



SECTION VI

ASSEMBLY

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ASSEMBLY HINTS

Soldering Technique
Assembling Resistors
Assembling Capacitors
Assembling ICs
Soldering IC Sockets

TOOLS REQUIRED

Small Screwdriver
Needlenose Pliers
Diagonal Cutters
Wire Strippers
Soldering Iron



MiniTerm Associates, inc.

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*****WARNING*****

The two boards of the MERLIN Video Interface are both very dense and complicated boards. As a consequence, the solder side of the boards are very crowded with printed circuit runs placed very close to the solder pads of some components. To help avoid solder bridge problems, the solder side of both boards have been masked with a green lacquer. However, good soldering technique is still required to avoid solder bridge problems! Read the section on solder technique before beginning assembly.

Solder Technique

Use a HOT soldering iron with a very small chisel tip. A 35 to 40 watt iron is recommended. If it takes more than one second, after touching the iron and solder to the solder pad, before the solder melts, the iron is too cold. A hot iron will speed the assembly work and reduce chances of cold solder joints and solder bridges. Do not use a soldering gun.

Keep soldering iron tip clean. Occasionally wipe the tip onto a wet sponge or rag to clean it.

Use only the resin core 60/40 solder provided with the kit. Do not use acid core solder.

<p>WARNING: Use of other than the resin core solder provided will void the warranty.</p>

To solder a component:

1. Place the iron tip such that it is in contact, on the bottom (solder) side of the board, with the solder pad and the component lead simultaneously.
2. Apply solder to the junction of the iron, pad and lead until the melted solder forms a fillet all the way around the component lead and pad. Do not use too much solder!
3. Remove the remaining unmelted solder while maintaining the iron on the solder pad.
4. HOLD THE IRON ON THE PAD FOR AN ADDITIONAL 1/2 SECOND AFTER REMOVING THE UNUSED SOLDER. This is the best protection against solder bridges and cold solder joints. The solder will naturally

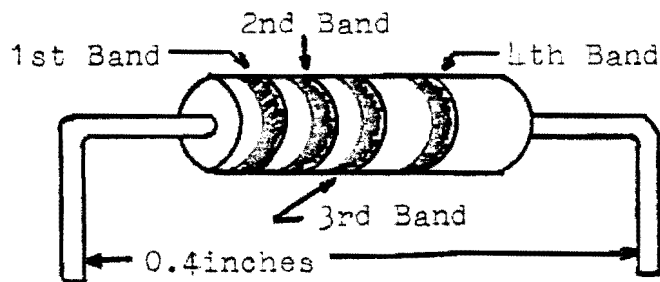


wick around the pad and component lead, breaking any solder bridges that have formed during solder application.

5. Now quickly remove the iron in an upward fashion along the component lead. The iron should not be in contact with the joint for more than one second.
6. Clip the excess lead length just below the top of the solder filet.

Assembling Resistors

All resistors of the MERLIN Kit are 1/4 watt resistors and all mounting positions require lead spacing of 0.4 inches. If you have a bending tool you may bend all resistor leads to 0.4 inches. If not, use a pair of needle-nose pliers to bend the leads at right angles such that they are perpendicular to the resistor body and 0.4 inches from each other.



Resistors are color coded by circular bands around the resistor body. The first three bands indicate the resistance value with the fourth band indicating tolerance. The first three band colors will be called out in the assembly procedure to identify the proper resistors.

To assemble a resistor to the PC boards:

1. Insert the correct color coded resistor with 0.4 inch lead spacing into the correct holes from the component (top) side of the PC board as indicated by the assembly instructions.
2. Turn the board over while holding the resistor in place with one hand and bend the leads slightly outward.
3. Solder the leads to the solder pads on the bottom



(solder masked) side of the board as indicated in the soldering technique section and clip the excess lead lengths. Protective glasses should be worn to be safe.

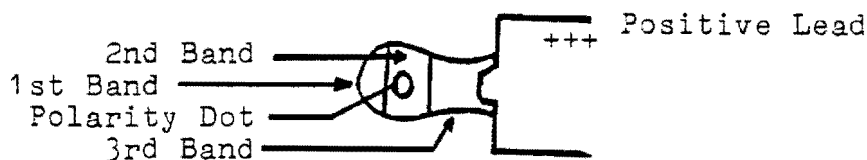
Assembling Capacitors

Two types of capacitors are supplied with the MERLIN kit. They are non-polarized, ceramic disk capacitors and polarized, dipped tantalum capacitors. Ceramic capacitors will have the value printed on them.

To assembly a ceramic capacitor to the PC boards:

1. Insert the capacitor leads into the correct holes according to the assembly instructions from the component (top) side of the PC board. Push the capacitor down until the ceramic insulation almost touches the PC board.
2. Turn the board over while holding the capacitor in place with one hand and bend the leads slightly outward.
3. Solder the leads to the solder pads on the bottom (solder masked) side of the board as indicated in the soldering technique section and clip the excess lead lengths. (Be careful of your eyes.)

Dipped tantalum capacitors will be marked in one of the three ways. In one method the capacitor value will be printed on the capacitor with a dot or plus sign closest to the lead that is the positive lead. In the second method the capacitors will be color coded with horizontal bands indicating the value, and a vertical stripe indicating the positive leads. In the third method, the capacitors are also color coded with horizontal bands. However, the third band does not indicate capacity value but, rather, voltage range. A dot is placed centrally between the leads of this type capacitor to indicate polarity (see the diagram below to determine the positive lead).



DIPPED TANTALUM CAPACITOR



The color of this dot indicates the multiplier. Since this dot has an obscure color coding, but the first two horizontal bands are color coded as in the second method, only the color coding for the second method will be called out in the assembly instructions. Ignore the third color band when capacitors marked with this third method are present. If you are not sure which capacitor is 3.3uf (orange, orange) and which is 33uf (orange, orange) remember that in general, the larger value capacitor is also larger in size. At each position of the PC boards where a polarized capacitor is to be mounted, a plus sign (in foil) will indicate in which hole to place a positive capacitor lead. It is very important that polarized capacitors be inserted with the correct polarity.

WARNING: An improperly polarized capacitor will get hot and may explode when power is applied!

To assemble a polarized dipped tantalum capacitor to the PC boards:

1. Bend the leads of the capacitor at right angles to match the hole spacing (0.2 inches) of the PC board. Some capacitors may already have their leads properly bent.
2. Insert the capacitor into the PC board at the location specified by the assembly instructions. Be sure to align the positive lead with the plus sign on the PC board.
3. Turn the board over while holding the capacitor in place with one hand and bend the leads slightly outward.
4. Solder the leads to the solder pads on the bottom (solder masked) side of the board as indicated in the soldering technique section and clip the excess lead lengths.

Assembling Integrated Circuits

All dual-inline IC's of the MERLIN kit are mounted in sockets. Do not unpack these integrated circuits until all soldering is complete on both MERLIN boards and until the assembly instructions call for them. In the MERLIN kit, the only integrated circuits that are soldered are the four three-terminal voltage regulators.



WARNING: You must use the IC sockets provided for mounting the ICs. Failure to use any socket (soldering a dip IC or a dip connector to the board) ...WILL VOID THE WARRANTY.

In addition, no unit will be accepted for repair work (in warranty or not) that has not been constructed with the IC sockets provided.

Assembling IC Sockets

There are many ways to assemble a group of IC sockets onto a PC board. Three such methods are presented. Choose the method you feel most comfortable with.

1. Tape Method.
Insert the socket into the proper PC board position and secure it by taping the socket to the board. Turn the board over and solder the pins to the foil.
2. Bending Pin Method.
Insert the socket into the proper PC board position. While holding the socket against the board, turn the board over and bend two diagonally opposite corner pins from the socket either in or out with a small screwdriver or needlenose plier. Be sure that any runs which the bent-over pins touch are runs that are normally connected to that pin. The best method is to bend the two corner power supply pins inward. These pins will then properly touch the heavy power supply traces. With this method, many sockets may be placed on the board to be soldered at the same time later.
3. Cardboard Method.
Insert a group of sockets into their proper positions on the PC board. Place a stiff piece of cardboard over the sockets to hold them in place while turning the board over and laying it on a flat surface. Solder the socket pins to the foil.



Soldering IC Sockets

Each socket should be properly seated flat against the board. To ensure this, when soldering sockets:

First, solder two diagonally opposite corner pins for each socket being assembled to hold it in place.

Pick the board up and apply pressure to each socket while reheating the two corner pins.

Solder the remaining pins.

As an option, you may elect to clip the excess pin length of the sockets. Make sure you wear protective glasses if you do this. This will make the board easier to handle when installing other components.



ASSEMBLY PROCEDURE

MERLIN Board #1 Assembly

- Resistors
- 16, 22 and 24 Pin Sockets
- 14 Pin Sockets and Connector Sockets
- Voltage Regulators
- Ceramic Capacitors
- Tantalum Capacitors

MERLIN Board #2 Assembly

- Resistors
- 16 and 24 Pin Sockets
- 14 Pin Sockets and Connector Sockets
- Ceramic Capacitors
- Tantalum Capacitors
- Crystals
- Coaxial Cable

- PC Board Cleaning and Inspection
- Power Supply Checkout, MERLIN Board #1
- Mounting MERLIN Boards Together
- Power Supply Checkout, MERLIN Board #2
- IC Installation
 - Handling Static Sensitive Devices (SSDs)
 - Preparing and Inserting ICs

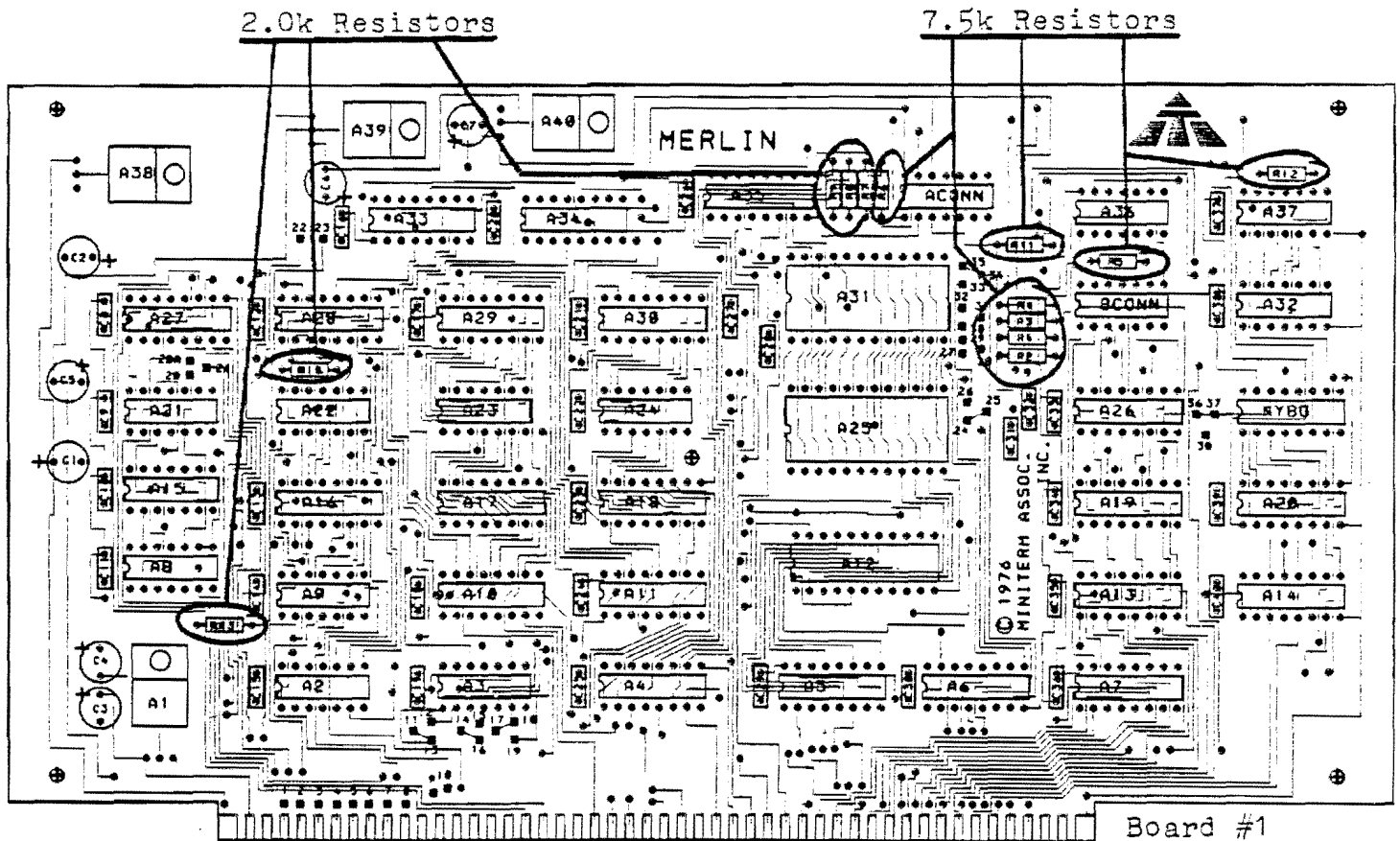


BOARD #1 ASSEMBLY

- (✓) Place Board #1 in front of you such that the gold fingers are at the bottom and the MiniTerm logo is at the top right. The side with the MiniTerm logo is the component side of the board. All components will be mounted on this side of the board and soldered to the foil on the reverse side of the board.

RESISTORS (Bag 1-2)

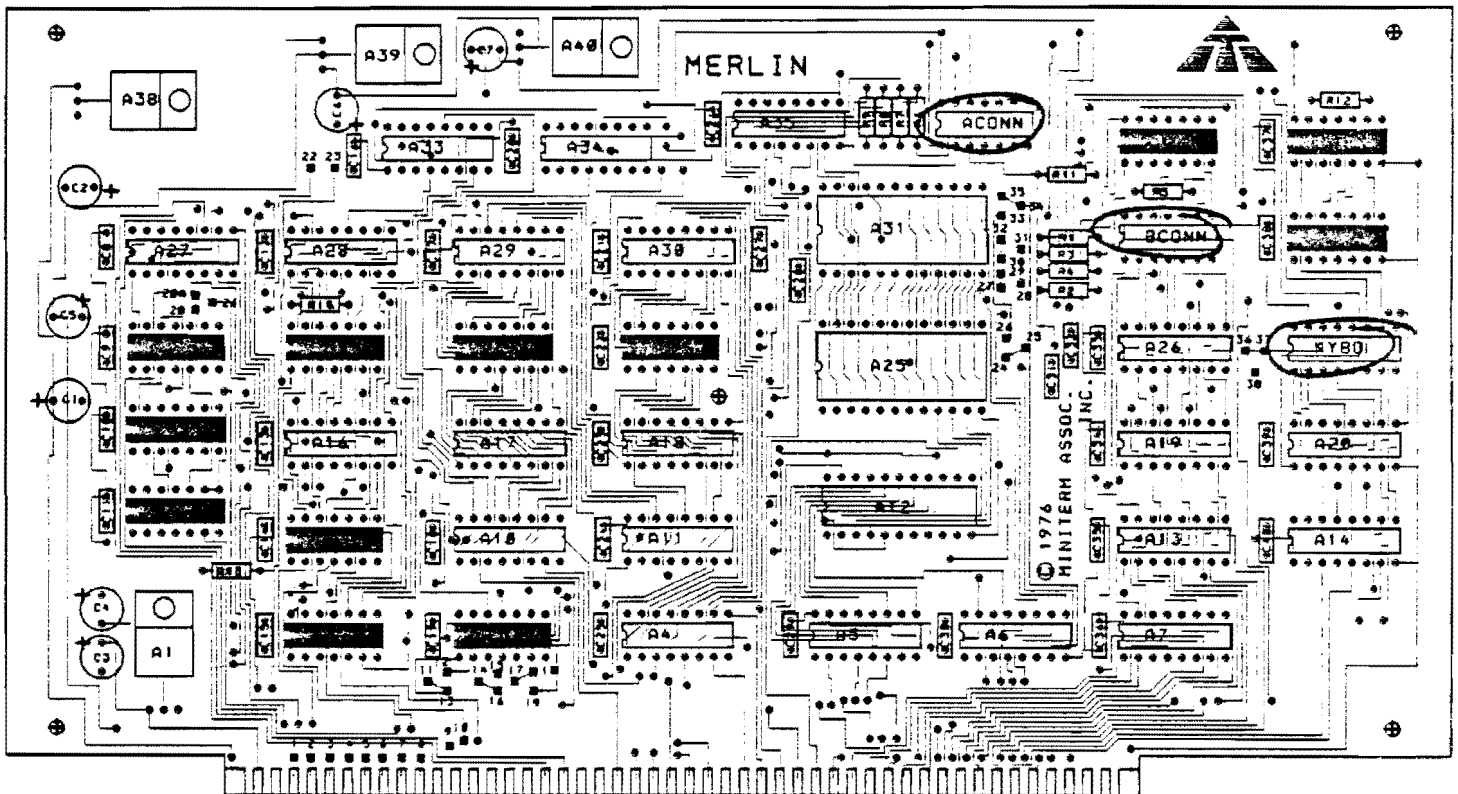
- (✓) Locate five (5) 2.0K resistors (red, black, red).
- (✓) Solder these resistors in locations R7, R8, R9, R10, and R13 as indicated on the assembly drawing below.
- (✓) Locate eight (8) 7.5K resistors (violet, green, red).
- (✓) Solder these resistors in locations R1, R2, R3, R4, R5, R6, R11, R12 as indicated on the assembly drawing below.





14 PIN IC SOCKETS AND CONNECTOR SOCKETS (Bag 1-4)

- (✓) Locate twelve (12) 14-pin sockets.
- (✓) Solder these sockets in the positions indicated by the blacked-out portions of the assembly diagram below. The pin 1 indicators on the sockets should be in the lower left hand corner when the socket is properly inserted in the board.
- (✓) Locate two (2) 14-pin Augat sockets. The Augat sockets have a notch in one end like many integrated circuits. When the notch is on the left side, as in the diagram below, pin 1 is the bottom left-most pin.
- (✓) Solder these sockets into the positions marked ACONN and BCONN on the assembly diagram. The notch should be to the left side.
- (✓) Locate and solder one (1) 16-pin Augat socket into the position marked KYBD on the assembly diagram. The notch should be to the left side.





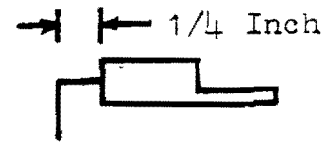
VOLTAGE REGULATORS (Bag 1-2)

- () Locate the four (4) 3-terminal voltage regulators supplied with the kit. There are four different non-interchangeable types, each of which may be labelled as follows:

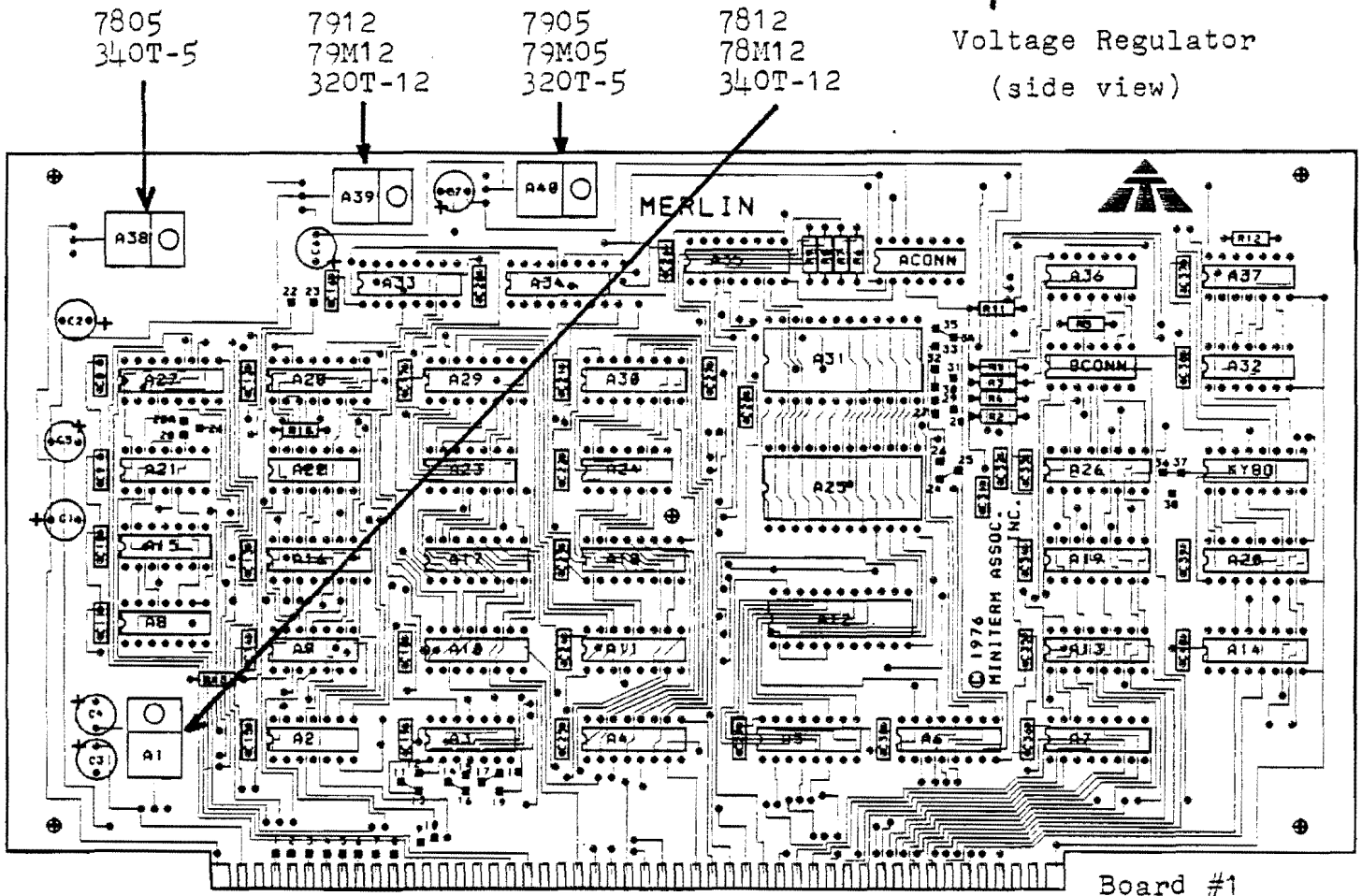
TABLE I

	<u>Regulator #</u>	<u>Device Labels</u>		
1.	A38	7805	----	340T-5
2.	A39	7912	79M12	320T-12
3.	A40	7905	79M05	320T-5
4.	A1	7812	78M12	340T-12

- () Using needlenose pliers, bend all three leads of each regulator downward at right angles 1/4 inch from the regulator body.

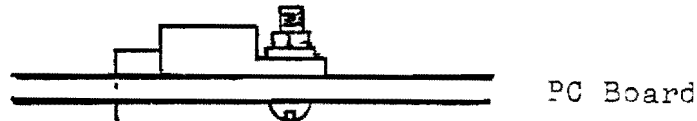


Voltage Regulator
(side view)





- (✓) Using Table I, determine the regulator to be mounted at position A1 (7812, 78M12, 340T-12).
- (✓) Slowly, insert the leads of this regulator into the three holes at position A1 of the assembly diagram such that the mounting holes of the regulator and PC board line up. If you have trouble inserting the leads, be sure there are no burrs or rough edges on the leads. Grasp all three leads at once with a pair of needlenose pliers. Gently rock the leads with the pliers while applying a slight pressure downward until the leads have penetrated the board.
- (✓) Locate three (3) sets of 6-32 hardware. A set consists of a 5/8 inch bolt, a star lockwasher, and a nut.
- (✓) Use one set of 6-32 hardware to mount regulator A1 to the PC board. Feed the bolt through the PC board from the bottom and up through the regulator. Place the lock-washer and the nut on the bolt and tighten securely.
- (✓) Solder the three regulator leads to the foil on the bottom side of the board. Clip the excess lead lengths.



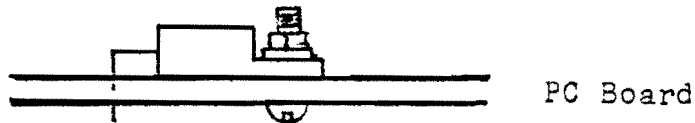
Voltage Regulator Mounting Diagram A1, A39, A40

- (✓) Repeat the regulator mounting procedure above when mounting A39. Be sure to mount the correct regulator (7912, 79M12, 320T-12).
- (✓) Repeat the regulator mounting procedure above for A40. Be sure to mount the correct regulator (7905, 79M05, 320T-5).
- (✓) Now remove the 6-32 hardware from regulator A40. This hardware will be used to mount regulator A38. A40 will be held in place by board standoff mounting hardware when the two MERLIN boards are assembled together.
- (✓) Locate the voltage regulator heatsink.
- (✓) Mount regulator A38 (7805, 340T-5) like A1, A39, and A40 but with the heatsink placed between the voltage regulator and PC board. Use the 6-32 mounting hardware removed from A40.



VI-14

- (✓) Using Table I, determine the regulator to be mounted at position A1 (7812, 78M12, 340T-12).
- (✓) Slowly, insert the leads of this regulator into the three holes at position A1 of the assembly diagram such that the mounting holes of the regulator and PC board line up. If you have trouble inserting the leads, be sure there are no burrs or rough edges on the leads. Grasp all three leads at once with a pair of needlenose pliers. Gently rock the leads with the pliers while applying a slight pressure downward until the leads have penetrated the board.
- (✓) Locate three (3) sets of 6-32 hardware. A set consists of a 5/8 inch bolt, a star lockwasher, and a nut.
- (✓) Use one set of 6-32 hardware to mount regulator A1 to the PC board. Feed the bolt through the PC board from the bottom and up through the regulator. Place the lockwasher and the nut on the bolt and tighten securely.
- (✓) Solder the three regulator leads to the foil on the bottom side of the board. Clip the excess lead lengths.



Voltage Regulator Mounting Diagram A1, A39, A40

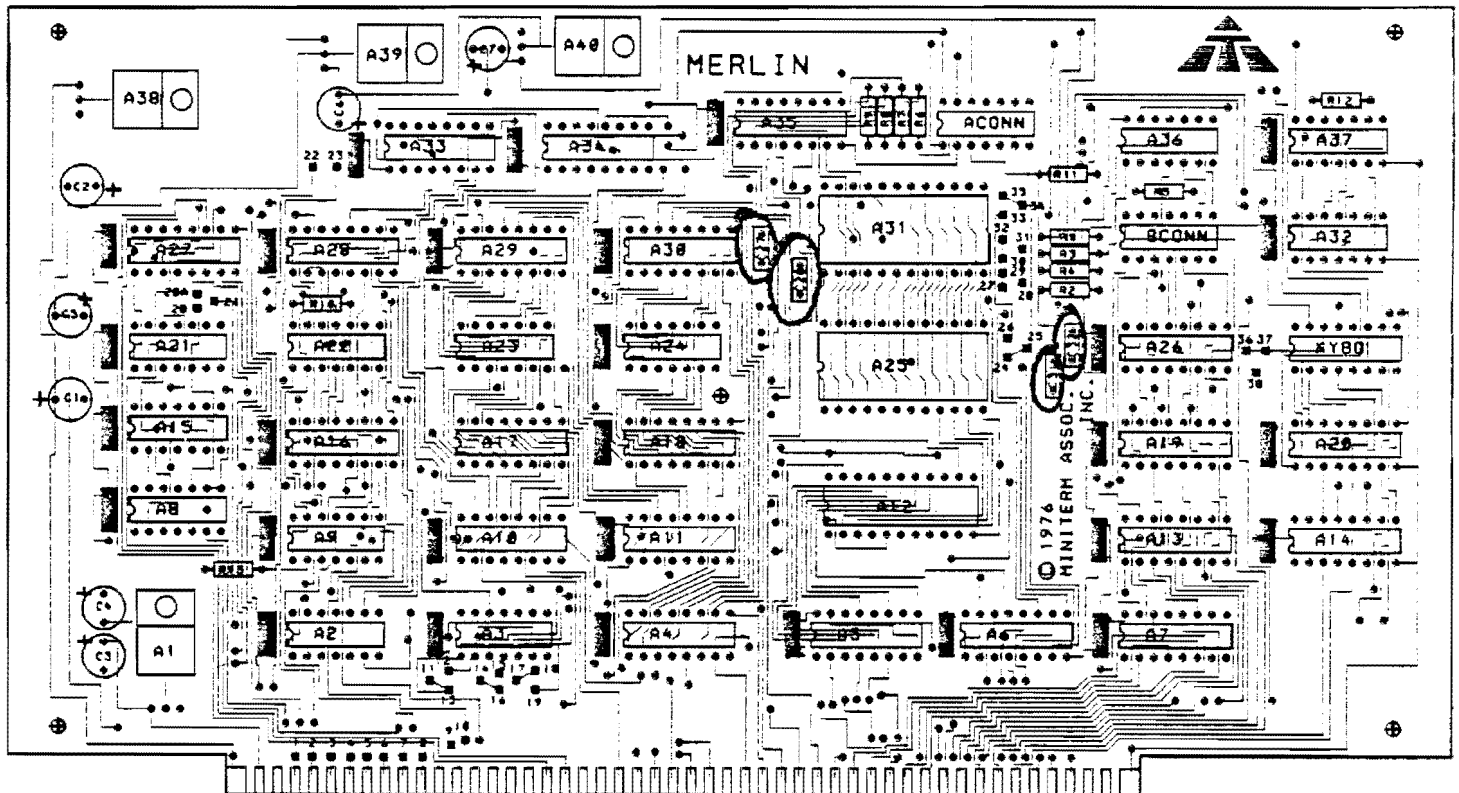
- (✓) Repeat the regulator mounting procedure above when mounting A39. Be sure to mount the correct regulator (7912, 79M12, 320T-12).
- (✓) Repeat the regulator mounting procedure above for A40. Be sure to mount the correct regulator (7905, 79M05, 320T-5).
- (✓) Now remove the 6-32 hardware from regulator A40. This hardware will be used to mount regulator A38. A40 will be held in place by board standoff mounting hardware when the two MERLIN boards are assembled together.
- (✓) Locate the voltage regulator heatsink.
- (✓) Mount regulator A38 (7805, 340T-5) like A1, A39, and A40 but with the heatsink placed between the voltage regulator and PC board. Use the 6-32 mounting hardware removed from A40.



CERAMIC CAPACITORS (Bag 1-3)

- (✓) Locate thirty-three (33) .05uf ceramic disc capacitors.
- (✓) Solder twenty-nine (29) of the capacitors into the blacked-out positions as shown on the assembly diagram below.
- (✓) The remaining four capacitors will be soldered into the circled positions next to the 24-pin sockets as shown on the assembly diagram only if 2708 EAROMs are to be used instead of the MBI and MEI ROMs.

NOTE: The MBI and MEI mask ROMs will not function with these capacitors in place.

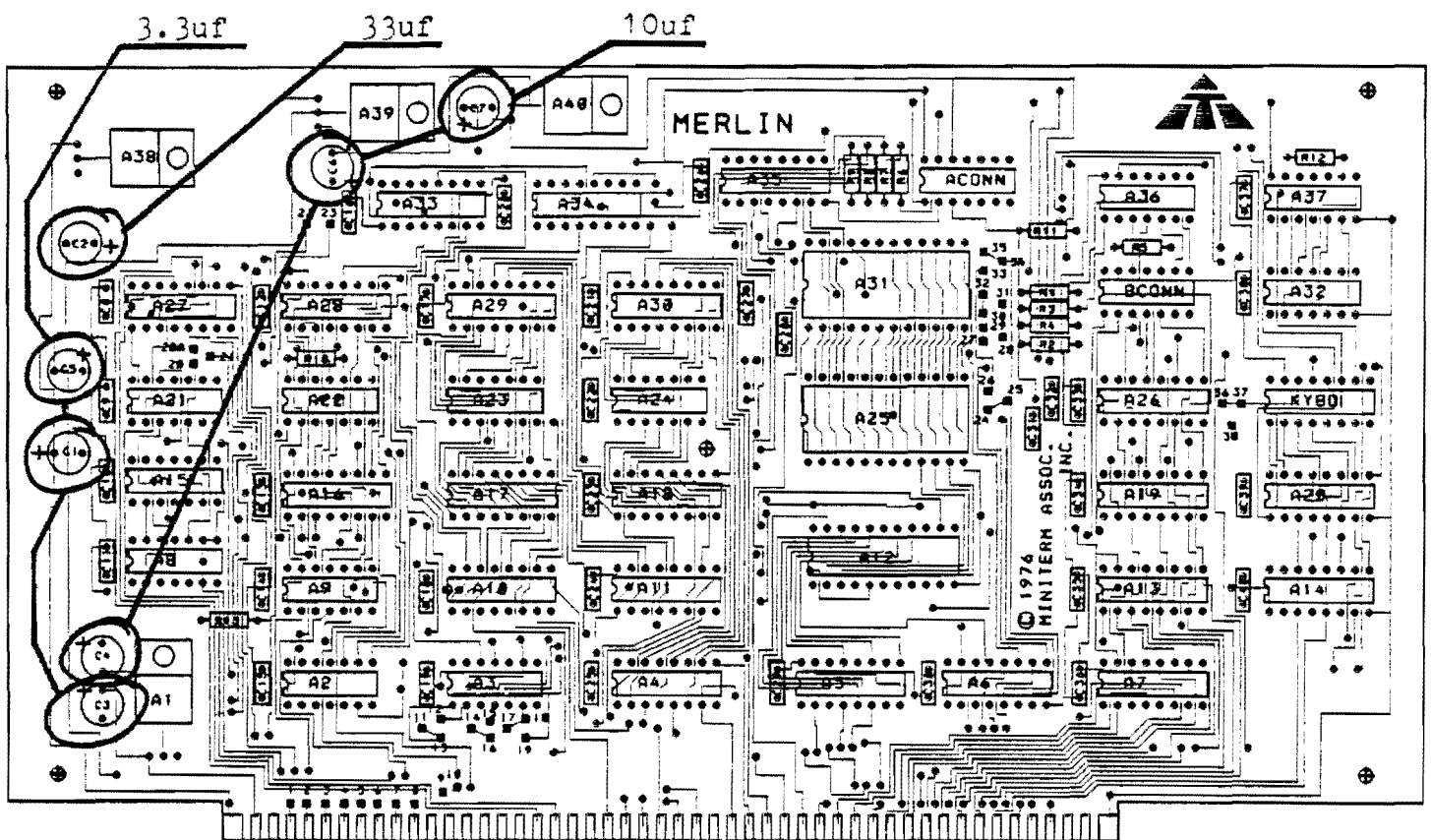




TANTALUM CAPACITORS (Bag 1-2)

- (d) Locate three (3) 3.3uf (orange, orange, green) polarized dipped tantalum capacitors
- (v) Solder these capacitors into positions C1, C3, and C5 as shown on the assembly drawing. Be sure to insert them with the positive lead in the hole nearest the plus sign on the PC board.
- (l) Locate one (1) 33uf (orange, orange, blue) polarized dipped tantalum capacitor.
- (v) Solder this capacitor with positive lead in the hole nearest the plus sign, into position C2 as shown on the assembly diagram.
- (v) Locate three (3) 10uf (brown, black, blue) polarized dipped tantalum capacitors.
- (v) Solder these capacitors, with positive leads in the holes nearest the plus sign, into positions C4, C6 and C7.

NOTE: Refer to the assembly hints section for aid in determining the positive lead of the tantalum capacitors.





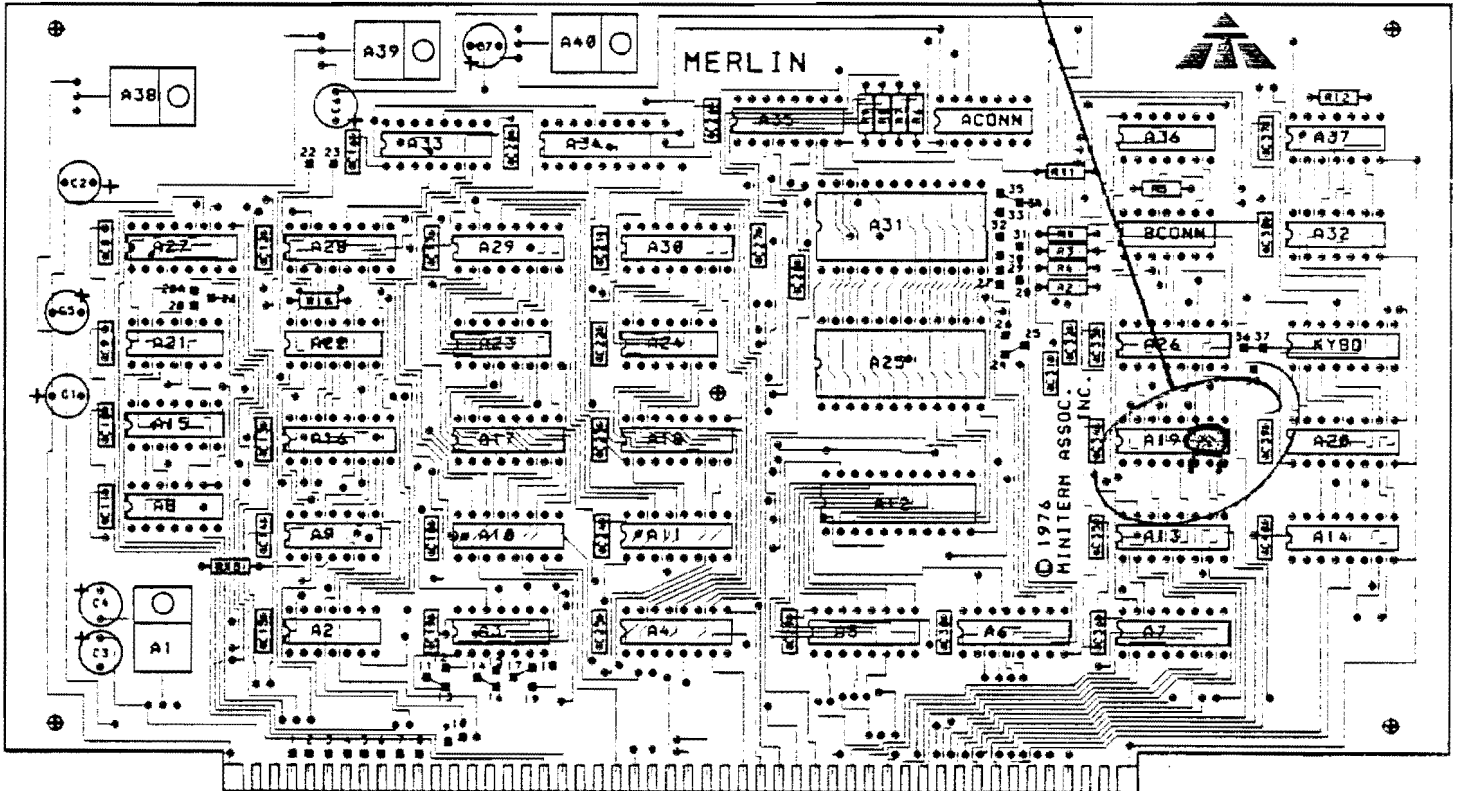
COMPONENT ADDITION TO MERLIN BOARD #1

A capacitor of 470pf must be added to the MERLIN Board #1 on the solder side of the board. The capacitor is connected between pins 6 and 8 of IC A19 as shown in the assembly diagram below.

- () Mount the 470pf capacitor (bag 1-2) beneath A19 directly to pins 6 and 8. Clip any excess lead lengths.

This completes the soldering of MERLIN Board #1. Do not insert any ICs at this time.

Mount the capacitor underneath the board.





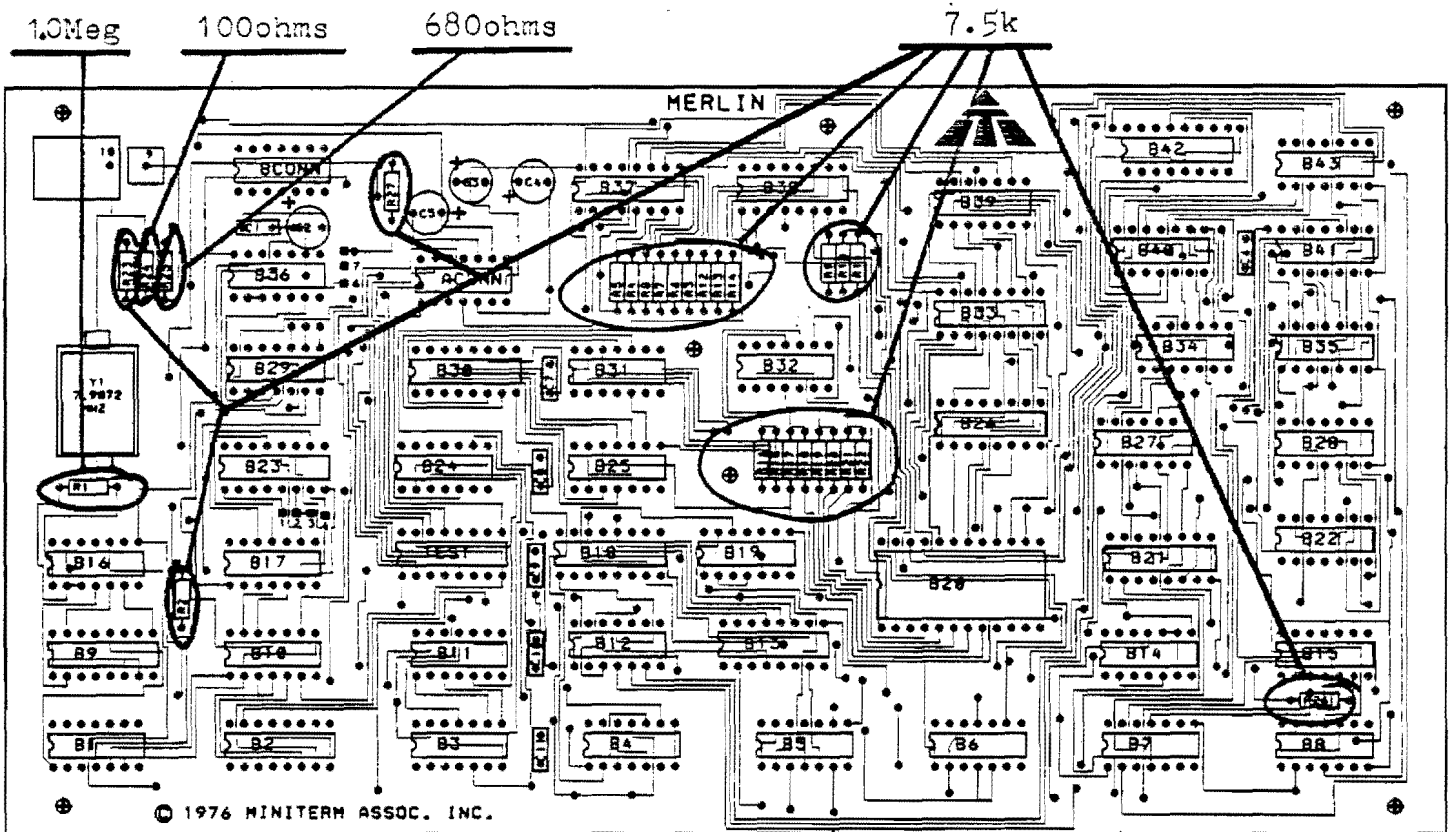
VI-18

BOARD #2 ASSEMBLY

✓ Place Board #2 in front of you such that the MiniTerm logo is at the top right as shown in the assembly diagram. All components will be mounted on this side of the board.

RESISTORS (Bags 2-2, 2-3)

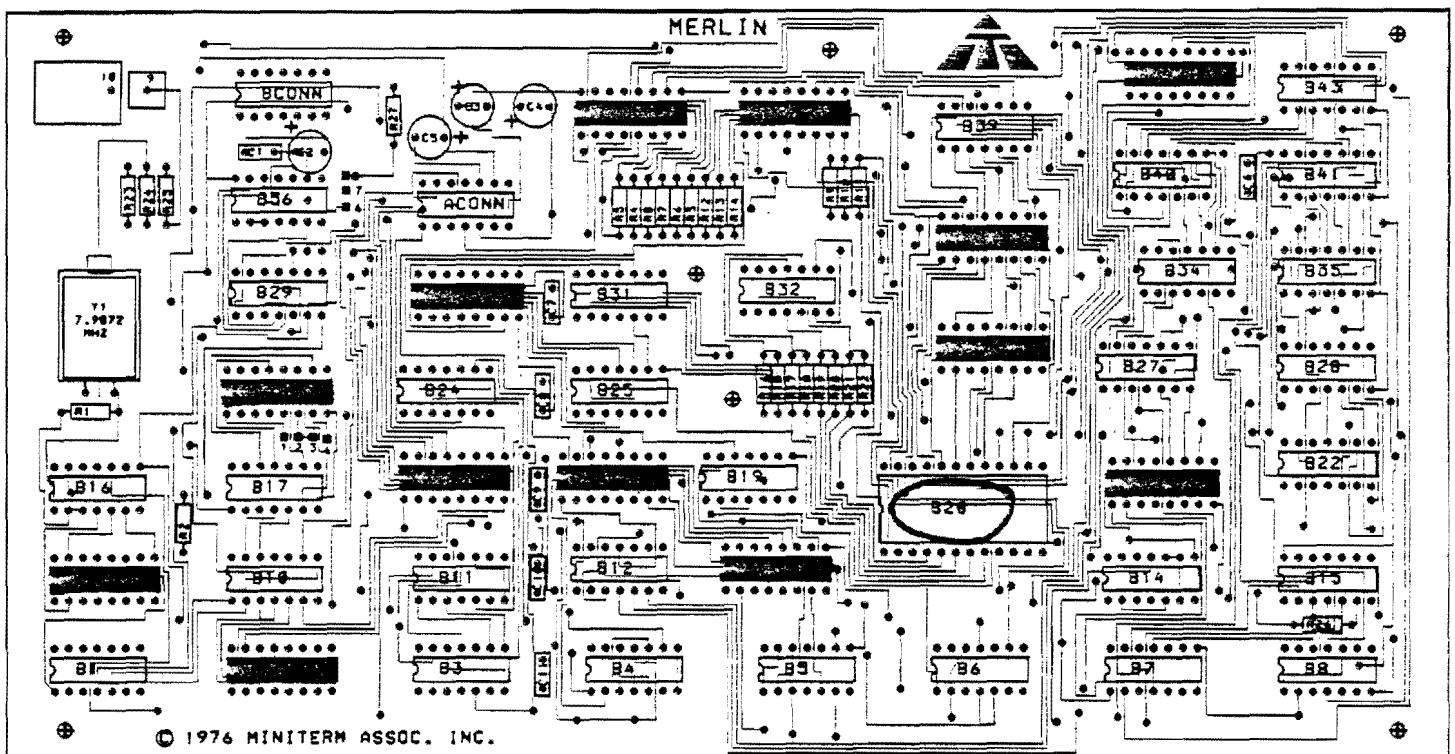
- ✓ Locate twenty-four (24) 7.5k (violet, green, red) resistors.
- ✓ Solder these resistors in the locations as shown on the assembly diagram.
- ✓ Locate one (1) 680ohm (blue, gray, brown) resistor and solder it in position R25 as shown on the assembly diagram.
- ✓ Locate one (1) 100ohm (brown, black, brown) resistor and solder it in position R24 as shown on the assembly diagram.
- ✓ Locate one (1) 1.0 Meg (brown, black, green) resistor and solder it in position R1 as shown on the assembly diagram.





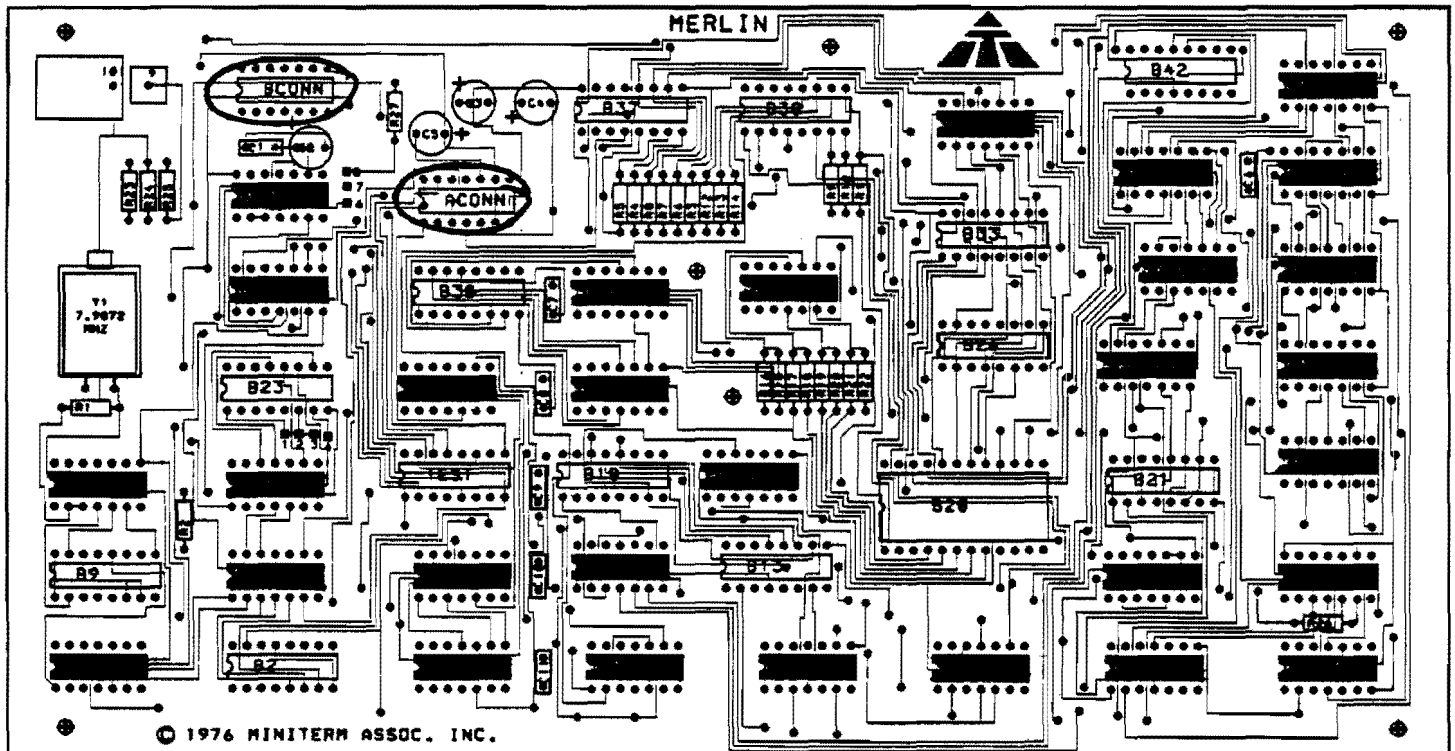
16 AND 24 PIN IC SOCKETS (Bag 2-4)

- (✓) Locate thirteen (13) 16-pin TI sockets.
- (✓) Solder these sockets into the positions indicated by the blacked out portions of the assembly diagram below. The pin 1 indicators on the sockets should be in the lower left hand corner when the socket is properly inserted in the board.
- (✓) Locate and solder one (1) 24-pin TI socket in position B20 as shown on the assembly diagram.



14 PIN IC AND CONNECTOR SOCKETS (Bag 2-4)

- (√) Locate thirty (30) 14-pin TI sockets.
- (√) Solder these sockets in the positions indicated by the blacked out portions of the assembly diagram below. The pin 1 indicators on the sockets should be in the lower left hand corner when the socket is properly inserted in the board.
- (√) Locate two (2) 14-pin Augat sockets.
- (√) Solder these sockets into the positions marked ACONN and BCONN on the assembly diagram. Insert these sockets such that the pin 1 indication notch is on the left side.





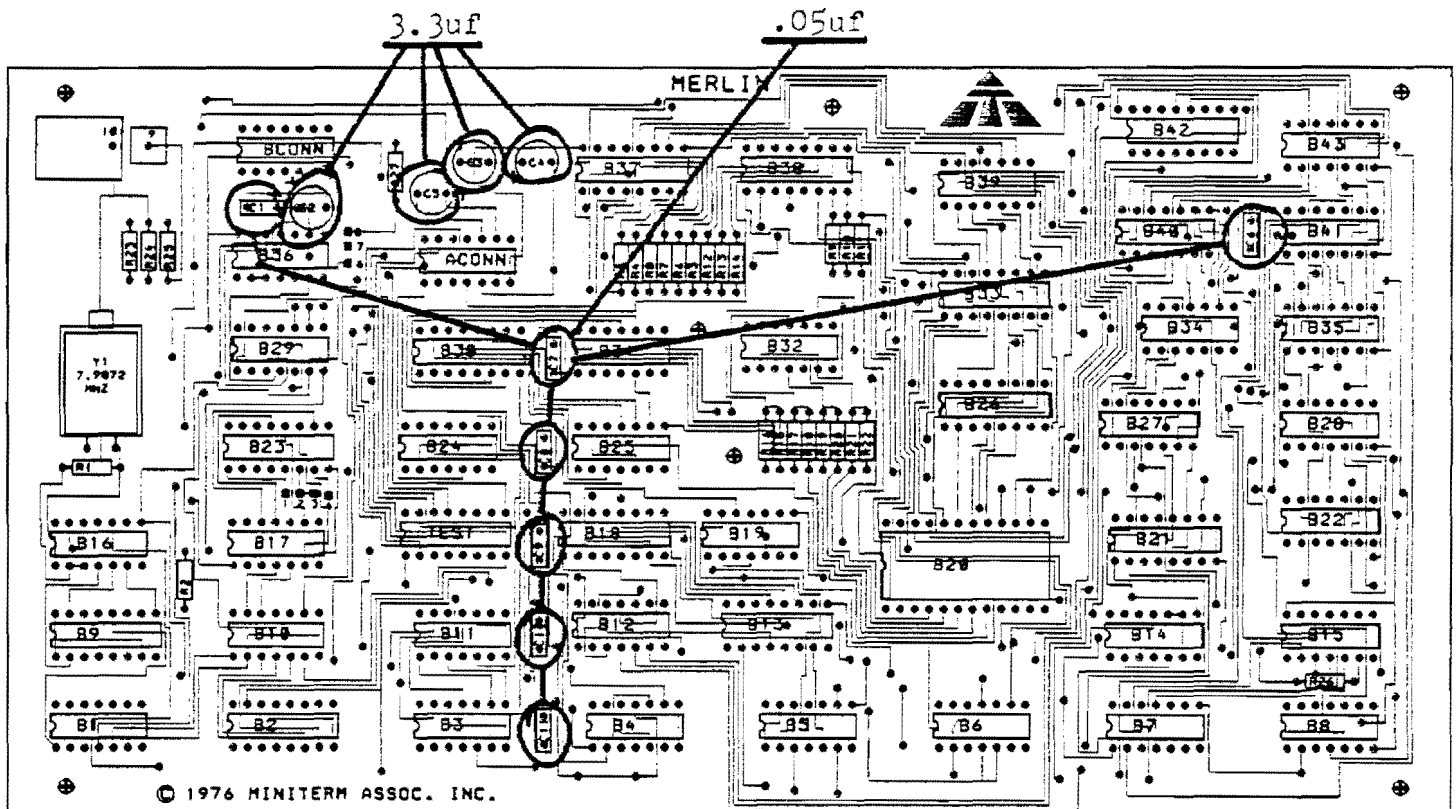
CERAMIC CAPACITORS (Bag 2-3)

- () Locate seven (7) .05uf ceramic disc capacitors.
- () Solder these capacitors into the positions as shown on the assembly diagram.

TANTALUM CAPACITORS (Bag 2-3)

- () Locate four (4) 3.3uf (orange, orange, green) polarized dipped tantalum capacitors.
- () Solder these capacitors into positions C2, C3, C4, and C5. Remember to place the positive lead of each capacitor into the hole nearest the plus sign polarity indicator.
- () Carefully push C3, C4, and C5 toward the top of the board until they are bent flat against the board. This will provide clearance for the A connector cable.

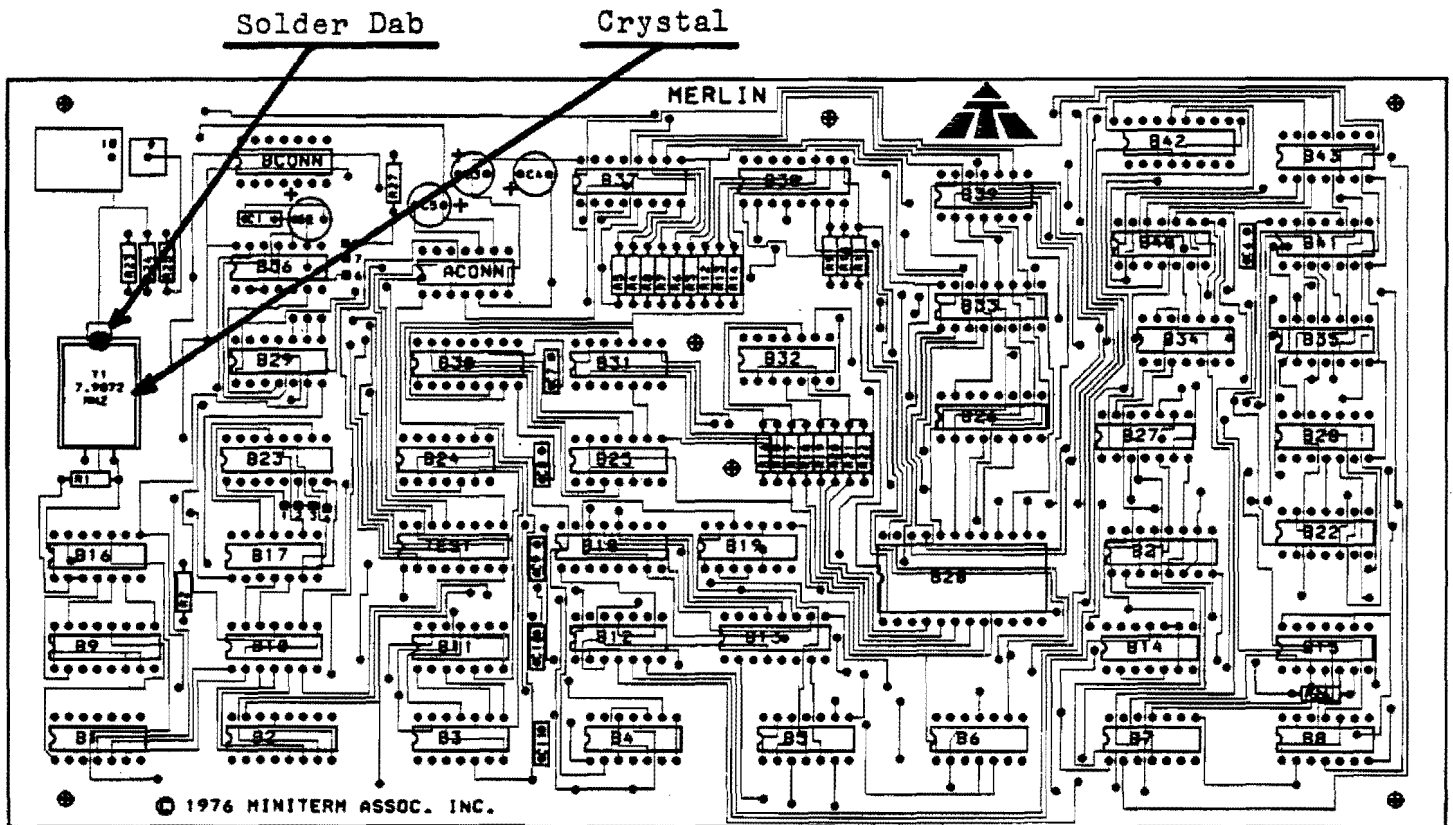
NOTE: See the assembly hints section if you have any difficulty determining the positive lead of the tantalum capacitors.





CRYSTAL (Bag 2-3)

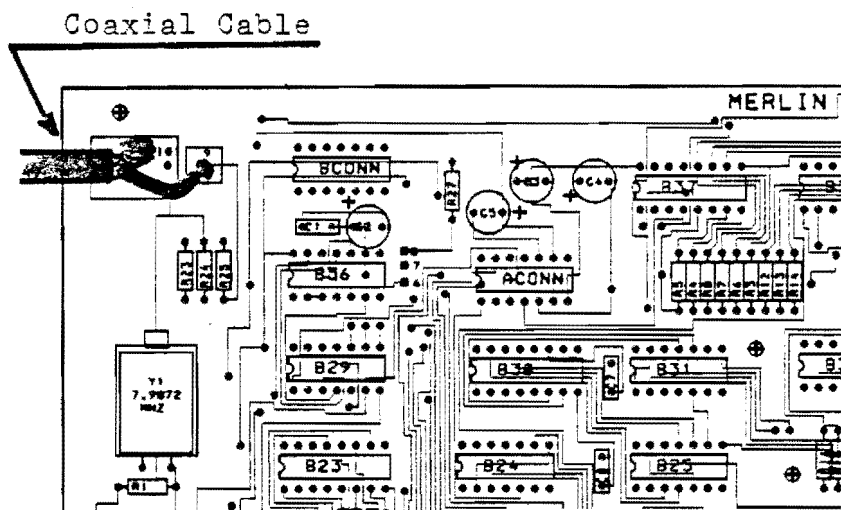
- (\) Locate the crystal. It has a metallic case with two wire leads.
- (\) Bend both wire leads downward at a right angle, 1/4 inch from the crystal body.
- (\) Insert the leads into the board and use a piece of tape to hold the crystal in place on top of the board.
- (\) Solder the leads to the foil on the bottom of the board and clip the excess lead lengths.
- (\) Solder the top edge of the crystal to the metal area under the crystal with one small dab of solder to hold the crystal in place. Do not overheat the crystal as excess heat will damage it! To solder the crystal without overheating it, melt a quantity of solder on the tip of your iron. Then place the tip of the iron at the junction of the PC board and the top of the crystal case. Hold the crystal against the board while doing this. Remove the iron as soon as the solder begins to flow on the PC board.





COAXIAL CABLE (Bag 2-2)

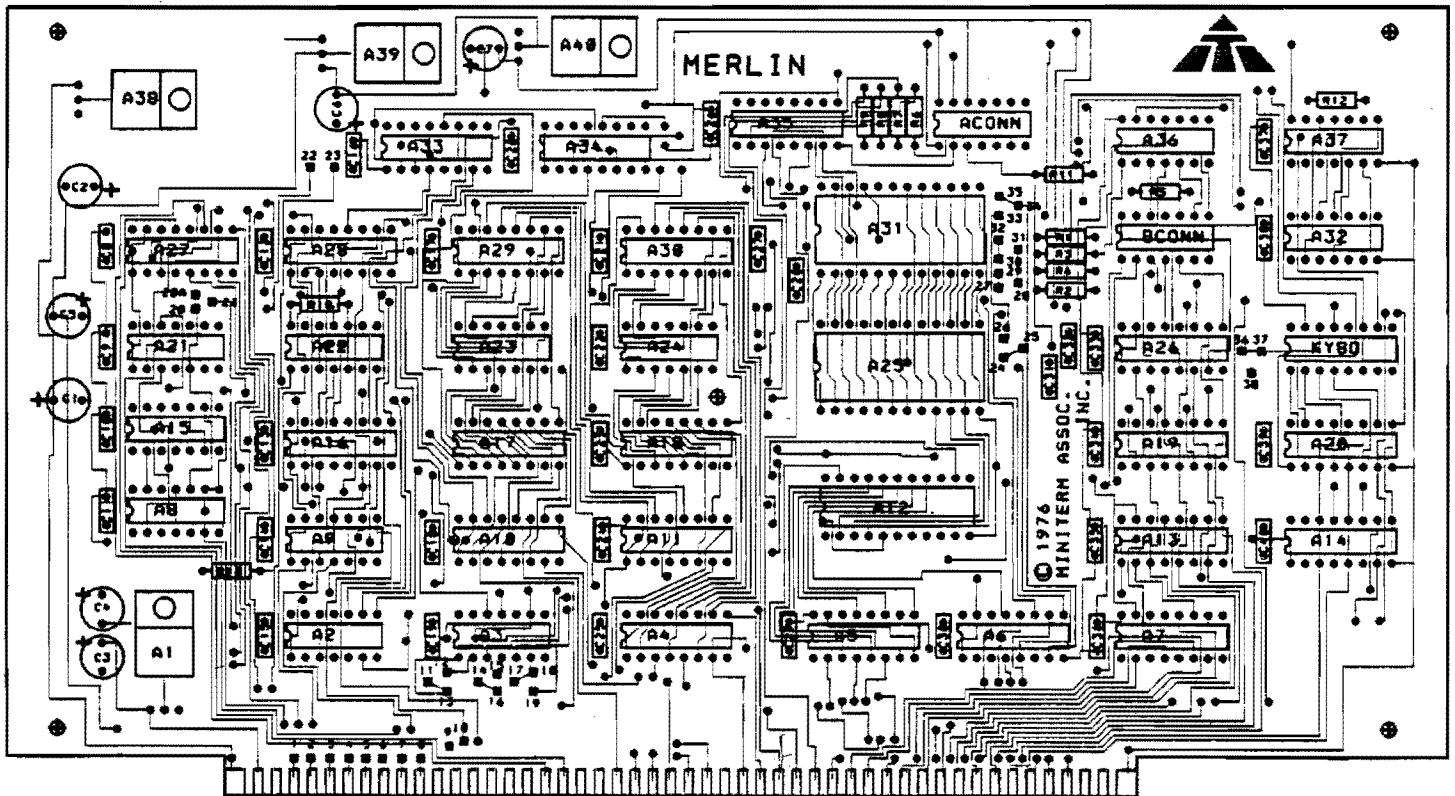
- () With a pair of wire strippers, strip $3/4$ inch of insulation off of one edge of the coaxial cable supplied. Be careful not to cut into the metal shield below the insulation.
- () Do not unbraid the shield, but rather separate the strands at the edge of the insulation to expose the insulated center conductor.
- () With a small screwdriver or awl, pull the center conductor up through the hole in the braid. Bending the wire at the hole in the braid will help to expose the center conductor.
- () Strip $1/8$ inch insulation from the center conductor and tin the wire with a small amount of solder.
- () Solder the center conductor to the PC board at pad #9 on the component side of the board as shown in the assembly diagram.
- () Tin the exposed shield with solder. Leave a small length of shield untinned near the cable insulation.
- () Trim the shield length to $3/8$ inch.
- () Solder the shield to the PC board at #10 as shown in the assembly diagram below. Be sure and leave some slack in the center conductor so that all of the strain is on the shield and not on the center conductor. Be careful not to melt the insulation of the center conductor.



PC BOARD CLEANING AND INSPECTION

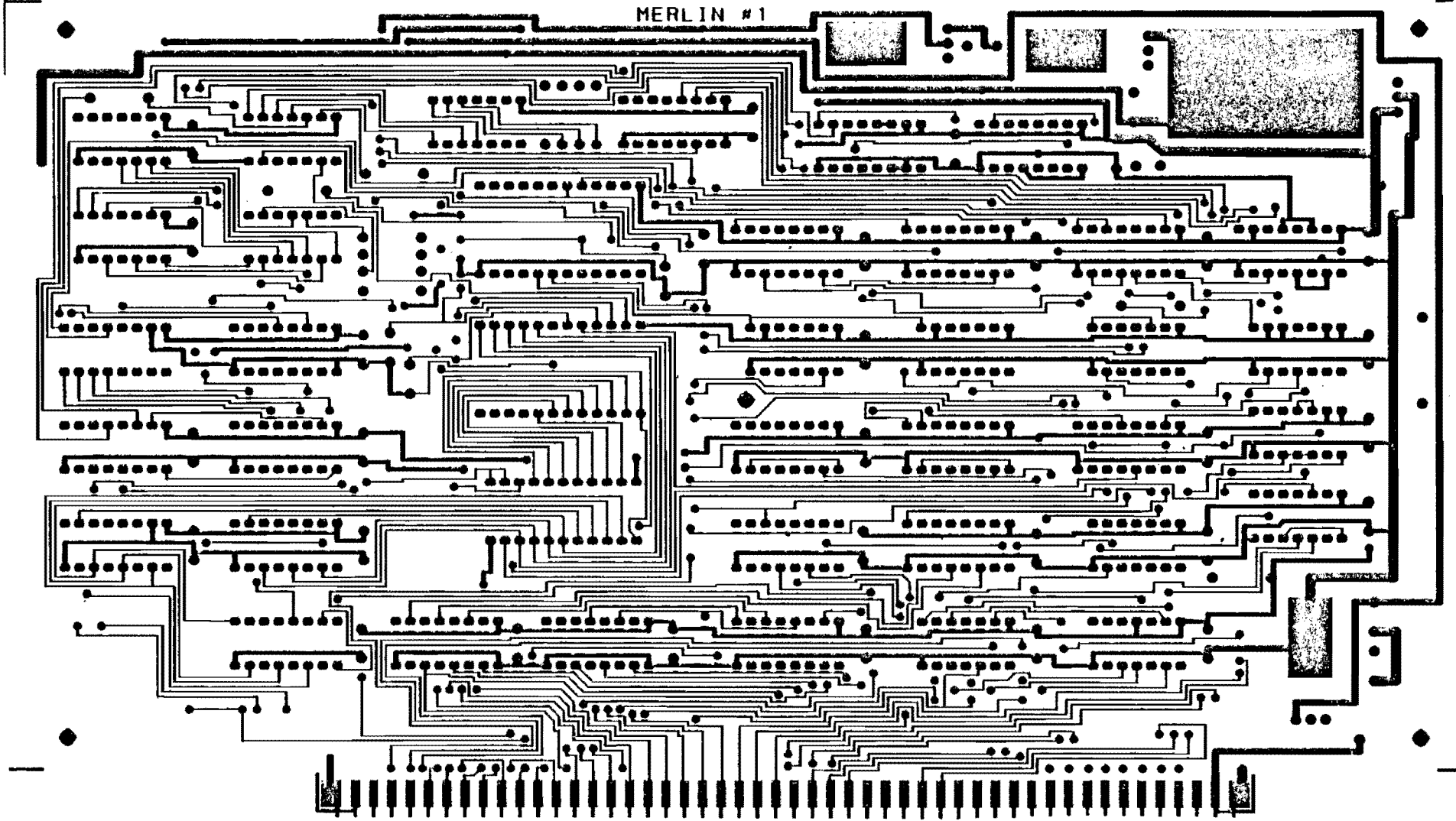
At this point all soldering is complete on both MERLIN boards and no integrated circuits have been installed except for the four voltage regulators of Board #1. Do not install ICs at this time.

- () Brush the solder side of both MERLIN boards with a small stiff brush such as an old tooth brush to remove any loose solder splashes.
- () Inspect the solder side of both boards for solder bridges and unsoldered components and IC socket pins. Occasionally, two adjacent solder pads are connected together by a foil run and will appear to be a solder bridge. If you suspect a solder bridge refer to the solder side layout diagram to verify it. Usually, just reheating the pads will break the solder bridge. Remove the solder bridge by reheating with solder wick and then resolder the pads correctly. A vacuum type solder sucker will also work.



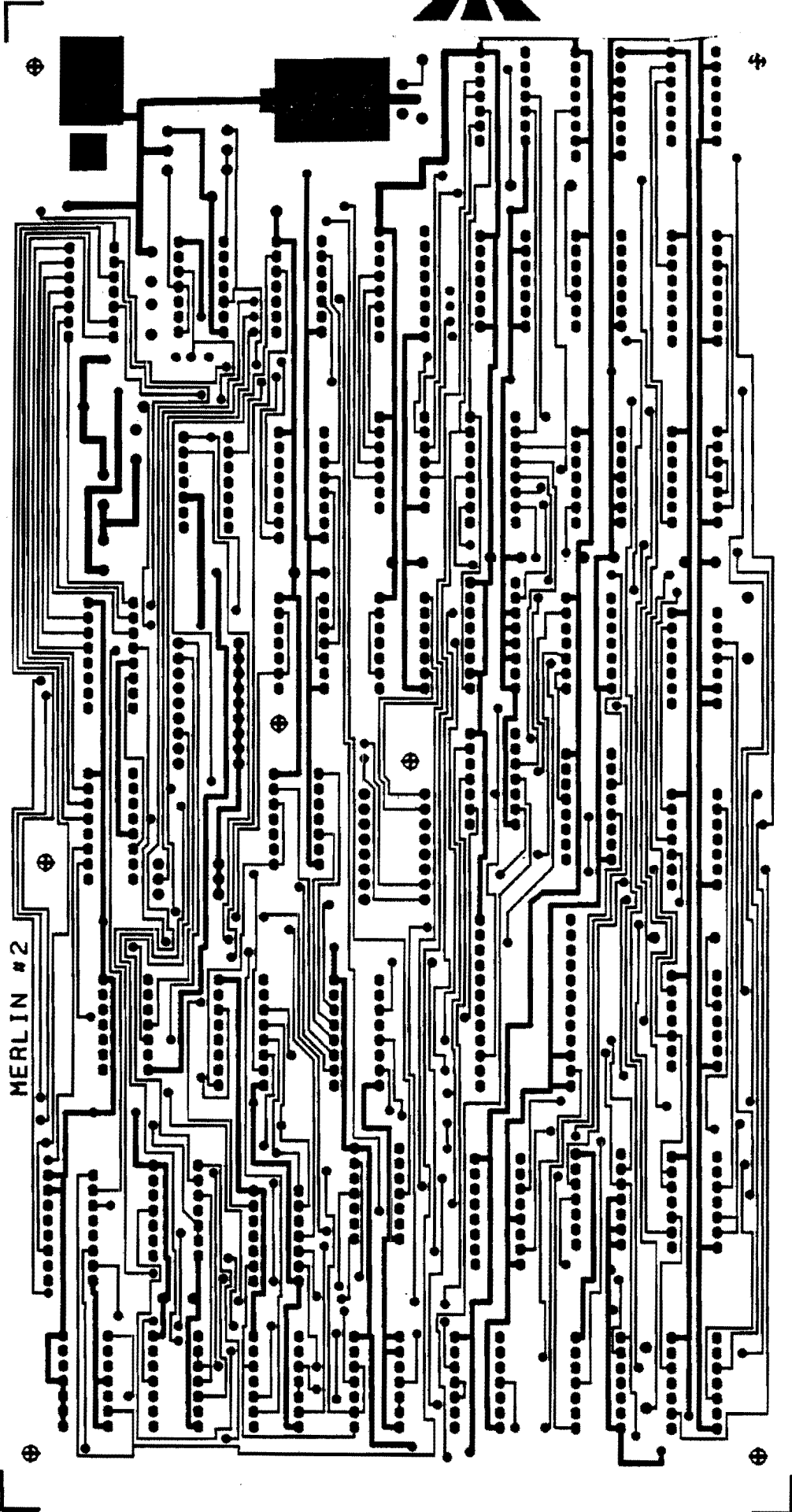


MiniTerm Associates, Inc.



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PC Layout, Board #1, solder side

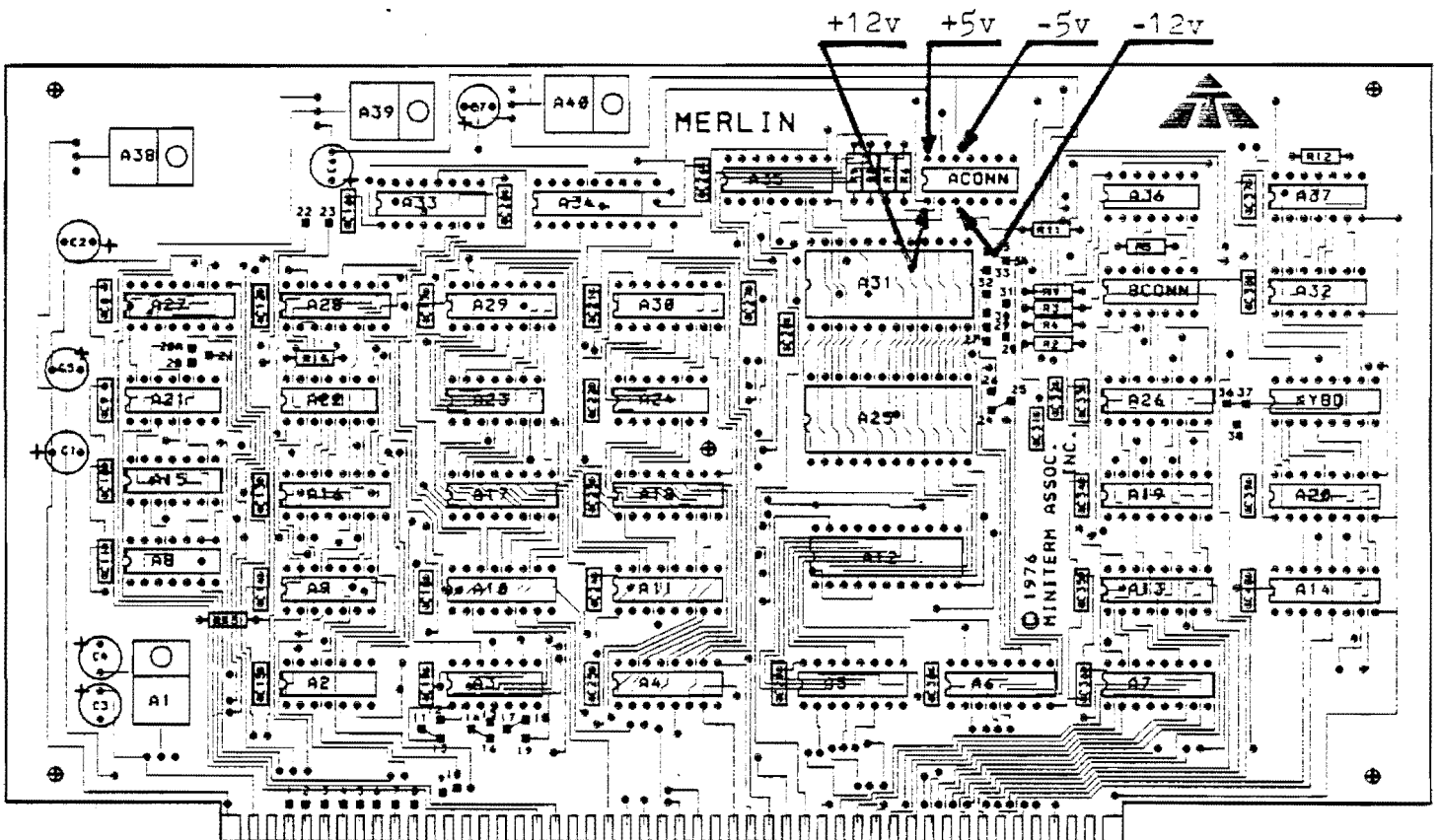


PC Layout, Board #2, solder side



POWER SUPPLY CHECKOUT

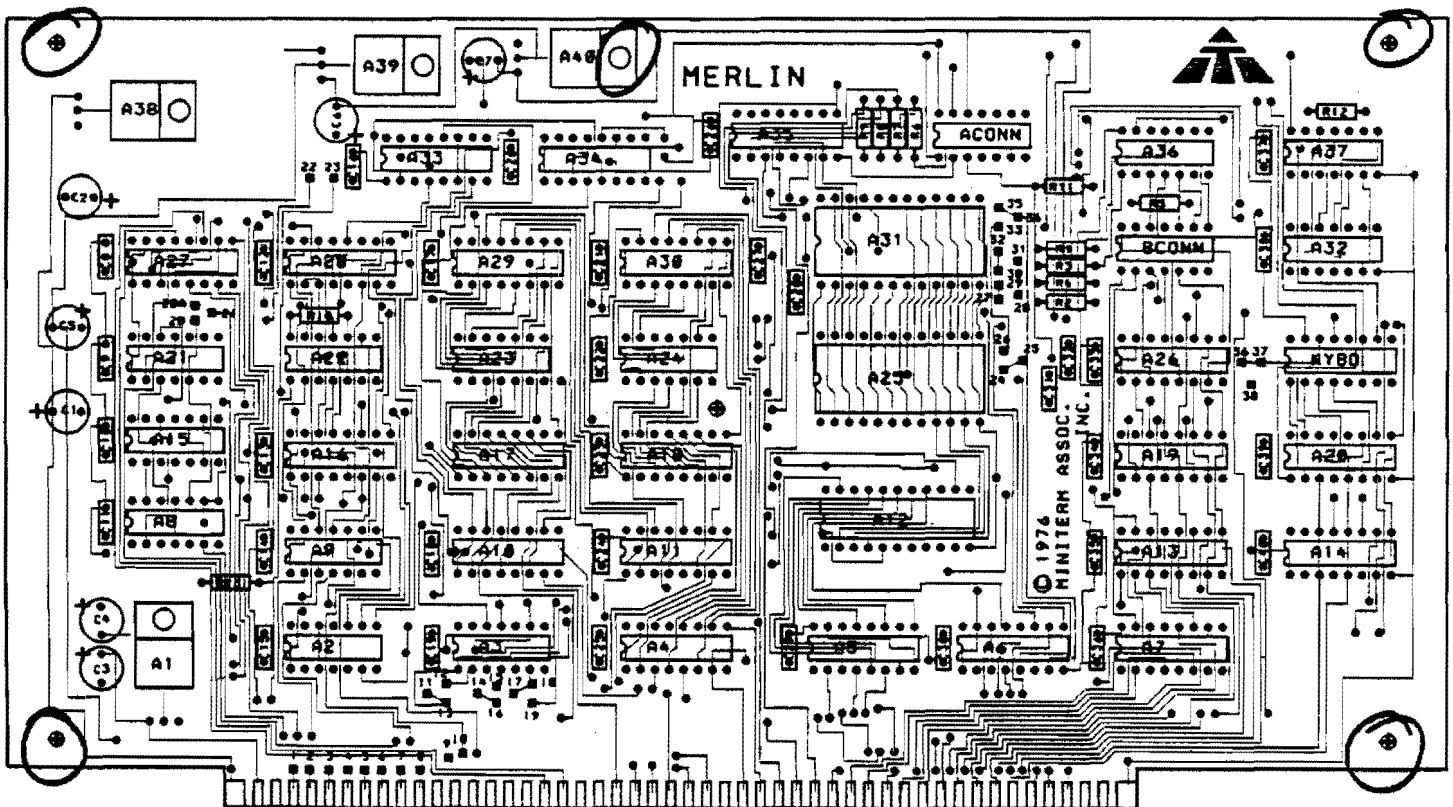
- () With the power shut off on your Altair, IMSAI, or other S100 bus computer, remove all circuit cards from the mother board and install MERLIN Board #1 only.
- () Turn the power on. None of the four voltages regulators should be hot or even warm. If they are, turn the power off and check to be sure that the correct regulator has been mounted in each position and that there are no solder bridges. None of the tantalum capacitors should get warm. If they do, the capacitor in question was probably mounted with reversed polarity or the wrong value capacitor has been mounted in that position.
- () Assuming that nothing has been heated up on MERLIN Board #1, you will now need a voltmeter to measure the four regulated supply voltages. Connect the common lead to the screw mounting the heatsink on MERLIN Board #1.
- () Using a straight pin to probe the ACONN socket, measure +5v on pin 14 and +12v on pin 1.
- () Measure -5v on pin 12 and -12v on pin 3 of the ACONN socket.
- () Do not continue beyond this point until all voltages check out correctly. If you have a problem be sure all voltage regulator input voltages (+8v, +18v, -18v) are being supplied by your computer. These voltages will vary but should measure at least +7v, +14v and -14v respectively.
- () Turn the power off and remove MERLIN Board #1.





MOUNTING MERLIN BOARDS #1 AND #2 TOGETHER

- () Locates five (5) sets of 4-40 hardware (bolt, nut, lock-washer) and five (5) 1/4 inch spacers from bag 2-3.
- () Place MERLIN Board #2 with the component side face down in front of you and with the coaxial cable leaving the board at the upper right hand side. On top of this board place Board #1 with the component side face-up as it appears in the assembly diagram below. This is how the two boards will be mounted together.
- () At each of the five positions as shown in the assembly diagram:
 1. Insert a 4-40 bolt through MERLIN Board #1.
 2. Place a spacer over the 4-40 bolt.
 3. Guide the bolt through the corresponding hole in MERLIN Board #2.
 4. Place a lockwasher over the bolt.
 5. Twist a nut on the bolt and loosely tighten.
- () When all five bolts have been installed tighten each one with a small screwdriver.
- () Locate the two 14-pin flat cables from bag 1-4 and connect them between Board #1 and Board #2 by plugging the cables into the Augat sockets shown in the assembly diagrams as ACONN and BCONN.

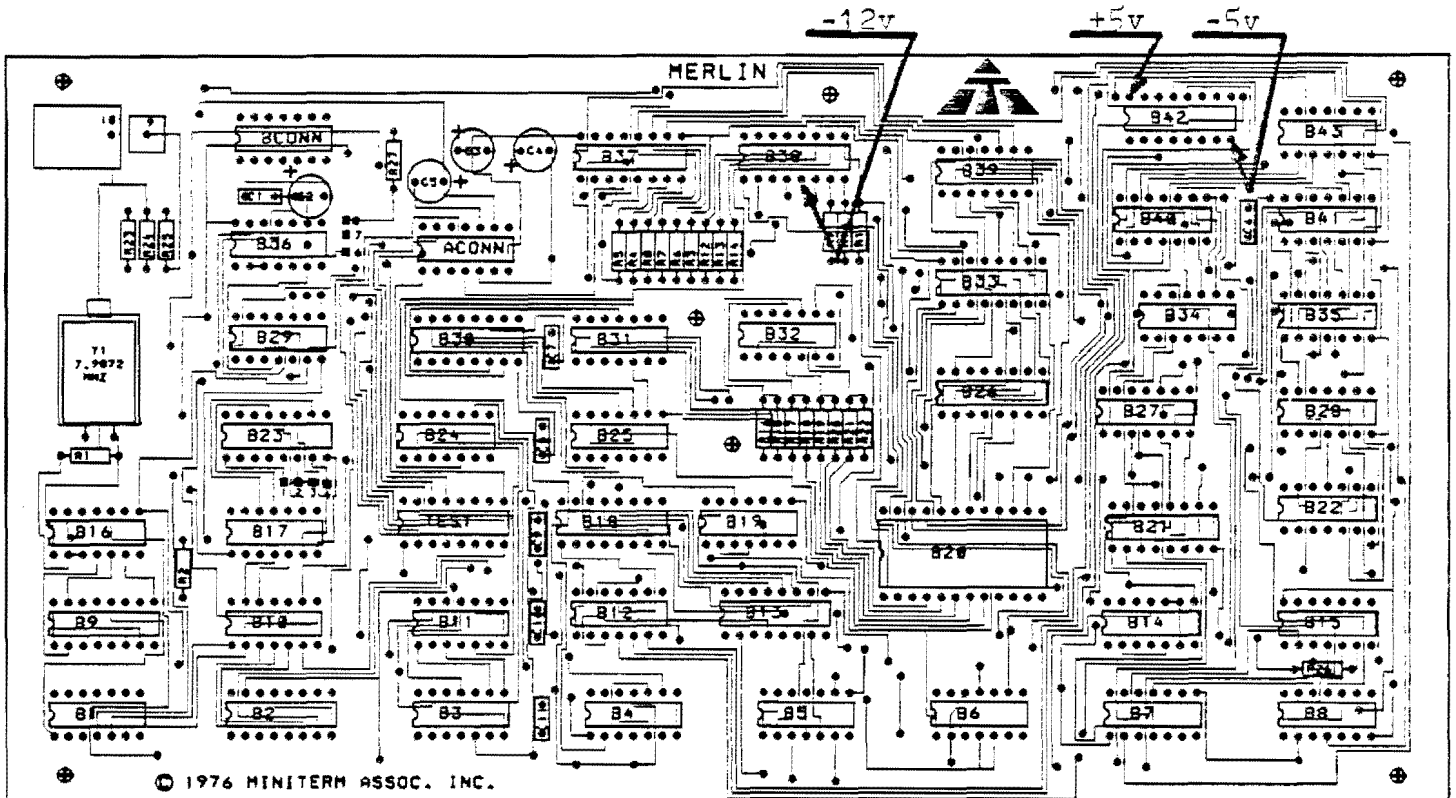




POWER SUPPLY CHECKOUT BOARD #2

- () With the power turned off, plug the two-board MERLIN assembly into the computer bus. Turn the power on and check that the regulators of Board #1 do not get warm. If they get warm, turn the computer power off and remove the cables connecting MERLIN Board #1 with MERLIN Board #2. Check the tantalum capacitors of Board #2 to see if any are warm. If they are, the polarity of the capacitor is probably wrong. With the cables off and the power turned back on, the regulators should again be cool and the voltages correct as measure at ACONN on Board #1. If there was no tantalum capacitor problem then suspect a short circuit on Board #2. Turn the power off, unmount the boards and check Board #2 for solder bridges, loose pieces of solder, etc.
- () Assuming that nothing has gotten warm and that the boards are properly connected with the flat cables, connect the common lead of a voltmeter to the mounting screw holding the heatsink to Board #1. Measure +5v at pin 16 of IC socket B42 on Board #2 as shown in the assembly diagram.
- () Measure -5v at pin 8 of IC socket B42 on Board #2.
- () Measure -12v at pin 5 of IC socket B38 on Board #2.

If any of the measurements are wrong, check for an open lead in the 14 pin flat cable connecting the ACONN connectors of Board #1 and Board #2. DO NOT CONTINUE UNTIL ALL VOLTAGES CHECK OUT CORRECTLY!



IC INSTALLATION (Bag 1-5, 2-5)*****WARNING*****

Approximately one-half of the ICs in this kit are static sensitive devices (SSDs). Those annoying little shocks we get when taking off a wool sweater or walking across a carpet and touching a metallic doorknob, can kill an SSD. Carefully follow the instructions in the next section on handling SSDs and you will have no problems.

Handling Static Sensitive Devices

All SSDs have been sent packaged in protective conductive foam. Do not remove any of these ICs from the foam until called for by the assembly procedure.

Do not wear clothing that will build up static charges. Avoid wool and synthetic fibers in preference for cotton.

Never set an SSD down except onto the black conductive foam provided. Make sure that you touch the foam with your free hand before you set the IC on the foam.

Preferably, work on a metal, wood or formica surface. Never work on a plastic surface.

To install an SSD type IC onto the PC board, first locate the IC on the conductive foam. Do not touch the IC but first touch the conductive foam while touching the PC board with your other hand. Remove the IC from the foam and install it into the correct location on the PC board.

Preparing and Inserting the ICs

With the exception of the one CMOS (SSD) device of board #1, all ICs of board #1 and board #2 have been packed in foam on an assembly diagram. The ICs are positioned on the assembly diagram exactly as they will be inserted on the boards. To install the ICs, transfer them from the assembly diagram on the foam to the corresponding locations on the boards. Preparing the IC pins will ease the job of installing the ICs in their sockets.

To Prepare an IC:

Grasp the IC by its ends between the thumb and forefingers with both hands.



With the pins facing out away from you, lower the IC to the table surface such that all of the bottom row of pins contact the table (for SSD ICs, be sure this surface is the surface that the black protective foam was resting on immediately prior to the IC's removal from the foam).

Roll the IC away from you slightly, causing the pins to bend inward toward the chip body. Bend the leads in this manner until they are perpendicular with the body of the IC.

Repeat this procedure for the other row of pins.

Use a pair of needlenose pliers to straighten any crooked pins.

Install the IC in its socket by first aligning all of its pins in the socket and then applying a gentle downward pressure. Do not use excessive force while installing the ICs. The result is usually bent pins.

INSPECT EACH IC AS YOU INSTALL IT. CHECK THAT ALL PINS HAVE BEEN INSERTED CORRECTLY AND THAT THERE ARE NO PINS BENT UNDER THE IC (unfortunately a common occurrence).

- () Locate MERLIN Board #1 ICs in bag 1-5.
- () Install all ICs into their sockets on board #1. IC A36 is packed with the board #2 ICs and will be installed later.
- () Locate MERLIN Board #2 ICs in bag 2-5.
- () Install all ICs into their sockets on board #2. The vertically positioned IC on the black protective foam is the one CMOS device that mounts on board #1.
- () Locate the vertically positioned IC on the black protective foam and install it at position A36 of board #1.

This completes the assembly of the MERLIN Video Interface.



MERLIN CHECK-OUT

At this point the MERLIN Video Interface is completely built and is ready for operational testing. During the testing procedure to follow, if at any point your MERLIN should fail a test, rethink what you are doing and repeat the test. Be sure that all ICs are properly seated in their sockets, that all cables are properly connected, and that your RAM memory board has not accidentally become write protected. Be sure to observe the operational restrictions while testing and using MERLIN.

Operational Restrictions

- * Always turn your computer off before removing or inserting MERLIN or any other board from or to the bus.
- * Never remove or connect the flat cables connecting the MERLIN boards with the computer power on.
- * Never run MERLIN with only one of the flat cables connected.
- * Always touch the computer frame before touching the MERLIN boards to remove any static charge from your body.
- * Never remove or insert ICs with the power on.
- * Never use an ohmmeter on the MERLIN boards when the ICs are in place.

Keyboard and MBI ROM

MERLIN has been designed as a software programmable display and is, therefore, dependent on software for control. In the most common usage of MERLIN, the MERLIN BASIC INTELLIGENCE (MBI) ROM will have been purchased to provide this software control. The MBI software has been programmed to accept command input from a modified ASCII keyboard via MERLIN's on-board keyboard port. Neither the MBI ROM nor keyboard input through the on-board port is required for operation of the MERLIN Video Interface. The keyboard and ROM are simply the most direct and easiest approach to a fully operational, intelligent keyboard/video I/O system. If you have purchased a MiniTerm keyboard and MBI ROM, do not plug them into the MERLIN board yet. For interfacing your own keyboard to MERLIN, see the keyboard section of this manual.



NOTE: The following tests of the MERLIN Video Interface call for the use of a front panel or some other means to load test programs into memory. If you have no such method to load memory, then you must have the MERLIN MBI ROM and the keyboard properly interfaced to MERLIN. Proceed on to the final section where the MBI ROM and keyboard are plugged in. If you have troubles then you are advised to debug them in a system with a front panel.

Video Output

In order to test MERLIN, a properly interfaced TV or monitor must be connected to the video output coaxial cable. The output of the MERLIN Video Interface is a DC coupled composite video signal with 100ohm output impedance. The white level is 2.0 volts, the black is 0.5 volts and the sync level is 0.0 volts, unterminated. This signal is suitable for direct coupling into standard video monitors such as the popular SANYO and Panasonic monitors. The MERLIN output is also capable of driving a standard unmodified TV directly through an interface at the video detector stage. One popular RF adaptor is available for \$8.50 from:

ATV Research
13-1 Broadway
Dakota City, Nebraska
68731

A good article written by Don Lancaster and appearing in BYTE magazine October '75 is very instructive for modifying a TV into a video monitor. In general, modifying a TV by going directly into the video stage produces a much sharper picture than going in through the RF route. Many computer retail stores now carry TVs and inexpensive kits to convert these TVs into video monitors.

NOTE: The rest of this testing section will use the term monitor to mean either a video monitor or a properly interfaced T.V.



MERLIN TESTING PROCEDURE

- () Remove all cards from your computer.
- () Connect the MERLIN video output coaxial cable to your monitor.
- () With your computer power off, plug MERLIN into the computer bus.
- () Turn your computer and monitor power on. A picture may or may not show on your screen. If a picture does show, it should be a stable picture. Adjust the horizontal and vertical hold controls of the monitor for a stable picture.

Check for Syncs

- () If you have a blank screen check for synchronizing signals. To check for vertical sync, adjust the vertical hold control until the picture rolls downward. As it rolls downward the vertical sync signal should appear as a narrow black bar across the screen. Readjust the V Hold control for a stable screen.
- () To view the horizontal sync signals, adjust the horizontal hold control until a black bar appears either on the right or left side of the screen. Some monitors or TVs will break up into a display of slanted black bars. That's fine. Those black bars are the horizontal sync pulses we're looking for. Readjust the H Hold control for a stable picture.

If you are unable to get a stable display and the sync signals are viewable with the H Hold and V Hold controls, check that you have not overly loaded down the video output. Don't be alarmed if you have a blank screen as long as you have sync signals. Since MERLIN is programmable, it is likely that the MERLIN has powered up programmed off.

<p><u>NOTE:</u> All data and addresses used in this section are in hexadecimal.</p>

Mode Register Test

The MERLIN mode register is an eight-bit, serially loaded register connected to the end of 16-bit, serially loaded scroll register. Therefore, to load the mode register a program to serially output 24 bits is required. The following test program outputs 32 bits serially to load both the mode register and the scroll register with the mode register value being read in from front panel sense switches at input port FF. The scroll register is loaded with the value 0100. This will be the address of the first displayed byte at the upper left side of the screen.

- () Turn the computer power off.
- () Plug at least 1k of memory into the computer bus at address 0000, and also the CPU and front panel.
- () Turn the computer on and load the following test program at location 0000.

Mode Register Test Program

<u>Address</u>	<u>Hex Code</u>	<u>Assembly Listing</u>
0000	00	NOP
0001	00	NOP
0002	00	NOP
0003	^{061 000 001} 31 00 01	LXI SP, 100 ; initialize the SP
0006	^{333 377} DB FF	IN FP ; read the front panel switches
0008	¹⁵⁷ 6F	MOV L,A
0009 ✓	^{315 023 000} CD 13 00	CALL S016
000C ✓	^{041 000 001} 21 00 01	LXI H,100 ; display start address
000F ✓	^{315 023 000} CD 13 00	CALL S016
0012 ✓	¹⁶⁶ 76	HLT
0013 ✓	^{006 020} 06 10	S016:MVI B, 16 ; initialize counter
0015 ✓	¹⁷⁴ 7C	MOV A, H
0016 ✓	^{062 000 330} 32 00 D8	STA OD800H ; address of register
0019 ✓	⁰⁵¹ 29	DAD H ; shift left one
001A ✓	⁰⁰⁵ 05	DRC B ; decrement counter
001B ✓	^{302 025 000} G2. 15 00	JNC S016 +2 ; test counter
001C	^{311 17} C9	RET



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- A0 240
20 040
09 011
11 021
- () Load the program from the front panel.
 - () Press "RESET".
 - () Load the display format into the "Programmed-Input" front panel switches - A0 is ASCII, Free Format; 20 is ASCII Fixed Format, 09 is dense graphics, 11 is sparse graphics.
 - () Then press "RUN"
- The computer will halt and the display should show either random characters (ASCII mode) or graphics.
- () Set the sense switches to a new setting.
 - () Press "RESET".
 - () You may continue setting the input switches and running the program by pressing "RESET" until you have exhausted your curiosity.

DMA Off Test

This test uses the mode register program of the previous section.

- () Set the input switches to A0 for ASCII mode and run the program. Notice that the hold light on your front panel is dimly lit.
- () Repeat with the switches set to 09 for Dense Graphics mode and notice that the hold light is brighter. The hold light indicates that a DMA is in progress in your computer.
- () Now repeat the test with the input switches set to 41 for MERLIN's DMA off mode. The hold light should extinguish and the display screen should go blank.

Scroll Register Test

The scroll register has already been partially tested since the mode register was serially loaded through the scroll register. This test will check the parallel output of the scroll register, the DMA address sequencer, and the bus address buffers. As in the last test, the front panel input switches will be used to input test data. This time, a fixed value of 20 will be loaded into the mode register, a value of 00 will be loaded into the most significant byte (MSB) of the scroll register, and the value of the input switches will be loaded into the least significant byte (LSB) of the scroll register. By incrementing the value



of the input switches, the information displayed on screen will be made to scroll. If the incrementing is by one, the characters on screen will move one position to the left. If the incrementing is done in multiples of 40 (28H, the number of characters per line), the display will scroll one line. Please note the address change on the second line.

Scroll Register Test Program

<u>Address</u>	<u>Hex Code</u>	<u>Assembly Listing</u>
0000	C3 20 00 ^{302 040}	JMP STRT
0020	31 00 01 ^{061 000 001}	STRT:LXI SP, 100
0023	21 20 00 ^{041 040 00}	LXI H, 20H
0026	CD 13 00 ^{315 023 000}	CALL S016
0029	DB FF ^{333 277}	IN FP
002B	6F ¹⁵⁷	MOV L, A
002C	CD 13 00 ^{315 023 000}	CALL S016
002F	76 ¹⁶⁶	HLT

This program uses the S016 subroutine of the Mode Register Test Program which must be loaded first.

- () Load the program from the front panel.
- () Press "RESET".
- () Set the front panel input switches to all zeros.
- () Press "RUN".

The computer will load the mode register with 20 (ASCII, fixed, i.e. 40 characters per line) and the scroll register with 0000.

- () Load 28 into the input switches.
- () Press "RESET".
- () The data will move up one line.
- () Load 29 into the input switches
- () Press "RESET".

The data will move left one character.



The data moves by whatever offset is loaded into the input switches. Increment by one and the data moves left one, decrement by one and the data moves right one; increment or decrement by 28 (40_{10}) and the data scrolls up or down a line.

Free Format Test

In the last test, you were able to scroll one line at a time by incrementing the scroll register by the number of characters in a line, 40. In this test, the length of lines are variable. Each line is terminated by a carriage return and may be as short as one character or as long as 40.

- () Change the contents of address location 0023 from 20 to A8 (modify the scroll register test program in computer memory). This will set the mode register for free format and also cause carriage returns to display as white boxes.
- () Load the following data into the computer memory (at the scroll address so that it will appear on screen).

```
0080 41; ASCII letter "A"
0081 41
0082 41
0083 41
0084 41
0085 41
0086 41
0087 41
0088 41
0089 41
008A 41
008B 0D; ASCII carriage return
008C 42; ASCII letter "B"
008D 0D; ASCII carriage return
008E 0D
008F 0D
```

- () Set the input switches (not the data switches) to 80.
- () Press "RESET".
- () Press "RUN".

The first four lines of the display should appear as in the diagram below:

```
AAAAAAAAAAAA■
B■
■
■
```



If you have problems, check that the program and data have been entered correctly.

- () Press "STOP" and modify the contents of address from 41 to 0D.
- () Reset input switches to 80, then press "RESET" and "RUN". Your display should show:

```
AAAAA ■
AAAAA ■
B ■
■
```

Notice that in this example, five lines of text in free format mode use up only 16 bytes of memory instead of the $40 \times 5 = 200$ bytes in fixed format mode.

Notice also that you need to increment the scroll register by only 6 (set sense switches to 86 and "RESET") to scroll to the next line.

Display Area Signal Test

The display area signal is a precise crystal controlled 60 HZ signal that is available to the CPU from the MERLIN Status Port on bit 1. It is useful for timing functions and implementing clock programs. The following program tests this signal by counting down from it to produce a 1 HZ output. The program will flash the interrupt enable light of your front panel at 1 HZ rate.

"Display Area Signal" Test Program

<u>Address</u>	<u>Hex Code</u>	<u>Assembly Listing</u>
0040	31 00 01	LXI SP, 0010H; initialize stack
0043	06 1E	S1:MVI B, 1E; initialize counter to 30 ₁₀
0045	CD 5A 00	S2:CALL SYNC
0048	05	DCR B; decrement counter
0049	C2 45 00	JNZ SZ; test counter*
004C	F3	DI; disable interrupts
004D	06 1E	MVI B, 1E
004F	CD 5A 00	S3:CALL SYNC
0052	05	DCR B
0053	C2 4F 00	JNZ S3



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<u>Address</u>	<u>Hex Code</u>	<u>Assembly Listing</u>
0056	FB	EI; enable interrupts
0057	C3 43 00	JMP SI; repeat
005A	3A 03 D8	SYNC:LDA OD803H; read status port
005D	E6 02	ANI 2; mask b1
005F	C2 5A 00	JNZ SYNC; wait for "zero"
0062	3A 03 D8	SYI:LDA OD803H
0065	E6 02	ANI 2
0067	CA 62 00	JZ SYI; wait for "one"
006A	C9	RET

If you would like to try writing a program of your own, an interesting program would be to combine the 1 HZ output program with either the mode register or scroll register test program. This can lead to some very interesting displays including diagonal scrolling. Hint: Increment or decrement the scroll register by 29 or 41 with the mode set to fixed format. Another interesting combination is to increment the scroll register by one in either the fixed or free format mode. Also try changing the scrolling speed. This program has been included in the software section for those of you who want to see it work immediately.

MBI ROM/RAM Test

This test will be performed only if you have ordered the optional MBI ROM/RAM Monitor/Editor software package. A full listing of the MBI ROM will be found in this manual.

- () Turn the computer power off.
- () Remove the MERLIN board assembly and place it such that Board #1 is face-up with the gold fingers closest to you.

Warning: The MBI ROM and RAM can be destroyed by static discharges.

- () Remove the MBI ROM from its protective foam and insert it into position A25 taking all precautions for static sensitive devices (SSDs) as mentioned in the IC Installation part of the assembly procedure. Install the ROM such that the pin 1 indication is on the left-hand side of the chip.
- () Install MERLIN back into the computer bus with the power off.



- () With the front panel, examine memory location C000.
- () With the examine next function, compare the first few bytes at C000 with the MBI ROM code listed below:

```

C000 3E
C001 FF
C002 32
C003 3F
C004 D0
C005 3E
C006 C3

```

Any discrepancy probably indicates a bad address or data buffer. Determine and correct the cause of any problems.

- () Turn the computer off and remove the MERLIN assembly.
- () Placing the board in front of you as before, remove the 256 x 8 RAM from its protective foam and install it into the 22-pin socket at position A12. Follow the precautions for handling SSDs when doing this.
- () Install MERLIN back into the computer bus with the power off.
- () With the front panel, examine memory location D000.
- () Use the deposit function of the front panel to write into the MBI RAM to test its operation.
- () Enter the simple loop program below as a further test of this RAM. The program will turn the interrupt light on and off with the position of the b7 sense switch.

<u>Address</u>	<u>Hex Code</u>	<u>Assembly Listing</u>
D000	DB FF ³³³ ³⁷⁷	SI,IN FF; read input switches
D002	B7 ²⁶⁷	ORA A; set flags
D003	³⁷² ⁰¹² ³¹⁰ FA OA DO	JM S2; test b7
D006	F3 ³⁴³	DI; disable interrupts
D007	³⁴³ ⁰⁰⁰ ³¹⁰ C3 00 DO	JMP S1; loop
D00A	FB ³⁷³	S2,EI; enable interrupts
D00B	³⁴³ ⁰⁰⁰ ³¹⁰ C3 00 DO	JMP S1; loop

- () "EXAMINE" address D000.
- () Press "RUN".



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Keyboard Test

- () With the power off, plug a properly interfaced keyboard into the KYBD and I/O 16-pin socket of the MERLIN Board #1. Be sure to orient the connector correctly!
- () Turn the computer on and run one of the previous test programs to ensure that MERLIN is functioning with the keyboard connected.

ASCII Code Testing

- () With the front panel, examine memory location D802. This is the keyboard input port and will cause the keyboard output to appear on the computer data bus.
- () Exercise the keys of your keyboard while checking the code presented on the data bus against the ASCII codes listed in the keyboard interface section. Remember that the code on the data bus will be inverted from the true ASCII code.

Edit Key Test

- () Exercise the edit key along with a character key. The front panel data bit 7 LED should extinguish.

Data Ready Test

This data ready test will test the functioning of the data ready flip flop on MERLIN Board #1.

- () Examine address D803. This is the MERLIN status port. Data bit 0 on the computer front panel should indicate a high level.
- () Press a number or letter key on your keyboard. Data bit 0 should now indicate a low level. Release the key. The data bit 0 should still indicate a low level.
- () Examine address D802 and then examine D803. Data bit 0 should now be set to a high level again. Examining the keyboard port of D802 simulates reading the keyboard port which is wired to reset the data ready flip flop.

Keyboard Strobe Timing Test

- () Restore address locations 0000, 0001, and 0002 to 00 (NOPs). This will cause the mode register program to run on "RESET" and initialize the scroll address to 0100.
- () Press "RESET".
- () Set the sense switches to 28 (Fixed format, ASCII).
- () Press "RUN".

- () Enter the following program at 0030. This program cycles on a test of the status port waiting for a data ready signal which indicates that a key has been pressed on the keyboard. The program then reads the keyboard port and outputs it to the display, starting at location 0100. It returns to looping on the status port waiting for the next keyboard data, after incrementing a memory pointer. The memory pointer indicates the address at which the data is stored.

Keyboard Strobe Test Program

<u>Address</u>	<u>Hex Code</u>	<u>Assembly Listing</u>
0030	21 00 01	LXI H, 100; initialize memory pointer
0033	3A 03 D8	SI:LDA STATUS; read status port
0036	0F	RRC; shift data ready into carry
0037	DA 33 00	JC SI; cycle until data ready
003A	3A 02 D8	LDA KYB; read KYB port
003D	2F	CMA; compliment data
003E	77	MOV M, A; store data on screen
003F	23	INX H; increment memory pointer
0040	C3 33 00	JMP SI; get next character

The data ready strobe timing of your keyboard is correct if the character that you key-in shows on the screen once only for each time you press the key. If the character shows twice, or once followed by a null (inverted @), or if the wrong data shows, then the strobe signal from your keyboard is most likely at fault.



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Keyboard and MBI Test

When your MERLIN and keyboard pass this test, then it is time to start exploring the MBI software.

- () Load C000 into the address switches.
- () Press "EXAMINE".
- () Press "RUN".

Your display should now be clear except for a "\ " and winking cursor (white box) at the upper left-hand corner of the display. This completes the check-out of MERLIN. You may now replace the rest of your cards into your system. When doing this, be sure that the power is off and that no boards are addressed in MERLIN's memory space (C000-DEFF). Add one board at a time and then test MERLIN.

If you have not read the software section of the Manual you should do so at this time.