400

In the hobbyist spirit we have developed a small dual-port memory card that fixes a major past issue of the ET-3400. The card we made (called the MEM-3400) allows you to replace the ET-3400's on-board RAM. The MEM-3400 then stores your HEX program in non-volatile RAM.

The ET-3400 by itself will keep only one program live during power off. Actually, the ET-3400 only turns the display off. In the event of a brief power glitch the contents of ET-3400 would be lost.

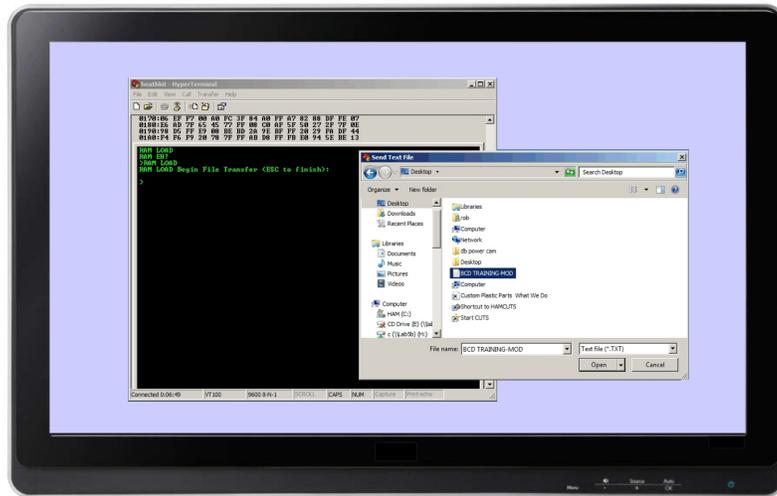
The MEM-3400 not only saves your program indefinitely but allows file transfer via ASCII terminal software.

Download/upload to a PC has the immense benefit of allowing 6800 assembly software to create, edit, and save code to the PC and ET-3400.



Use USB-RS232 and terminal software like HyperTerminal to transfer files back and forth to your PC.

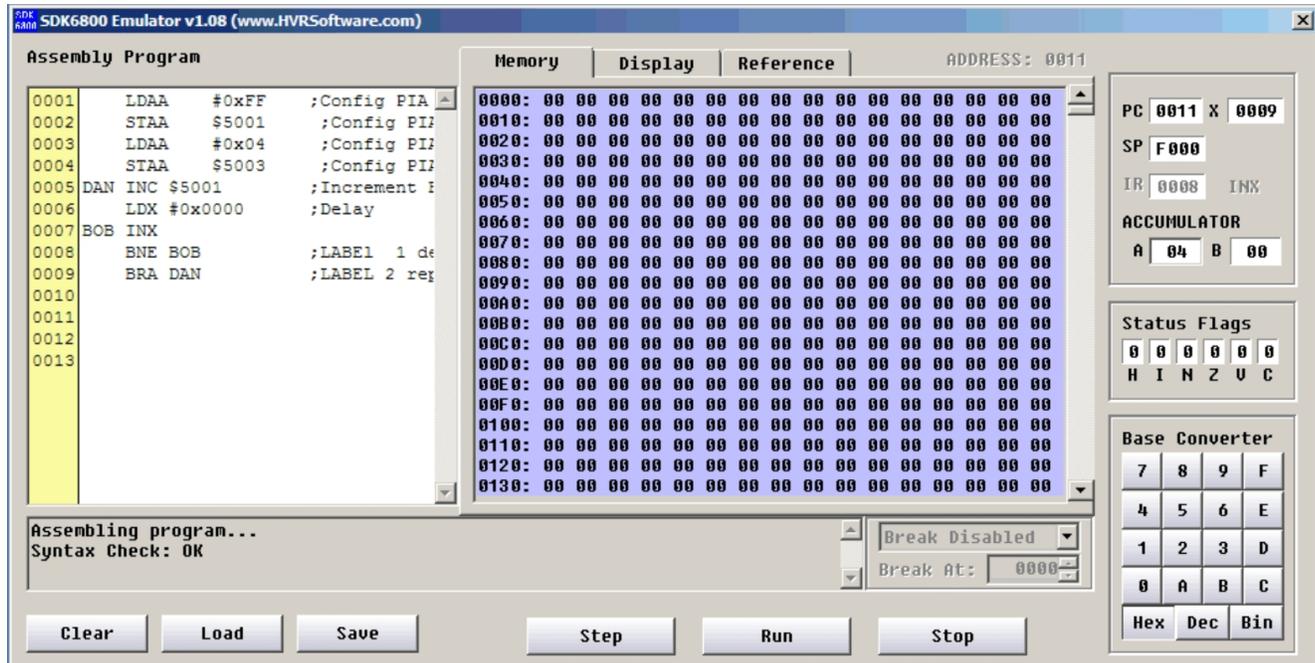
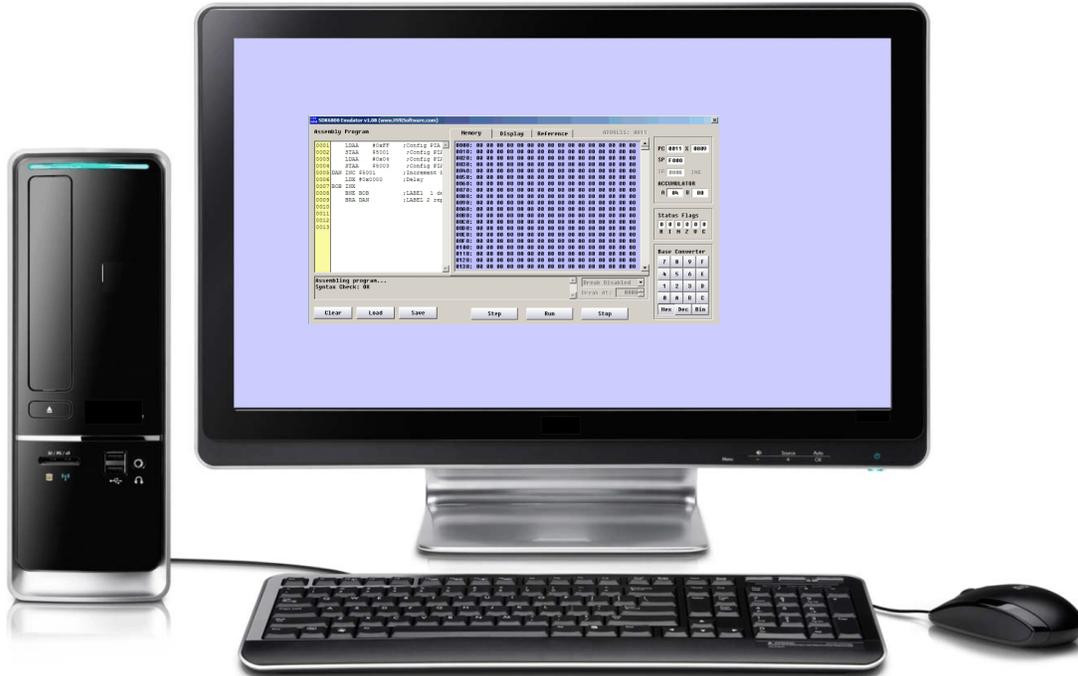
Save ET-3400 to ASCII files that can be directly imported to an assembly program such as SDK6800 !



There are several ASCII terminal programs on the web for free. We highly recommend the software HyperTerminal. Download is initially free but author does require a fee after a time period.

There are several 6800 assembler and cross assemblers on the web for free.

We highly recommend SDK6800 from HyperVision Research for an assembler.



We highly recommend using SDK6800 edit 6800 code.
Then use ASCII terminal software to transfer back to the HEX code back to ET-3400.

Free Assembler download at: <http://HVRsoftware.com>

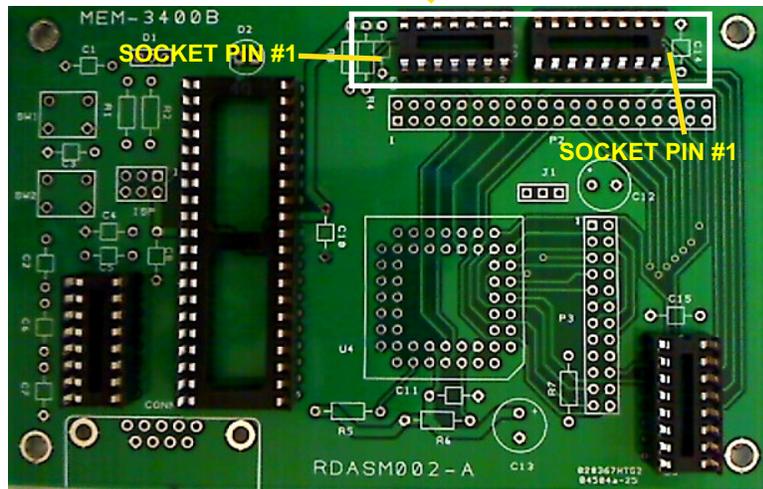
PART 2

Assembly Instructions for MEM-3400

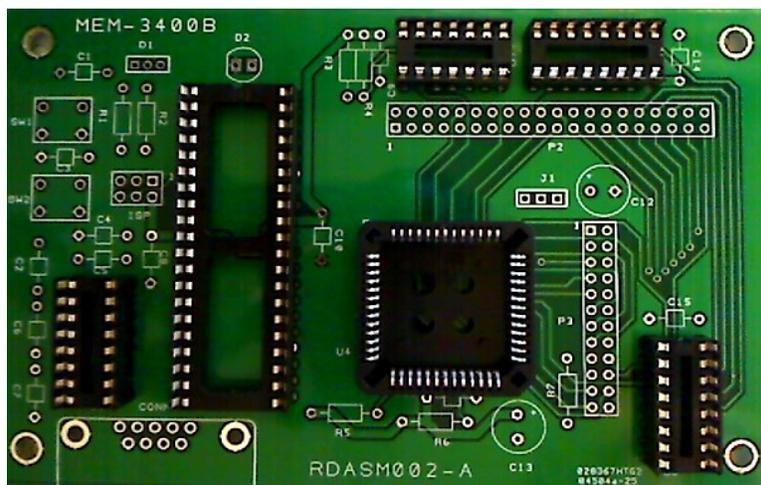
Install low profile IC sockets

Add low profile IC sockets first. Carefully position sockets face down on the workbench. Solder a starter hole on each end of the sockets. Press the PCB when heating first holes to make sure the sockets are flush and level with the PCB.

IMPORTANT NOTE: These 2 sockets face **OPPOSITE** concerning reference pin no. 1

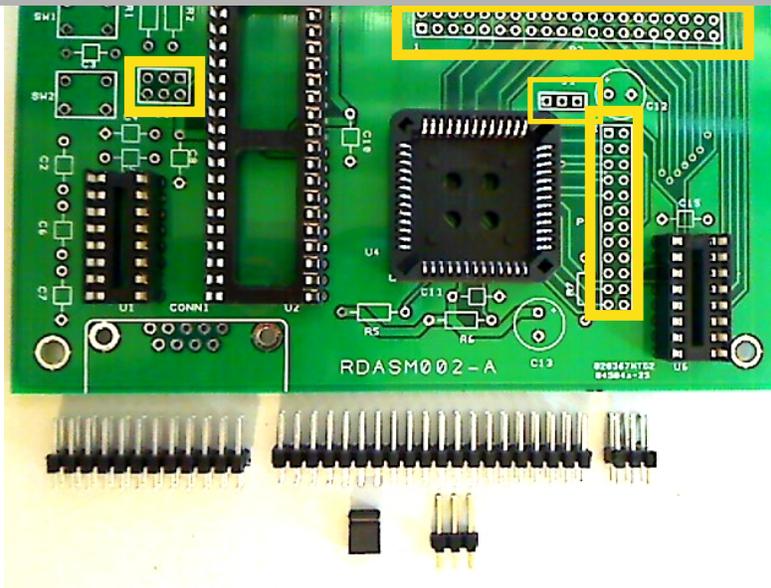


Next, add the square 52-pin PLCC socket to the PCB.
Please note the orientation notch on the PLCC and the PCB silk screen.

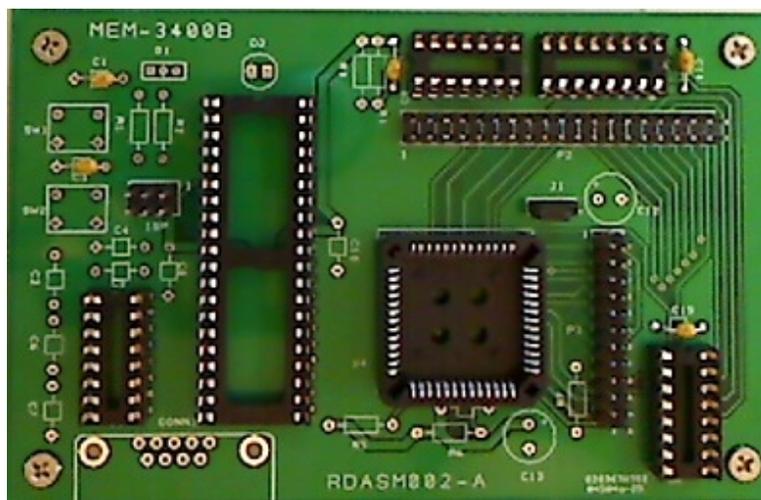


Install the 40-Pin,24-Pin,6-Pin headers and 3-Pin jumper.

IMPORTANT NOTE: The plastic molding around the headers' pins has a very low melting point. It is okay to have soldering iron on high. However, be quick about time spent heating pins.



When sockets, headers, and jumper are installed, then the next phase of soldering small discrete parts can begin.



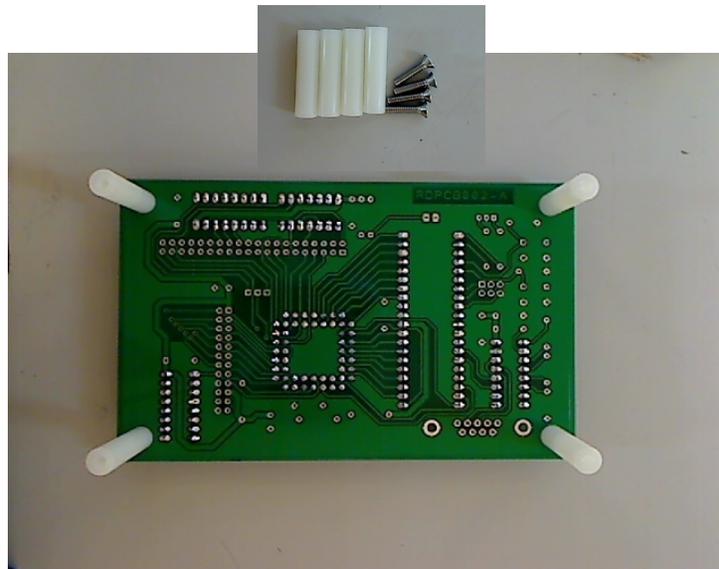
In the next step we will put 4 nylon standoff legs on the PCB. This step will allow us to “top solder” many of the discrete components to the PCB.

Next, add the four nylon 4-40 threaded legs to PCB board.
Carefully empty the small components pack onto your workbench.



To reiterate: the nylon legs are added to enable most discrete components to be top soldered.

Separate out the four quantity of the nylon standoffs and four x 4-40 screws.
Screw the four nylon standoffs into the PCB as shown below.

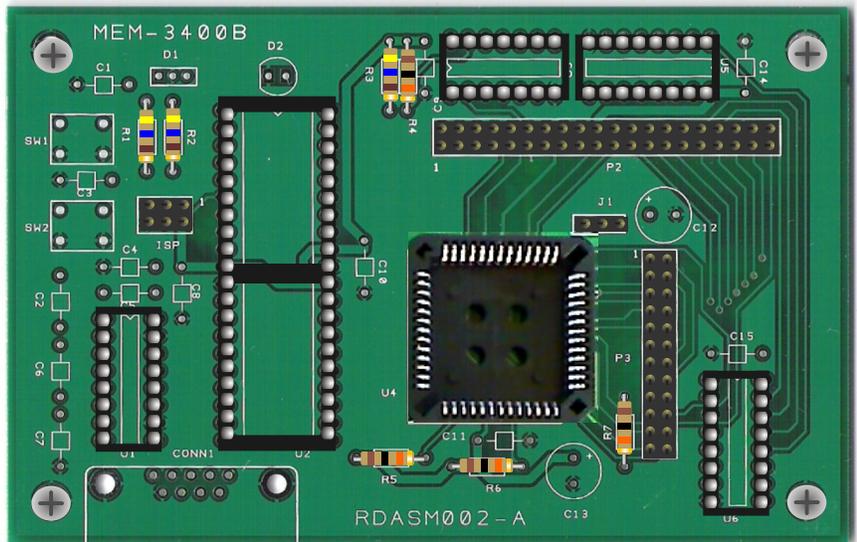


There should be six total of the 4-40 screws in the package.
The **two additional 4-40 screws will be used later** as an option on the RS-232 DB-9 connector.

Add 10K and 470 Ohm Resistors

10K 1/4W RESISTORS R4,R5,R6,R7 BROWN,BLACK,ORANGE

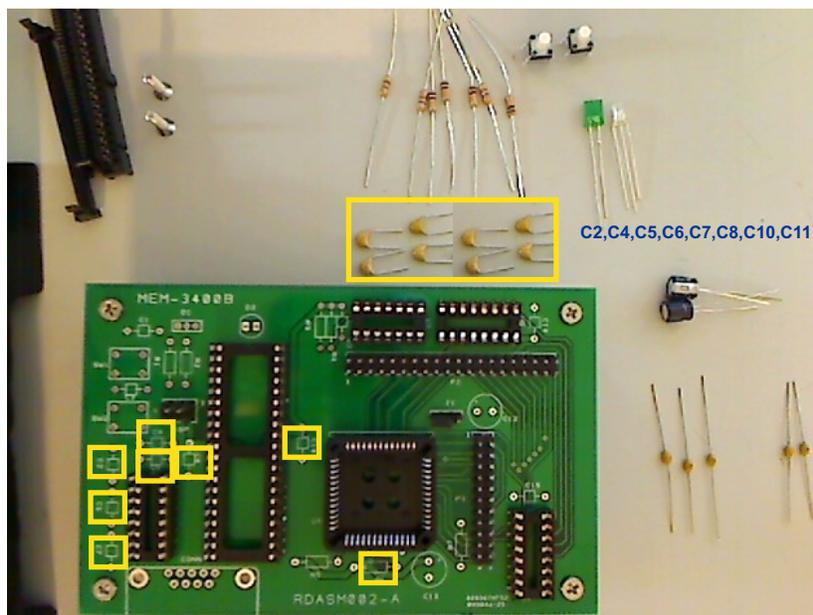
470 Ohm 1/4W RESISTORS R1,R2,R3 YELLOW,PURPLE,BROWN



1.0uF CERAMIC DISC CAPACITORS x8

Install eight ceramic capacitors {105}

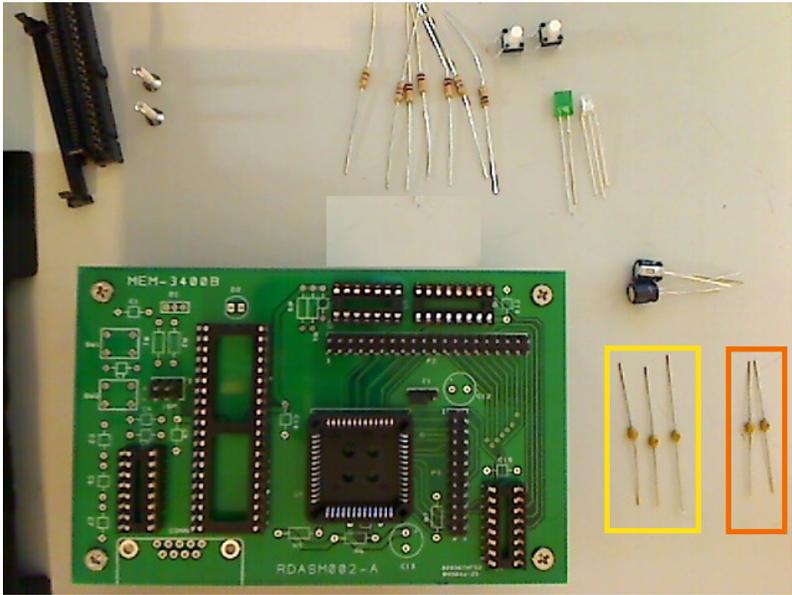
NOTE: Careful not to melt nearby sockets.



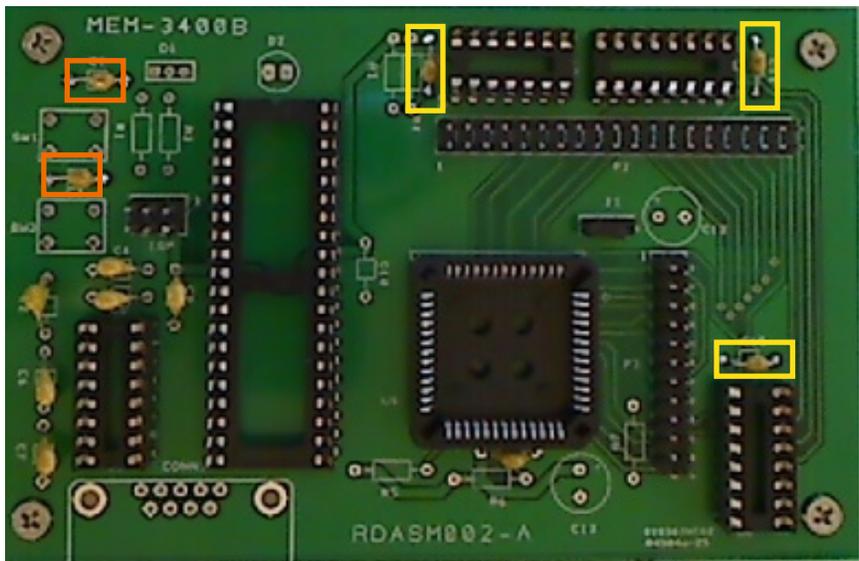
C2,C4,C5,C6,C7,C8,C10,C11

Install small ceramic capacitors

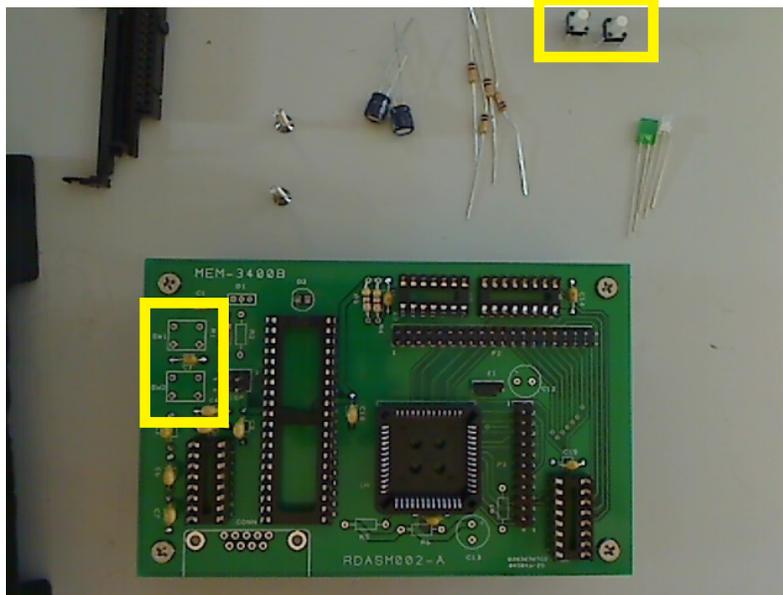
Three capacitors: C9,C14,C15, marked 104 (0.1 μ F)
Two capacitors: C1,C3 marked 102 (1 nF)



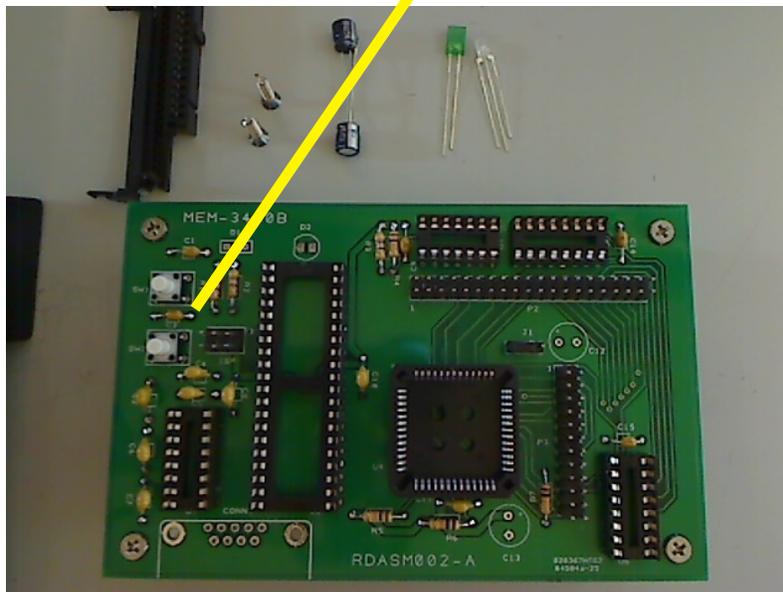
102 capacitors are highlighted in orange and the 104 capacitors in yellow.



Locate and install the two white push buttons.

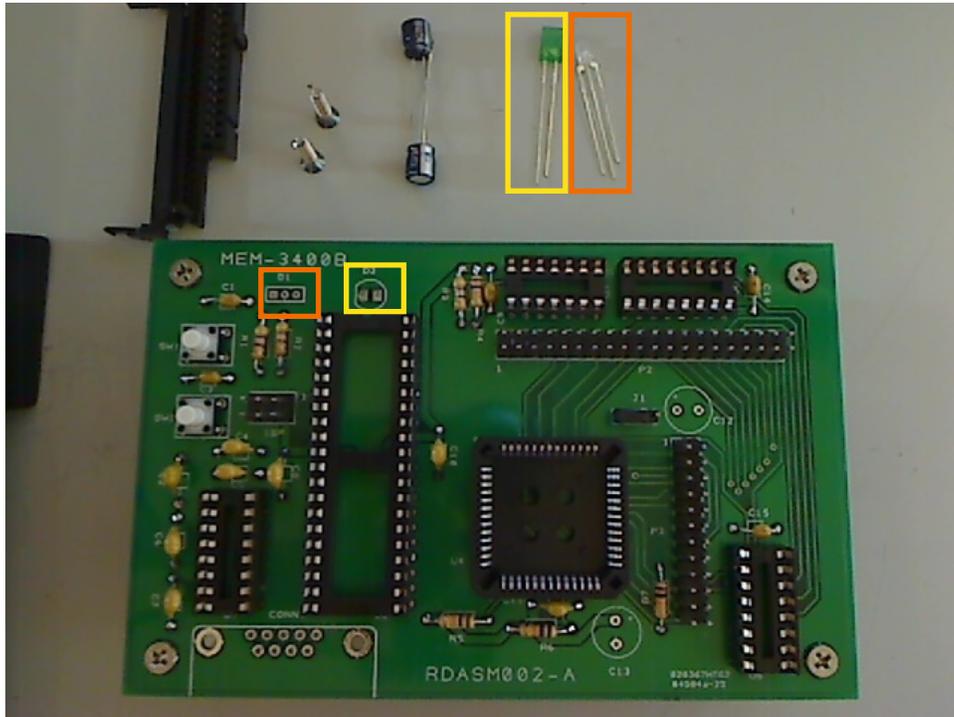


Installed white push buttons.

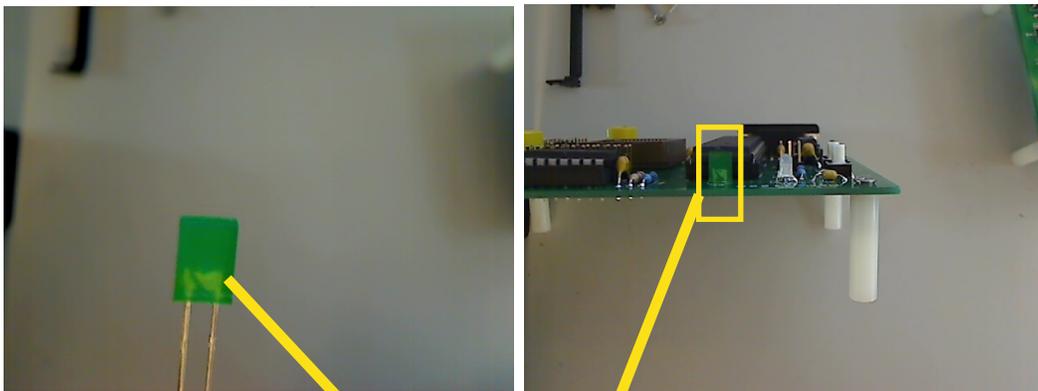


Bottom Solder the two push buttons.

Locate and install the two LEDs.

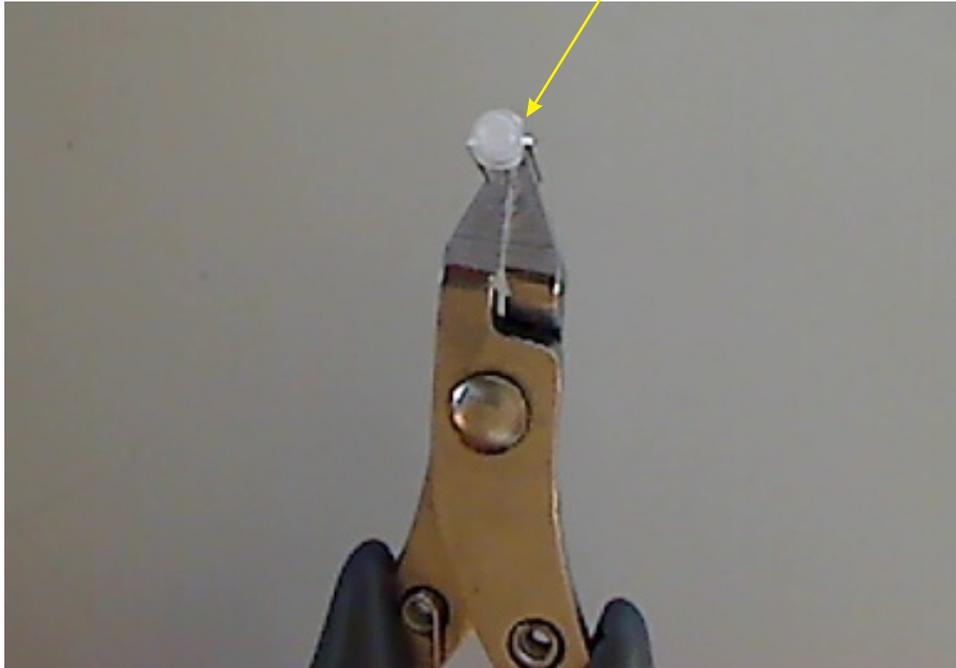


Bottom Solder the two LEDs.

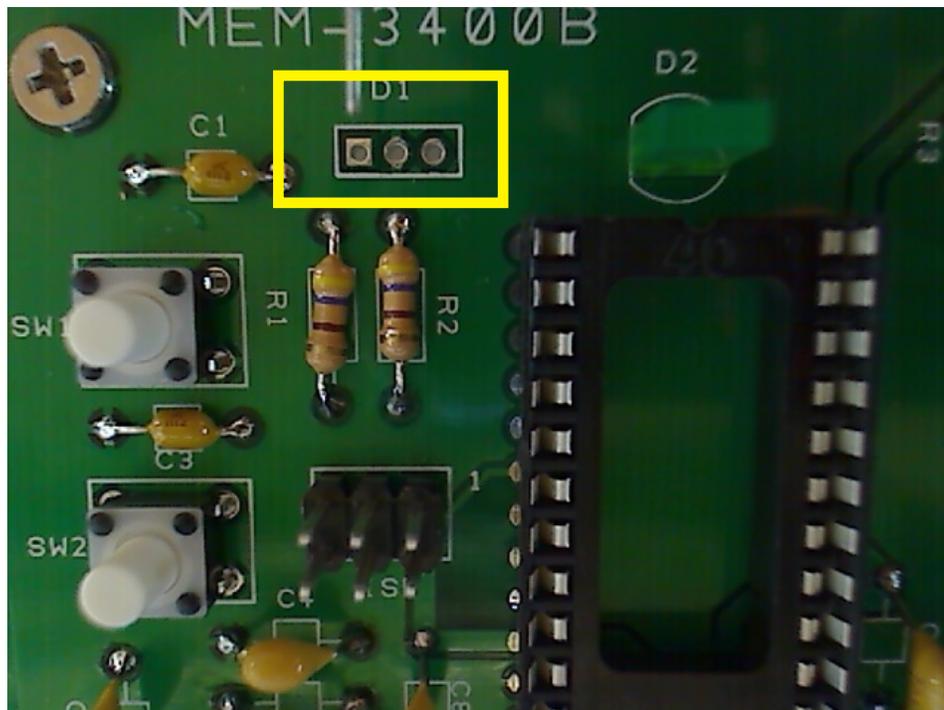


Bigger "anvil side" of diode facing towards white push buttons

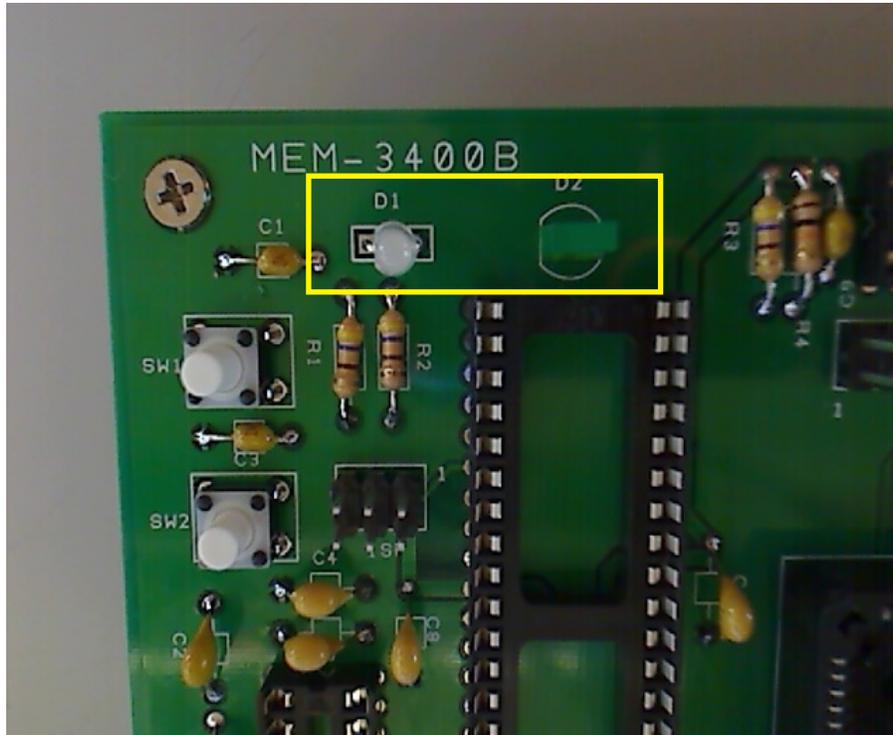
Take note of the “flat side” of the diode.



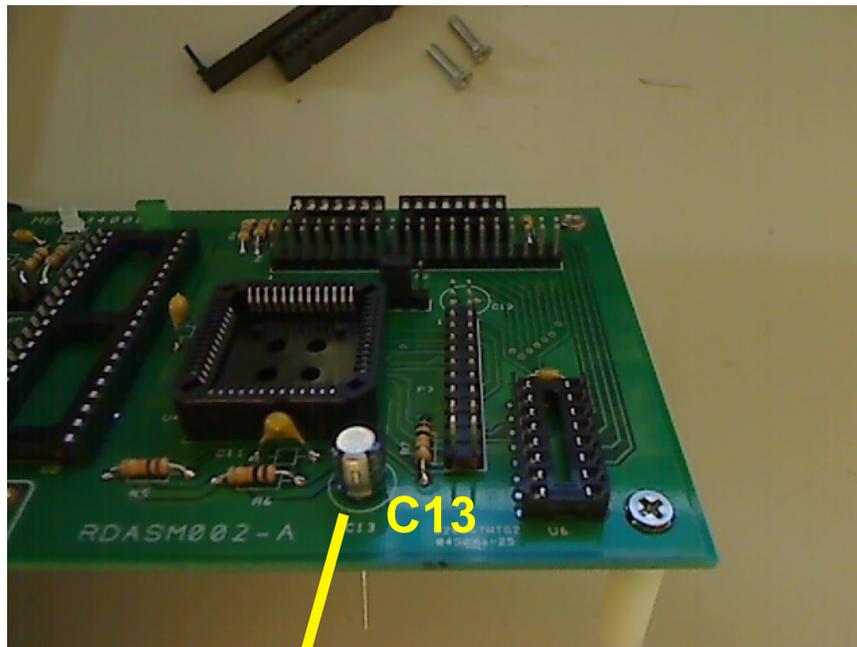
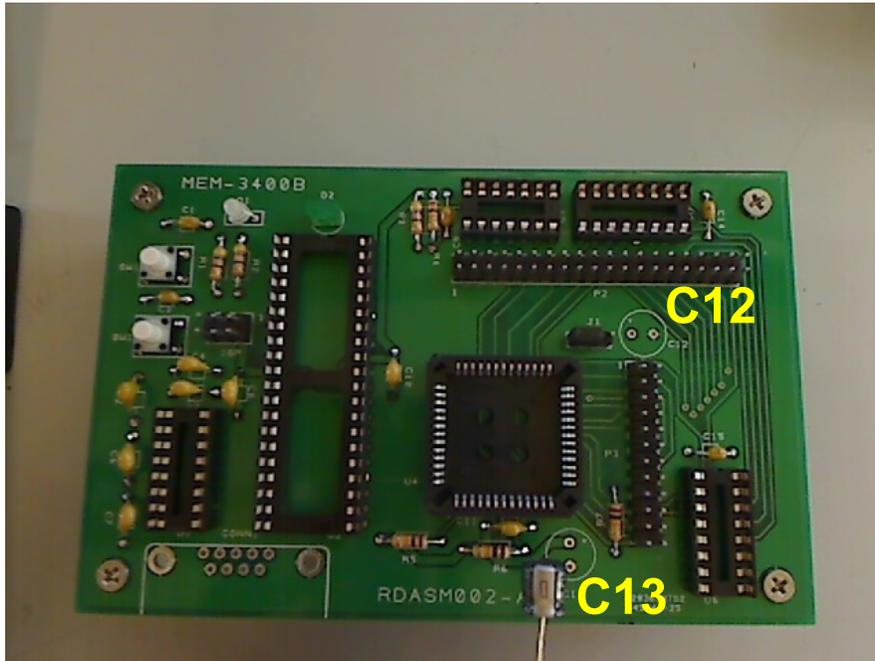
Place 3-legged diode with the “flat side” in the square hole.



Take note of the final placement of the two diodes

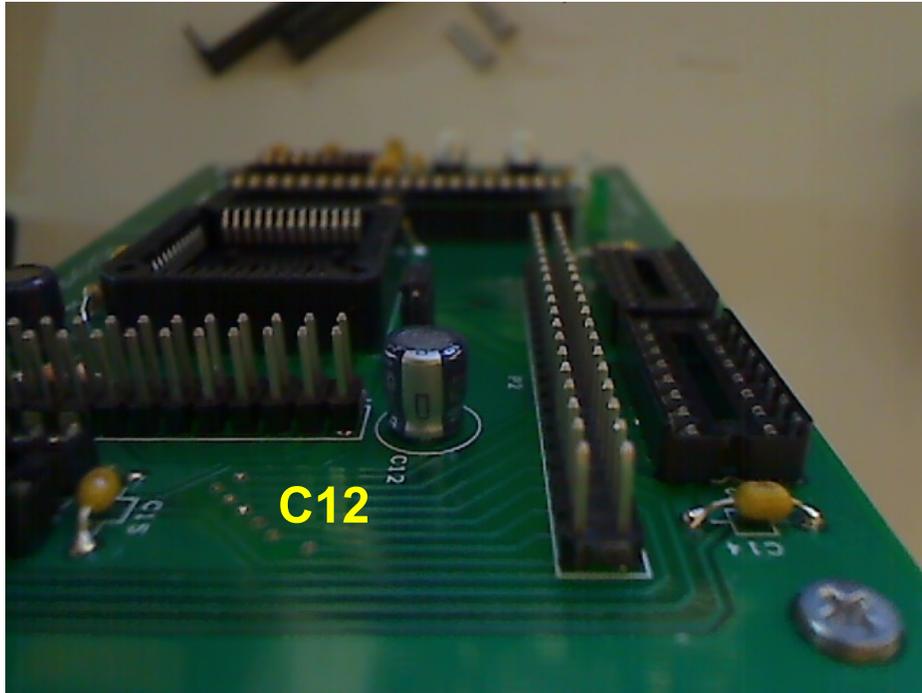


47uF electrolytic capacitors C12,C13.



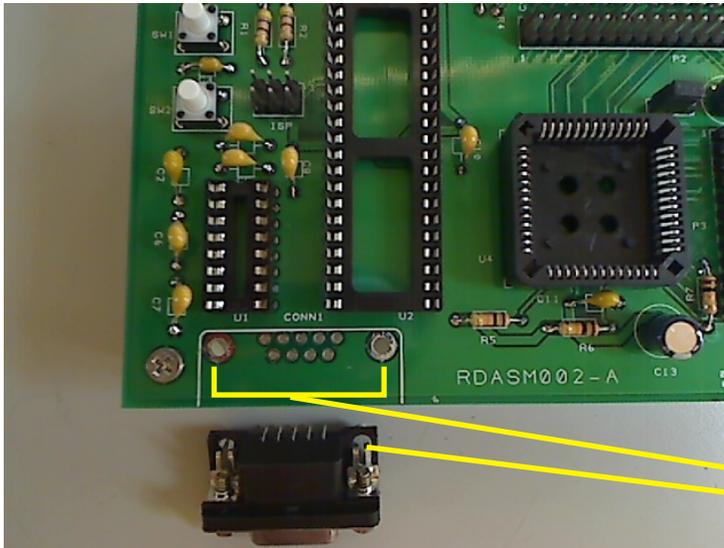
Place the two electrolytic capacitors with proper polarization.

C12 electrolytic capacitor placement.



Place C12 electrolytic capacitor with proper polarization.

DB-9 RS-232 connector (CONN1)



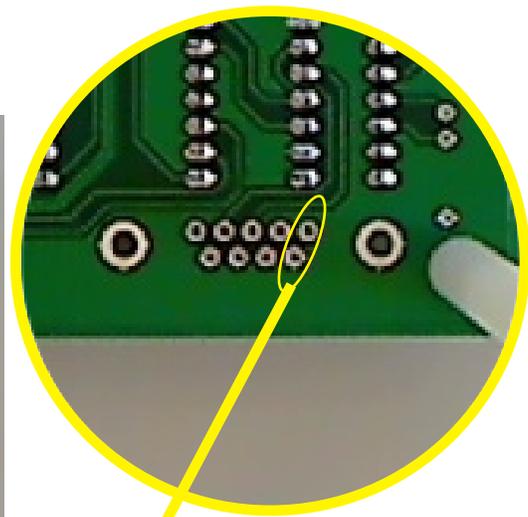
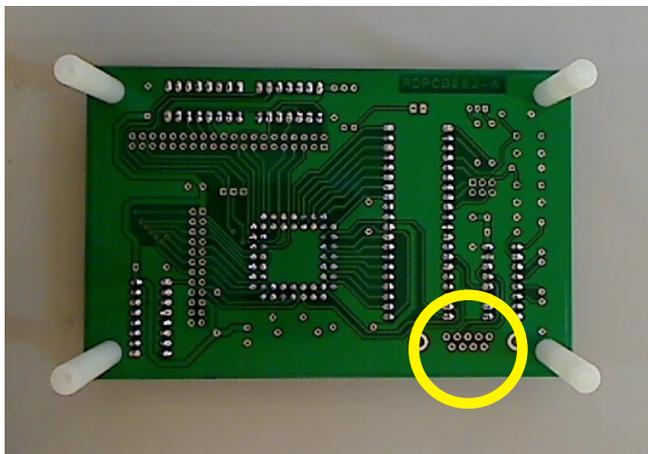
You will need to squeeze the DB-9's PCB solder anchors with a needle nose pliers. Otherwise the DB-9's solder anchors maybe too wide to fit into the PCB holes.

Two additional 4-40 screws are supplied for a modification to CONN1 (DB-9). This modification is used in the event that the DB9 connector's hex nuts might obstruct your PC's RS-232 cable. In this event remove the hex nuts from the MEM-3400's DB-9 connector. Then screw the two 4-40 screws in place of the hex nuts. This modification really depends on the type of DB-9 connector you PC cable has.

NOTE: Only attempt to remove the DB-9 hex nuts after the DB-9 has been soldered in place securely!

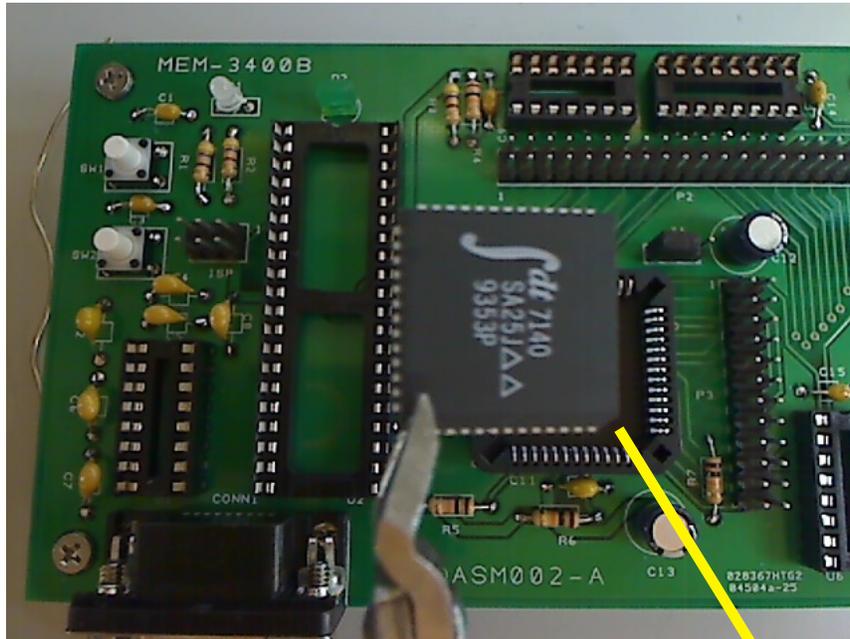
DB-9 RS-232 connector (CONN1)

A correction modification needs to be applied to 2 pins on the DB-9 connector
APPLY THE SOLDER BRIDGE CORRECTION ONLY AFTER THE DB-9 HAS BEEN INSTALLED.



Solder bridge on these 2 pins after the DB-9 has been installed.
This modification is only necessary for boards with silk screen code of RDASM002-A.

Note the Dual-port RAM in a 52-Pin a PLCC socket



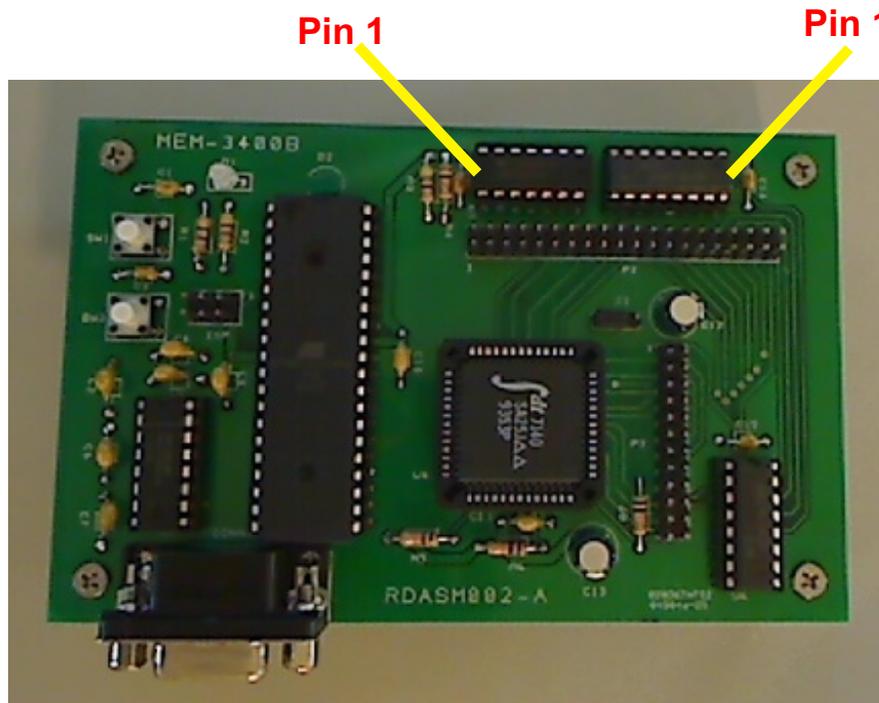
Observe the reference corner and notch on the PLCC

If you ever need to remove the chip in a PLCC socket, use the proper extraction tool to avoid damage to socket, chip, or PCB.



Populate the IC chips into their proper sockets.

NOTE: U3 ICs 74LS00 AND U5 74LS42 FACE OPPOSITE.



1x Max232epe

1x ATMEGA324PA-PU-ND

1x 74LS00

1x IDT7140SA

2x74LS42

5v RS-232 LEVEL CONVERTER

MCU AVR 32KB FLASH 40PDIP

QUAD NAND

Dual-port RAM

Decoder

U1

U2

U3

U4

U5,U6 *

PART 3

Installation of MEM-3400

Overview of two different options for implementing the MEM-3400.

Method A - directly into the ET-3400/ET-3400A 40 pin header.



This method **requires the 40-pin header to be modified as shown in Heathkit ETA-3400 Memory and I/O Accessory instructions.**

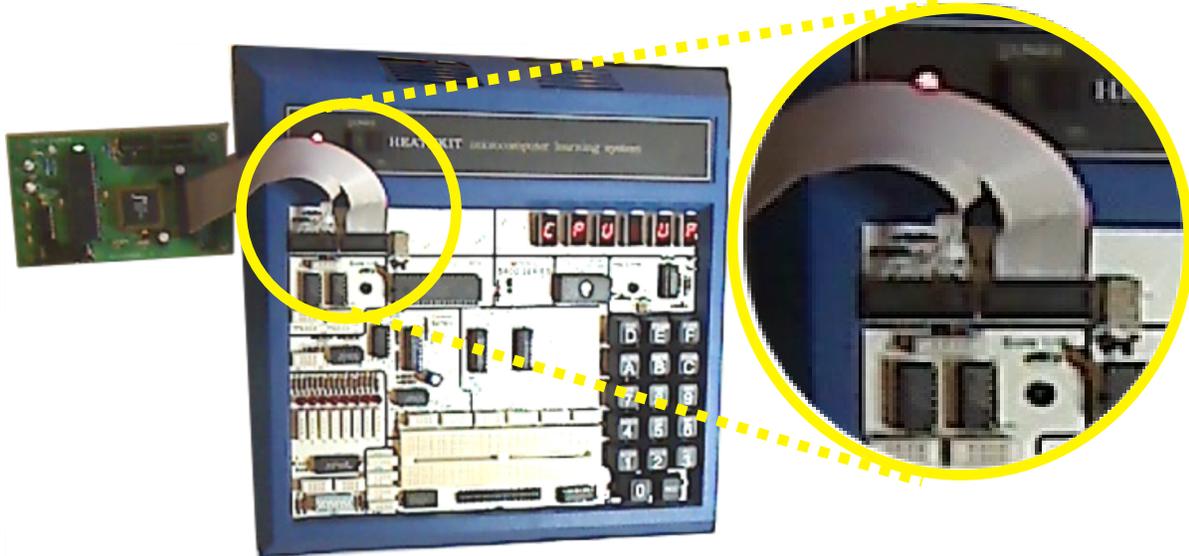
If you have a difficult time locating the ET-3400A and 3400A modification notes let us know and we will supply you with the proper documents.

Email: Lab7@owl-inc.com
Phone: (262)-473-0643 Ext. 111

Please note Jumper J1 must be jumped toward the PLCC dual-port RAM socket to be enabled for method A.

Also, the static RAM chips must be removed from the ET-3400/ET-3400A trainer to avoid an addressing conflict.

Method B (3400A only) - Directly into the 2114 static RAM sockets



This method requires the removal of the MEM-3400A's U6 and U5 ICs. Both chips are 74LS42 decoders. This step must be done to prevent them from chip selecting the dual-port ram. Using this method requires the assembly of a special jumper ribbon cable.

For help see the YouTube video <http://www.youtube.com/watch?v=q6blWLBb-gg>

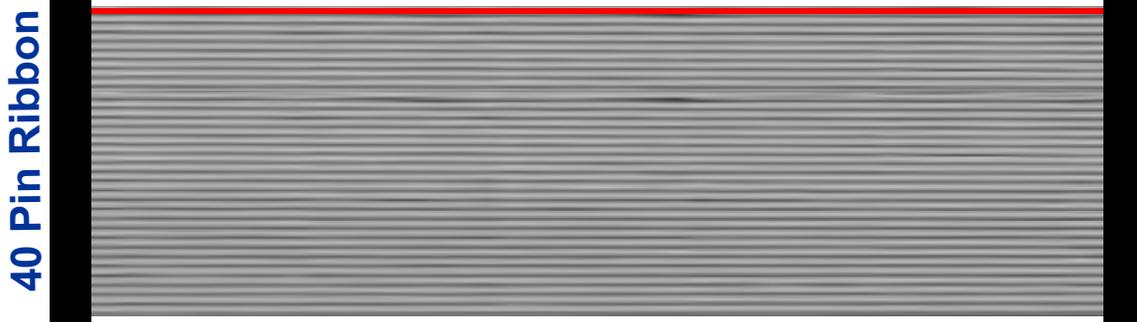
Method A set up (for ET-3400A or ET3400)

Assembly of the 40-pin Memory I/O Accessory Header.

This ribbon can be easily made and crimped in a vise. Align the headers as straight and even as possible, then apply enough pressure to the vise.

Usually a small audible click can be heard when the ribbon is sufficiently crimped

Although failure can come from excessive force on the headers, more often inadequate force is the cause of failure while crimping the 40-pin headers.

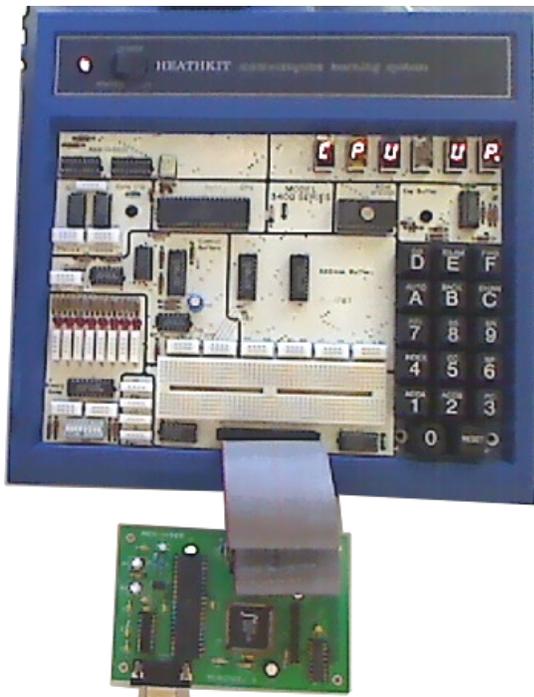


Take heed to the orientation of a red strand or a strand in the ribbon with red markings, for it is pin 1.

If you have successfully made the modifications to the ET-3400/3400A you are then ready to plug the header between the ET-3400 and the MEM-3400.

If upon powering up you do not see CPU UP then immediately power down and recheck all procedures.

Make sure pin 1 and all other pins are properly orientated and aligned before powering up the ET-3400



If your system when plugged in and powered says "CPU UP" then you may move onto the part 4:

Talking to the MEM-3400

Method B set up (ET-3400A only)*

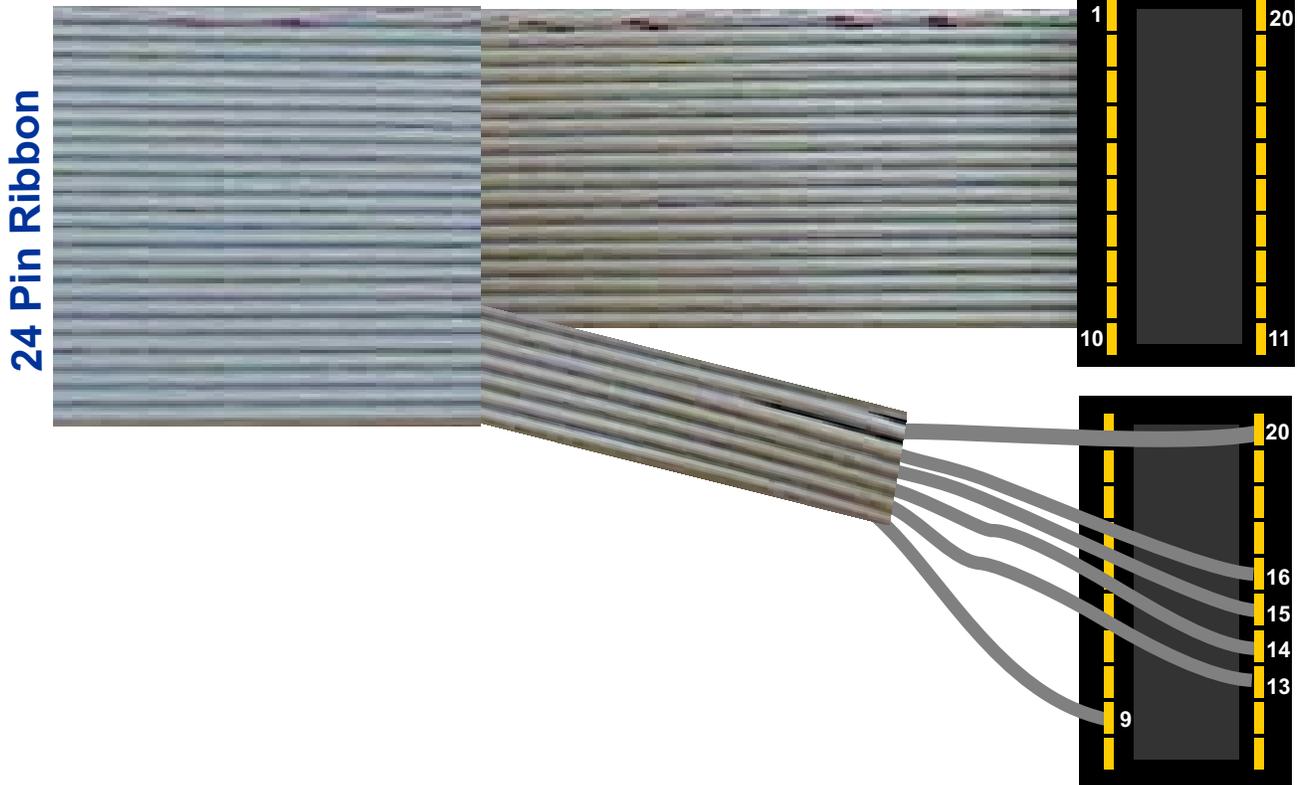
Plug the special ribbon with IC connector directly into the 2114 static RAM sockets

For help assembling this cable see the YouTube video

<http://www.youtube.com/watch?v=q6bIWLBb-gg>

(Cut and paste the above link into your browser's address bar)

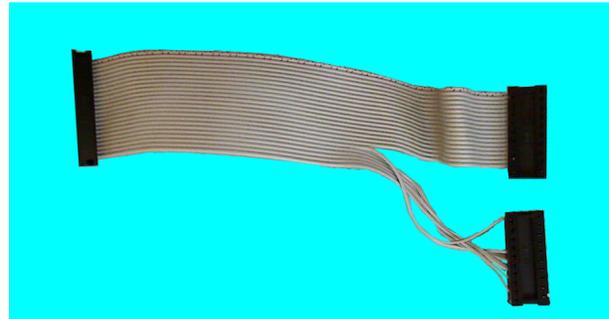
Top View of Pin Out



Bottom View

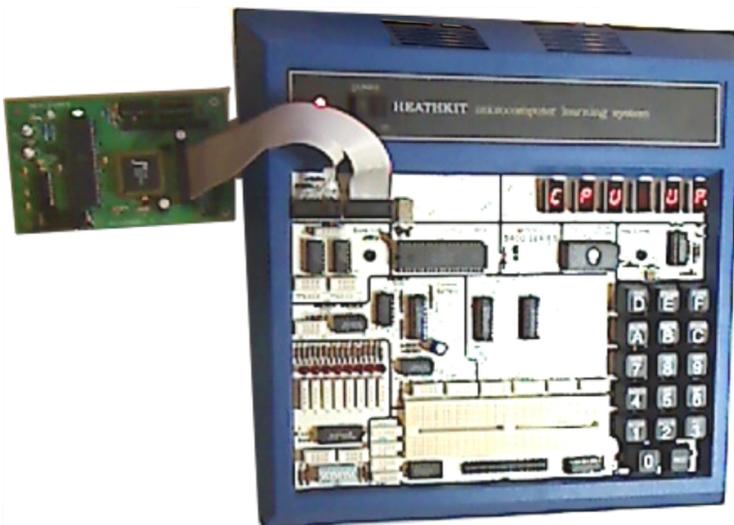
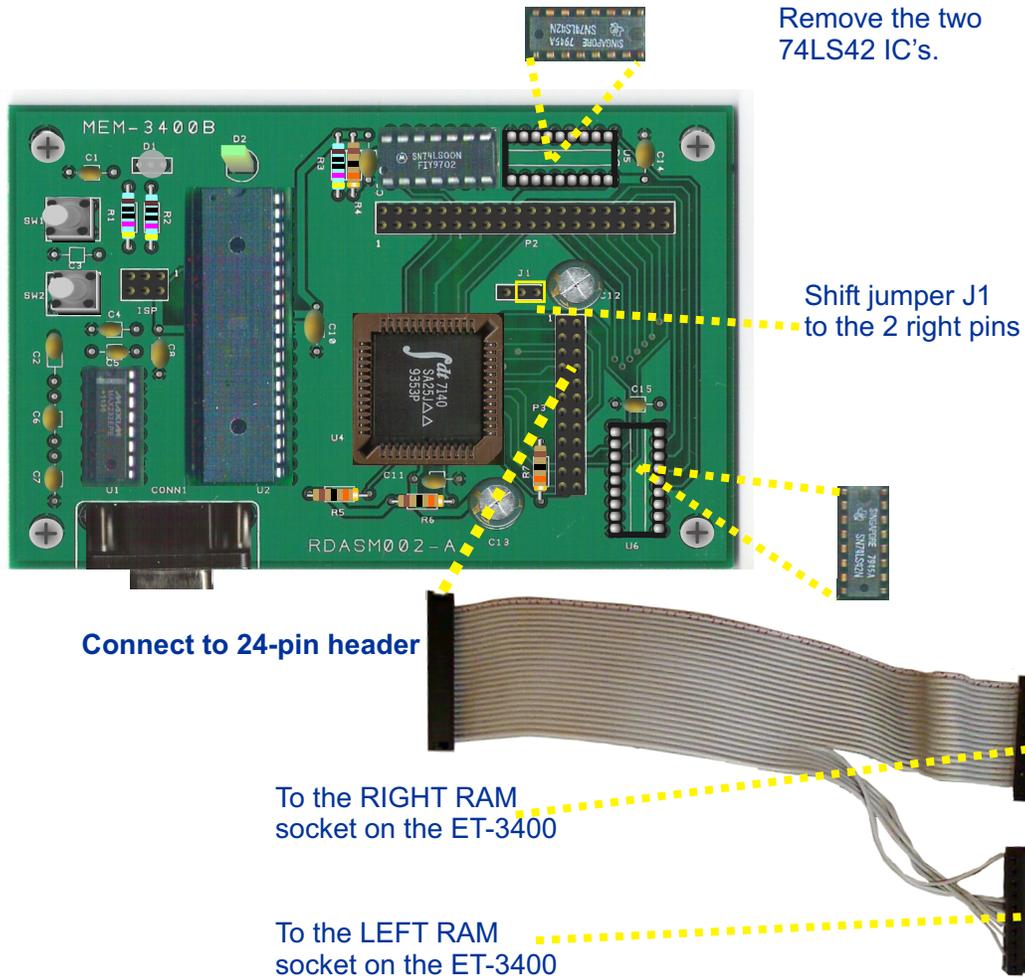


Top View



* A cable has not been made yet for the older ET-3400.

Method B -Setup (continued)



Your system when plugged in should now say CPU-UP and is now ready for use.

PART 4

Using the MEM-3400

Talking to the MEM-3400 (Intro.)

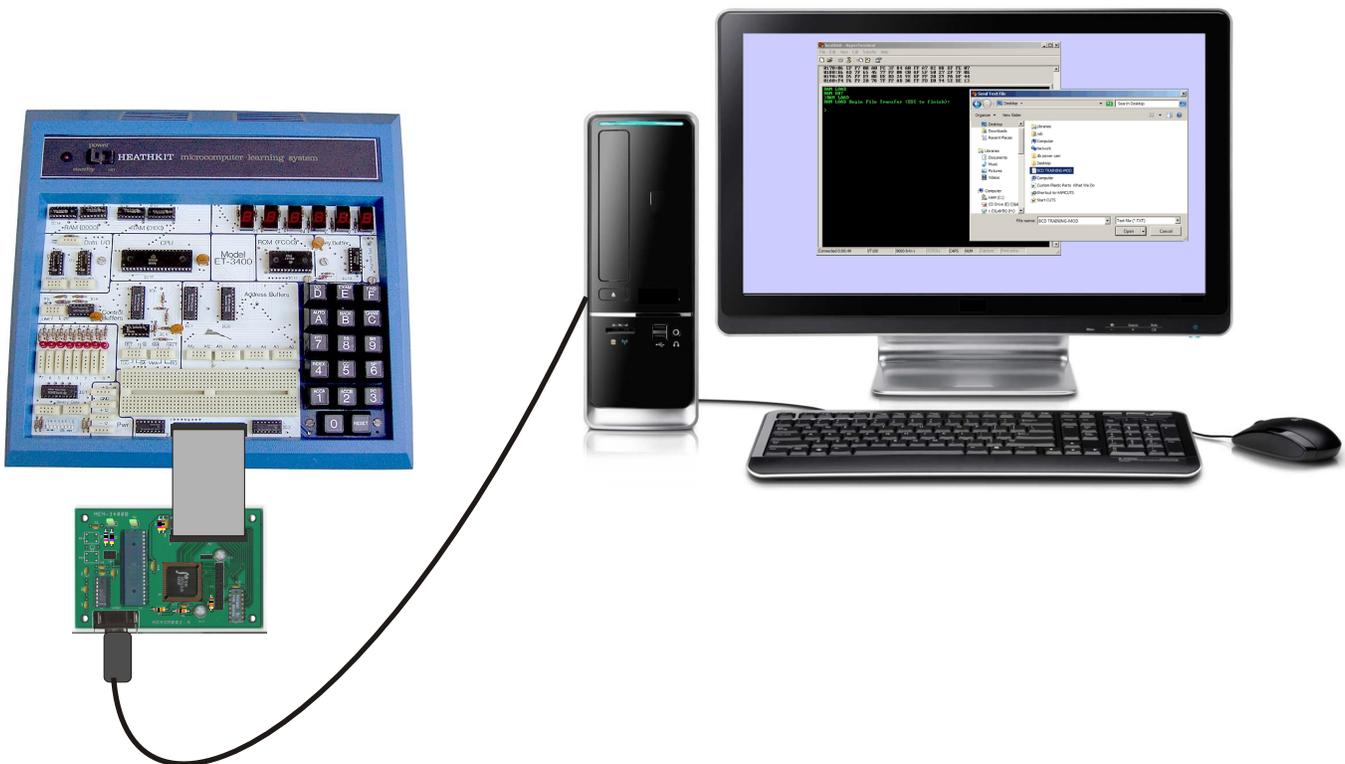
There are several freeware programs that do ASCII terminal emulation. However, HyperTerminal has been found to be the easiest to use with the MEM-3400 cards.

HyperTerminal used to be supplied free with Windows XP. Microsoft stopped supplying HyperTerminal with later versions of Windows. Unfortunately, the publishers of HyperTerminal are asking a fee for the new versions of HyperTerminal.

HyperTerminal can be found at: <http://www.hilgraeve.com/hyperterminal/>

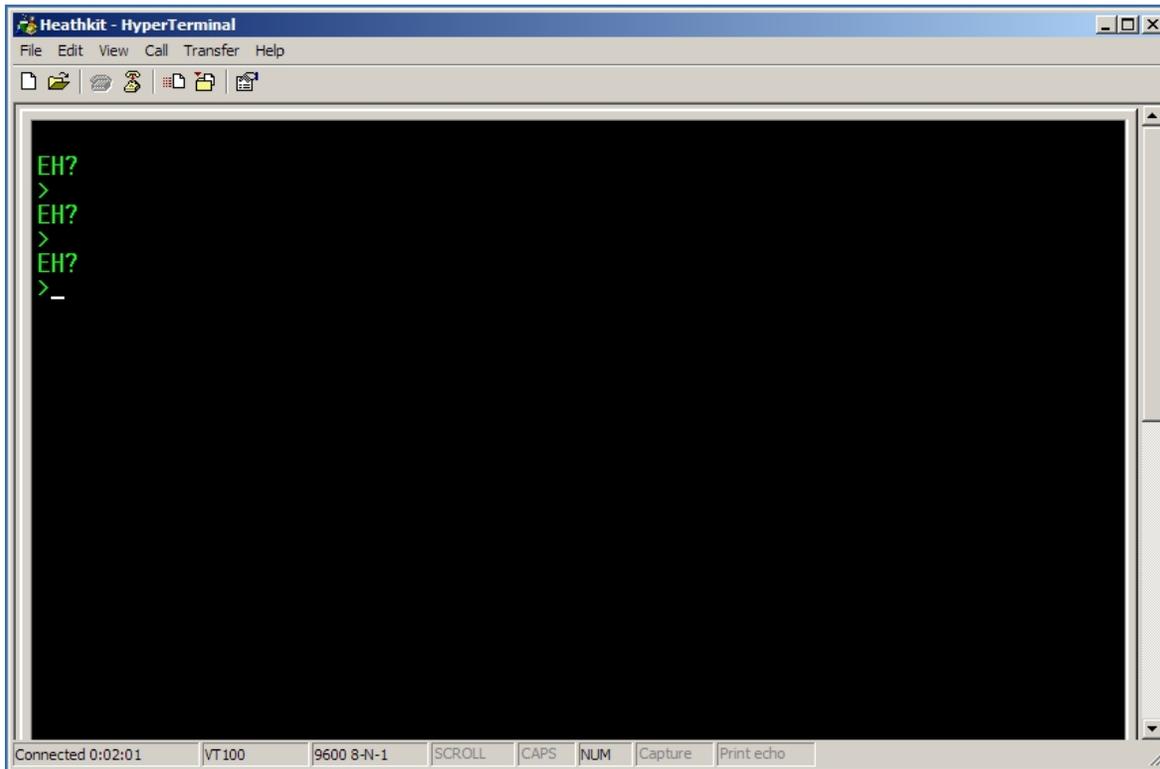
Note: in the HyperTerminal settings, choose VT100 emulation and COM Port setting of **9600,N,8,1 and No Flow Control**.

You may find it nostalgic to go into HyperTerminal properties then setting then colors to change your Hyperterminal fonts to bright green and screen background to black to give an old ASCII terminal appearance.



Talking to the MEM-3400 (RAM VIEW command)

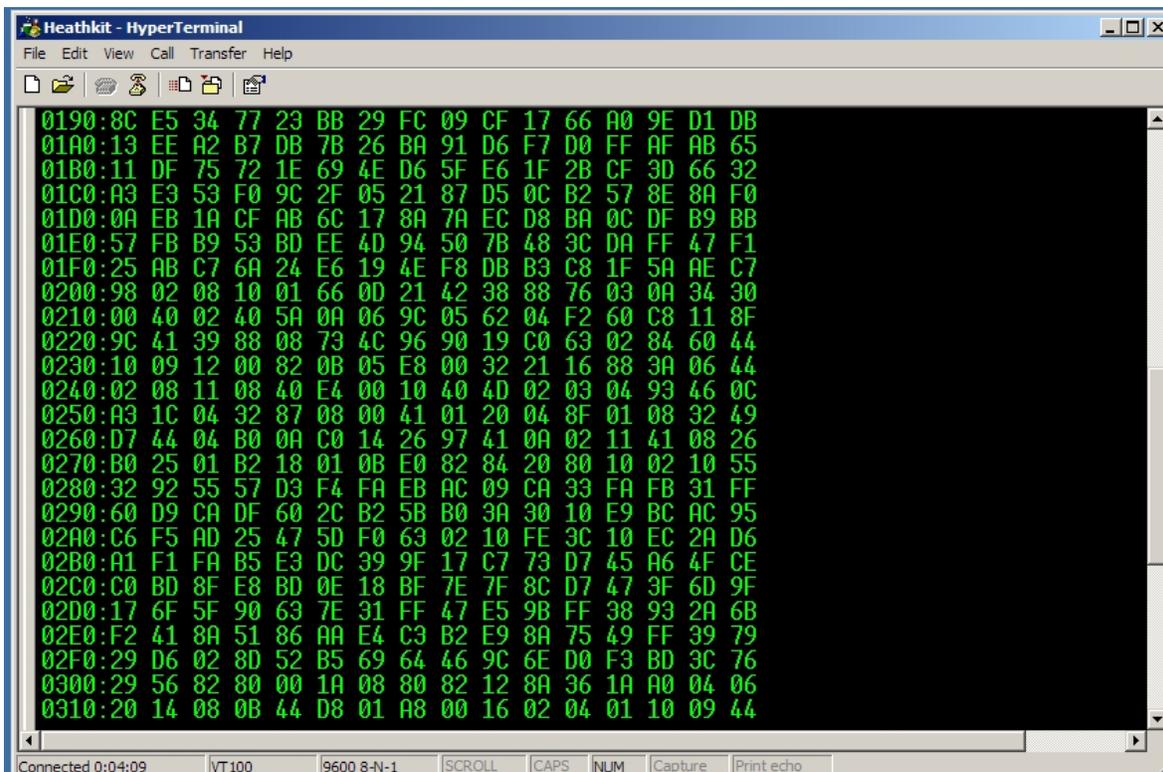
Once properly connected to MEM-3400, hit enter a few times you should get a prompt of EH?.



```
Heathkit - HyperTerminal
File Edit View Call Transfer Help
EH?
>
EH?
>
EH?
>
_
```

Connected 0:02:01 | VT100 | 9600 8-N-1 | SCROLL | CAPS | NUM | Capture | Print echo

One of the two commands for the MEM-3400 is **RAM VIEW**. This will screen dump the full 1K contents of the ET-3400A memory onto your HyperTerminal screen.

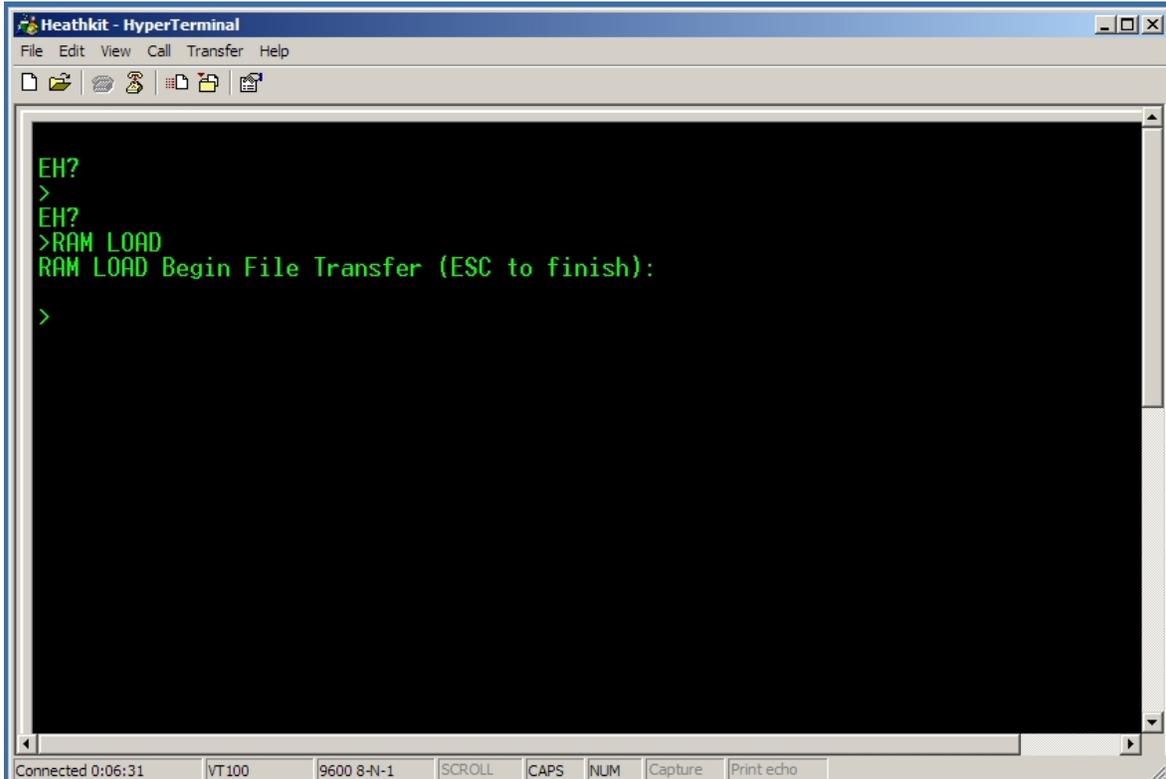


```
Heathkit - HyperTerminal
File Edit View Call Transfer Help
0190:8C E5 34 77 23 BB 29 FC 09 CF 17 66 A0 9E D1 DB
01A0:13 EE A2 B7 DB 7B 26 BA 91 D6 F7 D0 FF AF AB 65
01B0:11 DF 75 72 1E 69 4E D6 5F E6 1F 2B CF 3D 66 32
01C0:A3 E3 53 F0 9C 2F 05 21 87 D5 0C B2 57 8E 8A F0
01D0:0A EB 1A CF AB 6C 17 8A 7A EC D8 BA 0C DF B9 BB
01E0:57 FB B9 53 BD EE 4D 94 50 7B 48 3C DA FF 47 F1
01F0:25 AB C7 6A 24 E6 19 4E F8 DB B3 C8 1F 5A AE C7
0200:98 02 08 10 01 66 0D 21 42 38 88 76 03 0A 34 30
0210:00 40 02 40 5A 0A 06 9C 05 62 04 F2 60 C8 11 8F
0220:9C 41 39 88 08 73 4C 96 90 19 C0 63 02 84 60 44
0230:10 09 12 00 82 0B 05 E8 00 32 21 16 88 3A 06 44
0240:02 08 11 08 40 E4 00 10 40 4D 02 03 04 93 46 0C
0250:A3 1C 04 32 87 08 00 41 01 20 04 8F 01 08 32 49
0260:D7 44 04 B0 0A C0 14 26 97 41 0A 02 11 41 08 26
0270:B0 25 01 B2 18 01 0B E0 82 84 20 80 10 02 10 55
0280:32 92 55 57 D3 F4 FA EB AC 09 CA 33 FA FB 31 FF
0290:60 D9 CA DF 60 2C B2 5B B0 3A 30 10 E9 BC AC 95
02A0:C6 F5 AD 25 47 5D F0 63 02 10 FE 3C 10 EC 2A D6
02B0:A1 F1 FA B5 E3 DC 39 9F 17 C7 73 D7 45 A6 4F CE
02C0:C0 BD 8F E8 BD 0E 18 BF 7E 7F 8C D7 47 3F 6D 9F
02D0:17 6F 5F 90 63 7E 31 FF 47 E5 9B FF 38 93 2A 6B
02E0:F2 41 8A 51 86 AA E4 C3 B2 E9 8A 75 49 FF 39 79
02F0:29 D6 02 8D 52 B5 69 64 46 9C 6E D0 F3 BD 3C 76
0300:29 56 82 80 00 1A 08 80 82 12 8A 36 1A A0 04 06
0310:20 14 08 0B 44 D8 01 A8 00 16 02 04 01 10 09 44
```

Connected 0:04:09 | VT100 | 9600 8-N-1 | SCROLL | CAPS | NUM | Capture | Print echo

Talking to the MEM-3400 (RAM LOAD Command)

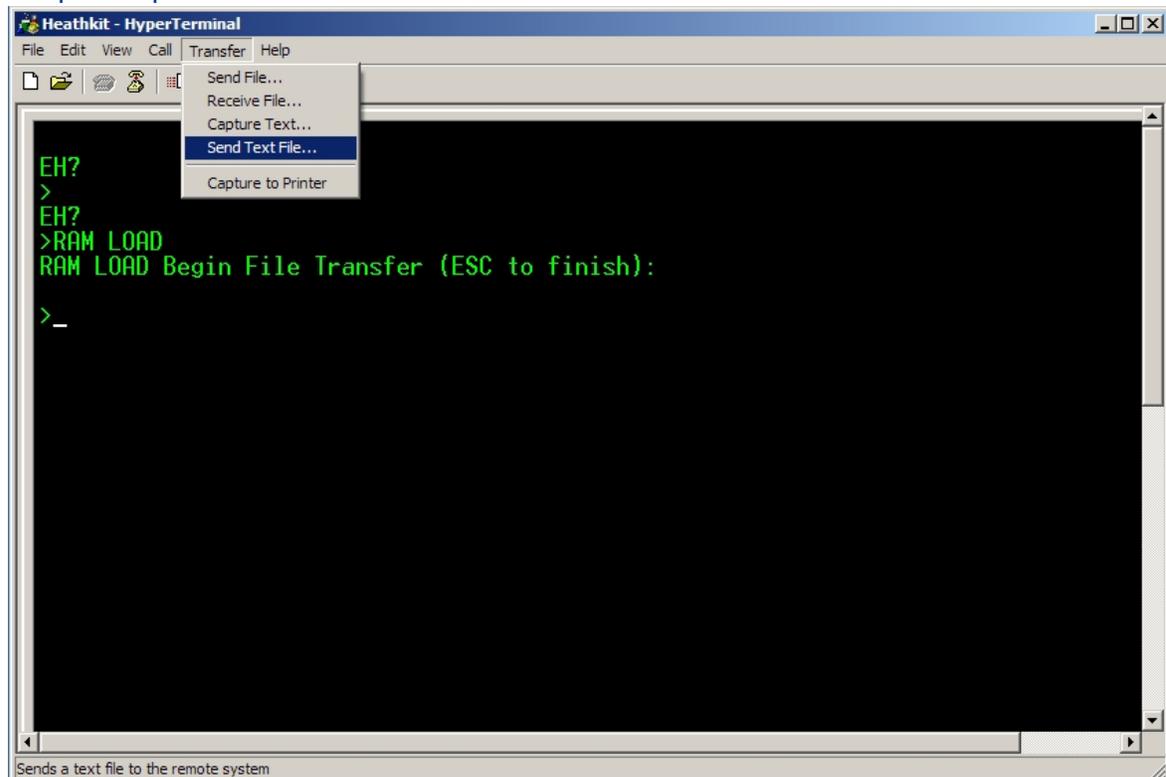
The other command for the MEM-3400 is RAM LOAD. This command begins to initiate a file transfer. **It is very important to note this is a text only file transfer of ET-3400 hex codes.**



```
Heathkit - HyperTerminal
File Edit View Call Transfer Help
RAM LOAD
RAM LOAD Begin File Transfer (ESC to finish):
```

Connected 0:06:31 VT100 9600 8-N-1 SCROLL CAPS NUM Capture Print echo

Go to the HyperTerminal command bar and select Transfer, then select **“Send Text File”** from the drop down menu. **Be very careful NOT to select “Send File”** which would invoke incompatible protocols such as Kermit or Xmodem.

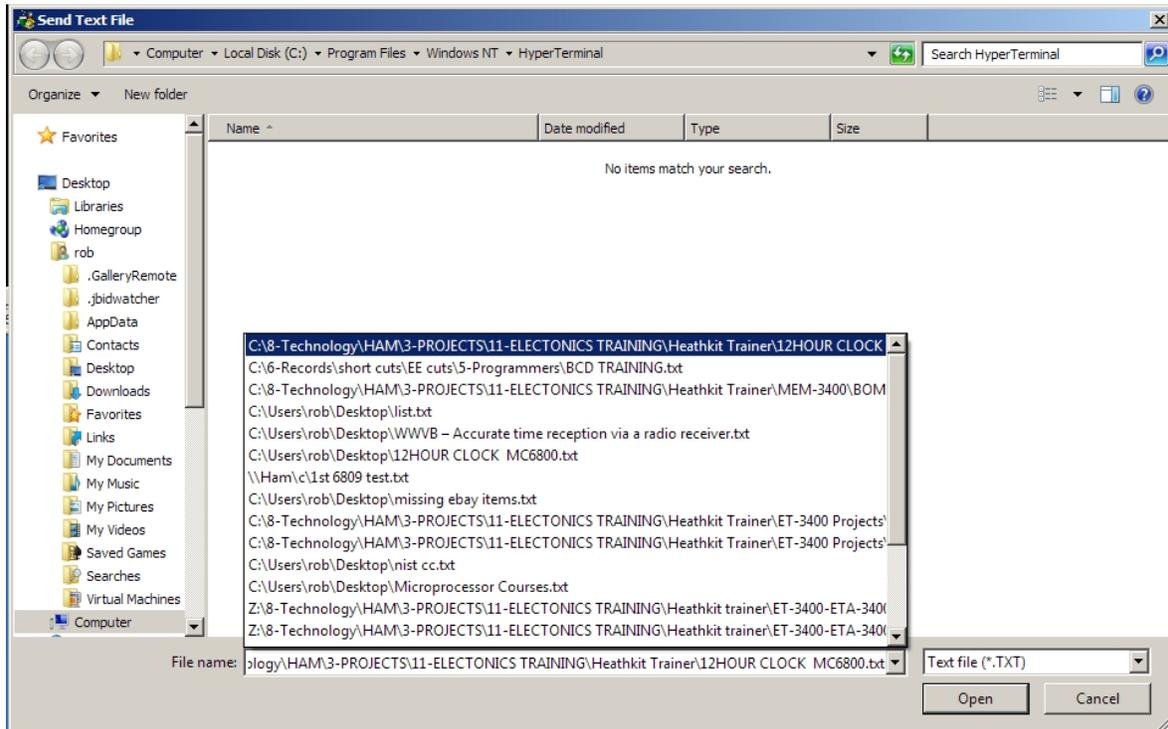


```
Heathkit - HyperTerminal
File Edit View Call Transfer Help
Send File...
Receive File...
Capture Text...
Send Text File...
Capture to Printer
RAM LOAD
RAM LOAD Begin File Transfer (ESC to finish):
```

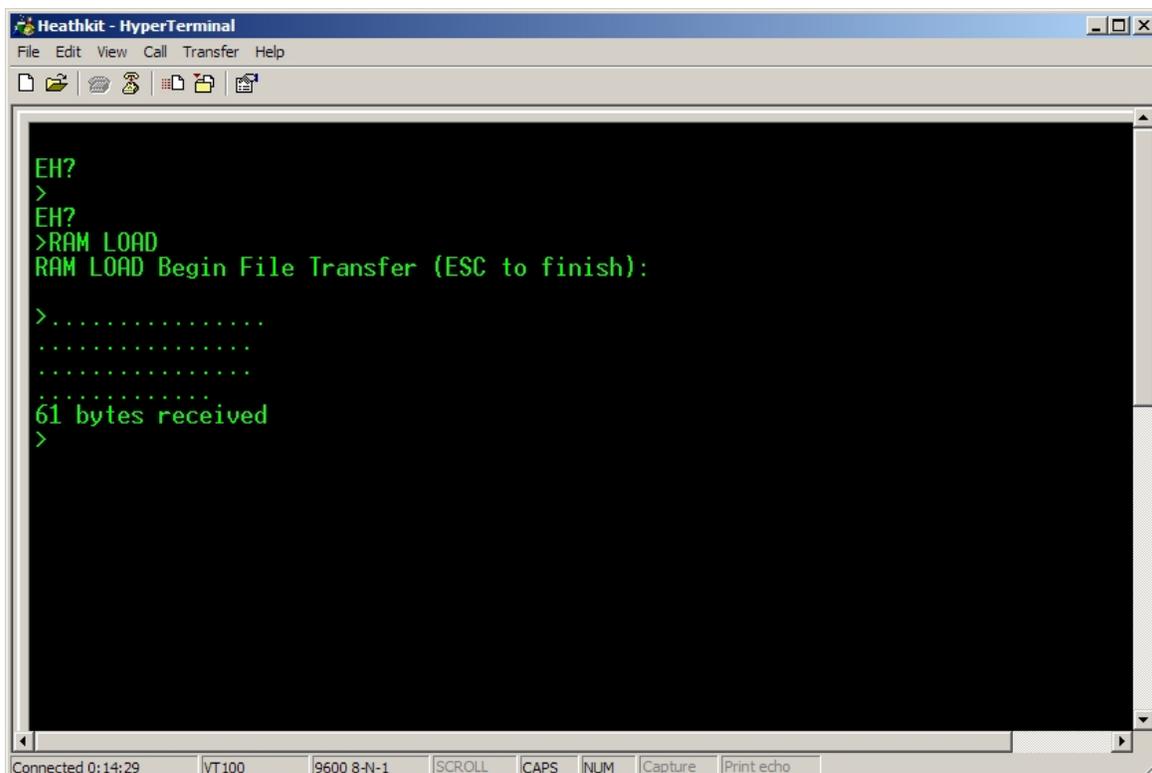
Sends a text file to the remote system

Talking to the MEM-3400 (RAM LOAD Command)

HyperTerminal will open a file window as shown below. This will let you browse your Windows file system to locate your ASCII hex file for uploading.



Once you have located your file and click open, then the HyperTerminal prompt will show a series of dots to indicate upload progress. When dots are finished then press the ESC key on your keyboard. Your program of hex code is now loaded into your ET-3400 trainer for execution.



Additional MEM-3400 features.

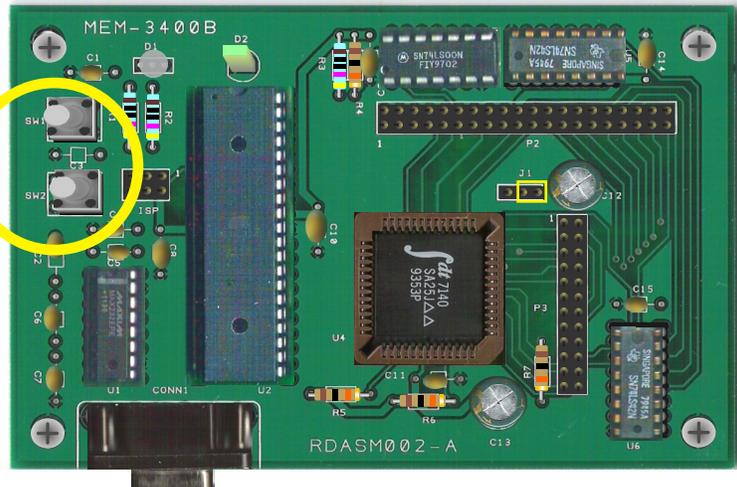
Push button switch 1 (SW1) saves the ET-3400 memory into EEROM in the Atmel MCU.

Push button switch 2 (SW2) loads your saved EEROM code from the Atmel MCU back into the ET-3400 for program execution.

These two switches make saving an retrieving ASCII hex code possible without the use of a computer.

SW1 Saves ET-3400 RAM to EEROM

SW2 Loads from EEROM to the ET-3400 dualport RAM.



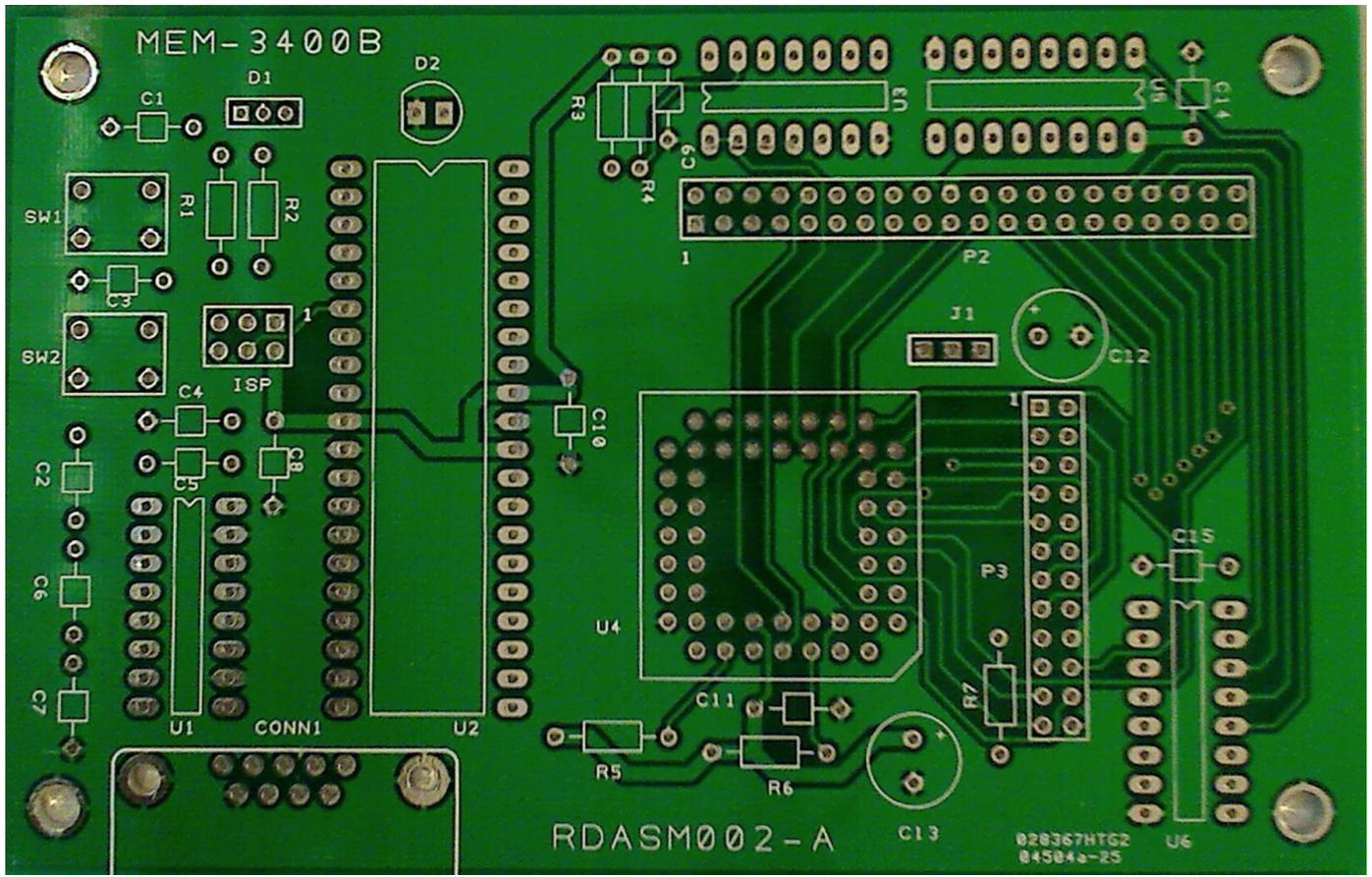
Capturing using RAM VIEW command.

By using the right mouse click drag and highlight you can copy cut and paste your ET-3400 ASCII hex codes into Notepad, several assemblers, cross assemblers and disassemblers for further storage and modifications.

```
Heathkit - HyperTerminal
File Edit View Call Transfer Help
RAM VIEW
RAM VIEW
0000:00 01 00 05 CE B5 00 09 26 FD C6 60 0D 8D 0F 8D
0010:10 C6 13 8D 0C BD FC BC C6 03 8D 16 20 E6 CE 00
0020:03 A6 00 89 00 19 11 25 01 4F A7 00 09 07 88 01
0030:06 39 96 01 26 03 7C 00 01 08 7E FD 7B 43 28 2B
0040:34 16 04 40 10 88 60 93 31 2A 23 20 C0 82 22 ED
0050:FF 80 C0 10 20 4A 12 88 00 11 28 C3 79 0F 4C 62
0060:BF 22 00 38 89 58 00 14 26 C5 08 14 04 0D C3 9A
0070:FF 84 FF 81 FF 08 00 FF 03 E0 02 53 8C AA F0 FF
0080:3F 7A 9A EF C2 D1 95 FB 9A 06 79 D3 01 C2 0A CA
0090:A4 5B E4 9A 0F CC 1D 97 15 DD 9E EC 84 25 30 BA
00A0:88 7F 24 3E 4E A4 15 5D 83 7E 34 65 93 35 BE A8
00B0:78 74 AB 66 51 94 86 17 60 8A E8 66 DE E9 28 F8
0100:3C 81 82 00 05 80 91 02 40 04 01 10 10 CB 04 03
0110:04 0A 00 20 06 2A 00 03 05 BA 00 02 89 8C 80 60
0120:1C E4 00 E4 06 40 00 2A 20 48 40 20 90 61 18 E0
0130:30 40 44 0E 02 22 02 7C 00 43 47 88 01 1C 83 D9
0140:01 03 20 7F 08 4F 60 56 64 04 00 0C 8C 0E 02 14
0150:45 92 00 84 A0 04 33 0A 08 24 00 0D 0E A0 04 D4
0160:29 81 04 49 80 14 46 15 10 46 07 01 90 44 00 40
0170:27 6A 24 F7 34 04 80 81 4A 44 86 00 F1 80 20 10
0180:1E 74 8E 1E 01 5F 12 17 96 AA CF 5A 24 7C 47 AC
0190:8C E5 34 77 23 BB 29 FC 09 CF 17 66 A0 9E D1 DB
Connected 0:06:12 VT100 9600 8-N-1 SCROLL CAPS NUM Capture Print echo
```

PART 5
APPENDIX

Bill Of Material (BOM) and Silk Screen



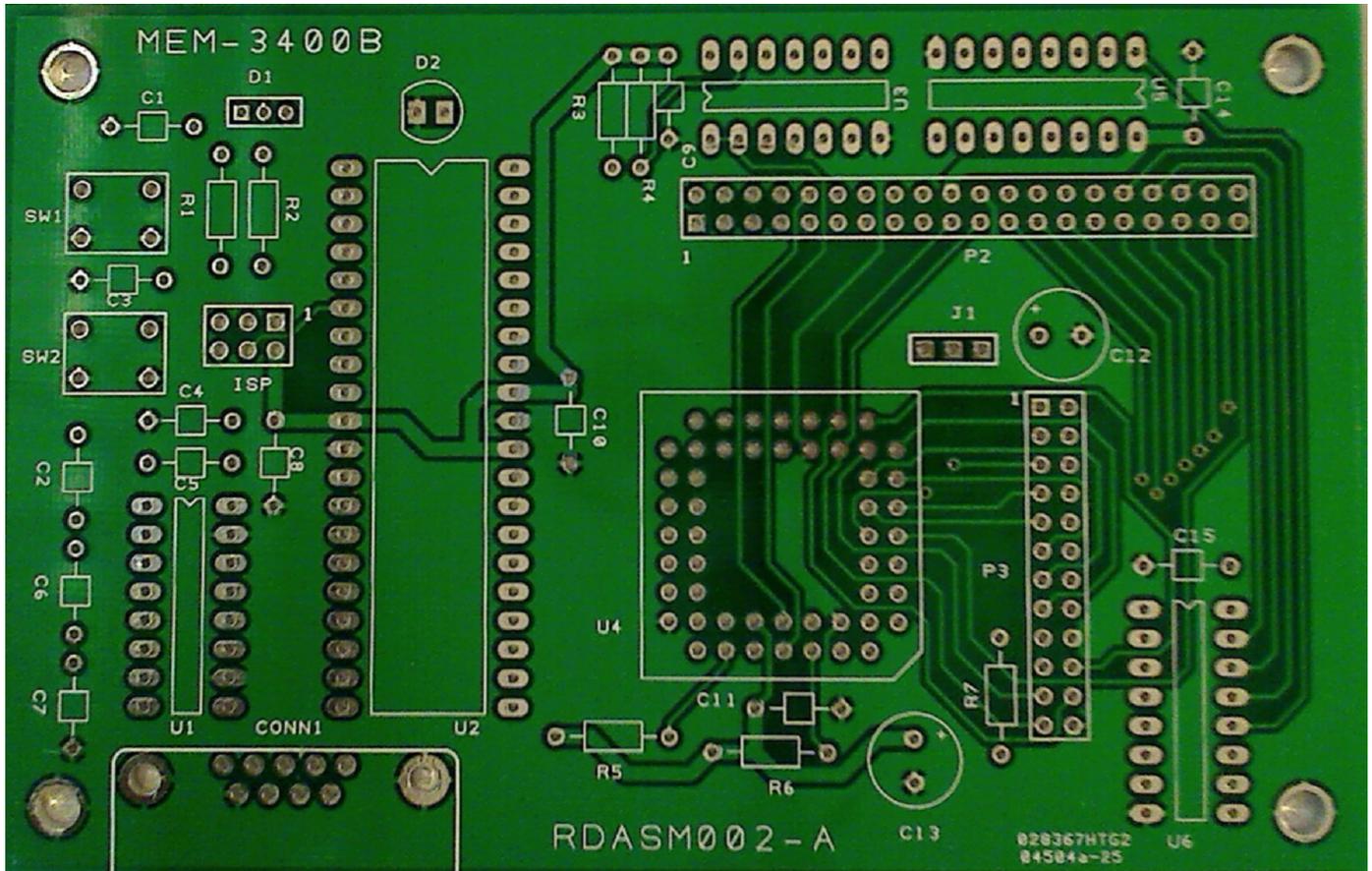
Bill of Materials

Project: MEM-3400
Date: 04/25/13

Part Number	Description	Silk Screen Designation
CHIPS		
1x Max232epe	5v RS-232 Level converter	U1
1x 74LS00	QUAD NAND	U3
2x74LS42	Decode	U5,U6
1x ATMEGA324PA-PU-ND	MCU AVR 32KB FLASH 40PDIP	U2
1x IDT7140SA	Dual-port RAM	U4
SOCKETS, CONNECTORS, AND HEADERS		
1x D990F	RS-232 DB9 Female CONN1	CONN1
1x PLCC52	52 Pin DIP Socket Adapter PLCC	U4
1x 1-746611-0-ND	CONN PLUG 20 POS .100 AU DIP	
1x ED10504-ND	CONN SOCKET IDC 24POS W/KEY GOL	
1x 40PINDIP	40 PIN DIP SOCKET	U2
1x 16PINDIP	16 PIN IC SOCKET	U1,U5,U6
3x 14PINDIP	14 PIN IC SOCKETS x3	U3
1x1175-1437-ND	40 IDC SOCKET 0.10020 POS	
1xS2012EC-40-ND	40 DIP MALE PIN HEADER	P2
1xS2012EC-40-ND	24 DIP MALE PIN HEADER	P3
1xJUMP	3 PIN JUMPER	J1
1x 6PIN HEADER	ISP INTERFACE JUMPER	ISP

(Continued on the next page)

Bill Of Material (BOM) and Silk Screen (Continued)



Part Number	Description	Silk Screen Designation
DISCRETE COMPONENTS		
8x C-105	1.0uF CERAMIC CAPACITORS	C2,C4,C5,C6,C 7,C8,C10,C11
2x 1216PHCT-ND{102}	1.0nF CERAMIC CAPACITORS {102}	C1,C3
2x P836-ND	47uF ELECTROLYTIC CAPACITORS	C12,C13
4x CF14JT10K0CT-ND	10K 1/4W RESISTORS	R4,R5,R6,R7 BROWN,BLACK,ORANGE
3x CF14JT470RCT-ND	470 1/4W RESISTORS	R1,R2,R3 YELLOW,PURPLE,BROWN
1x WP3VEGW	TRI-COLOR LED	D1
1x GRNLED	GREEN LED	D2
3x 0.1uF	0.1 uF {104}	C9,C14,C15

MISCELLANEOUS		
1xRDASM002	PCB	
1x TL1105CF160Q	SPST PUSH BTN SWITCH eSWITCH x2	
1x MI15TSP005	Nylon 440 Threaded Standoffs	
1x 1FT40CRC	1FT 40 CONDUCTOR RIBBON CABLE	
1x 4-40MSCREWS	4-40 SCREWS 0.25 LONG X 4	
2xS-1293	3"x5" PLASTIC SHIPPING BAGS	
1x S-7759	7 1/8 x 6 3/4" Self-Seal Bubble-Lined Mailers	
1x 32958	US POSTAGE & MISC HANDLING	
1x HDBC-1224.25	7 SQ. INCHES ANTI STATIC FOAM	