SDK-51
MCS-51™ SYSTEM DESIGN KIT
ASSEMBLY MANUAL

Manual Order No: 121589-001

intel®

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PREFACE

This manual provides a simple step-by-step procedure for assembling your SDK-51 kit. Information on how to operate the kit is provided in the *SDK-51 MCS-51™ System Design Kit User's Guide,* Manual Order No. 121588.

SERVICE ASSISTANCE

If, following assembly, you cannot get your kit to operate correctly, the Intel Technical Support Center "Service Hotline" is available for assistance. This service is provided during the hours of 8AM to 5PM (Mountain Time), Monday through Friday. The toll-free Hotline telephone numbers are:

All U.S. locations except Alaska, Arizona, and Hawaii:
(800) 528-0595

All other locations:
(602) 869-4600

TWX Number:
910 - 951-1330

The Hotline is intended expressly to help you get your kit running and is not intended to assist you in circuit designs or applications. Telephone assistance is limited to one call per problem. If a problem cannot be remedied over the telephone, you may, at your discretion, return your assembled kit to Intel for repair. To return your kit, a Return Authorization Number must be obtained from the Technical Support Center prior to sending in your kit. Also, either a purchase order for the repairs must be furnished to the center or a money order (no personal checks please) must be included with the kit being returned. Repairs resulting from defective components supplied with your kit will be done at no charge, and all prepayments will be refunded. Repairs necessitated as a result of customer error, damage or misuse will be billed at a fixed, flat-rate charge which will be quoted by the Technical Support Center.

NOTE

The Technical Support Center will not repair an SDK-51 Kit that has been modified and, when circuitry has been added to the user design area, may request that the circuitry be disconnected prior to submitting the kit to the center for repair.

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FIGURES

CHAPTER 1
GETTING STARTED

BEFORE STARTING

All of the parts for your MCS-51 System Design Kit (SDK-51) are included in a skin-wrapped package. Do not open the package yet! Do a little reading first. You may save yourself time and expense.

CAUTION

Static electricity can permanently damage the metal-oxide semiconductor (MOS) integrated circuits included in your kit. Do not remove an integrated circuit from its protective foam backing until you have read the precautions concerning integrated circuit handling and until you have been instructed to do so.

This chapter reviews the basic techniques of board assembly required to put together your SDK-51 kit, beginning with suggestions for laying out an efficient work area. The chapter includes a check list of required and optional tools and equipment. Assembly techniques include parts orientation, lead bending, soldering techniques, and removing parts. Safety precautions are emphasized where appropriate.

Subsequent chapters contain the complete parts list for the kit, and the step-by-step assembly procedures.

If you're an experienced kit builder, you already know that it's a good idea to read through this manual before starting your project. As you assemble your kit, take your time, don't rush, and be sure to check each part you install before soldering it in place. Read this manual carefully and follow the assembly instructions faithfully, and you will greatly reduce your chances for mistakes.

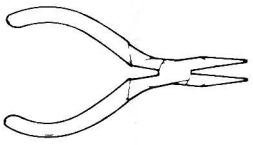
GETTING ORGANIZED

Before starting to assemble the kit, organize your work space. The workspace should have enough room for the assembly manual (lying open), the circuit boards, the parts and components to be installed, the required tools, and a soldering pencil. To sort and store the small parts, use plastic compartmented parts boxes, a muffin pan, an egg carton, or small boxes or jars. It also might prove helpful to write the part values on small cards as you identify each part and place the card with the part for quick identification.

REQUIRED AND OPTIONAL TOOLS

Here is a checklist of tools and materials to be used in assembling the kit. Most of the tools are required; optional equipment is identified as such in the text. None of the equipment in this list is furnished with the kit (see Chapter 2 for a checklist of parts and material furnished in the kit).

- ☐ Needle-nose pliers



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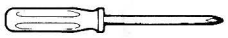
- ☐ Small Phillips screwdriver



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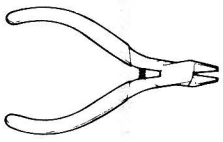
- ☐ Small diagonal wire cutters



0054

- ☐ Soldering pencil. Not more than 30 watts with an extra-small diameter tip (1/16 inch).

0055

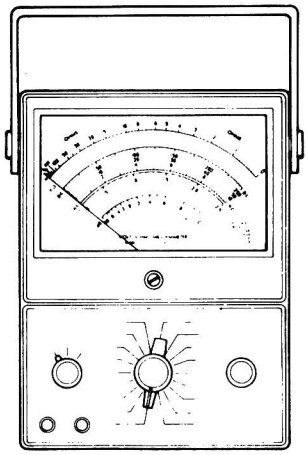
- ☐ Rosin-core solder. 60-40 (60% tin, 40% lead), small diameter (0.05 inch, equivalent to AWG 22 wire, or less).

0056

NOTE

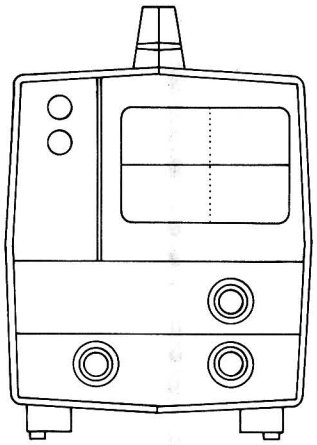
Soldering paste or flux is not needed. The solder contains a sufficient amount of flux.

- ☐ Volt-Ohm-Milliammeter with 1 megohm input impedance.



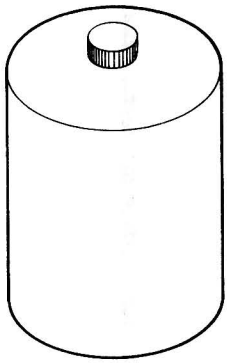
0057

- ☐ Oscilloscope. Vertical sensitivity 1 volt/division, sweep rate up to 200 microseconds/division, and triggered sweep with internal triggering. (The manual includes checkout procedures at key points in the assembly process, so that any faults can be isolated within the functional areas being tested; the oscilloscope is required for these intermediate checks. However, the SDK-51 kit can be assembled and operated without checking these sections.)



0058

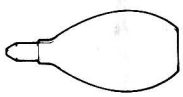
- ☐ Solder Flux Solvent. Any standard flux solvent may be used. Some solvents provide a brush to apply the solvent to the solder joints, others are supplied in aerosol cans. A stiff brush is required in either case to clean thoroughly.



0135

If you make an error and must remove a soldered part from the circuit board, the following items are required:

- ☐ Desoldering device, either the bulb type (shown) or the pump type.



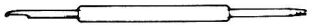
0059

- ☐ Length of copper braid ("solder wick") to draw solder out of a hole or to remove a solder bridge between circuits.

0060

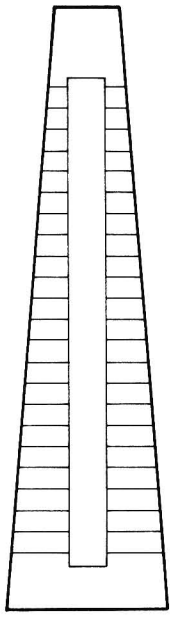
The following items are optional:

- ☐ Soldering aid with a small-tipped fork at one end and a reamer at the other. This tool will help to maneuver leads into holes and to manipulate small parts.



0061

- ☐ Lead bending jig. This device helps you obtain the proper spacing for the leads of devices such as resistors, capacitors and diodes.



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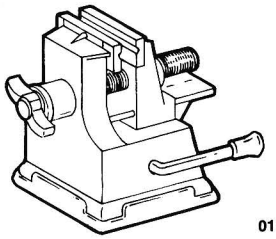
- ☐ Small vise or printed circuit board holder to give you a "third hand" during some operations.



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BASIC ASSEMBLY TECHNIQUES

Read the following sections on basic assembly techniques before assembling your kit.

CIRCUIT BOARD LAYOUT

Pick up the circuit board; one side has been silkscreened with component reference designations and position outlines, major circuit areas and other information. This side of the board will be referred to as the *top* or *component side.* The other side, (*bottom* or *solder side*) has reference designators to help you locate the parts to solder, but no component outlines or other labels. In general, insert the parts in the board from the top (over their outlines), then turn the board over and solder the parts from the bottom.

PARTS ORIENTATION

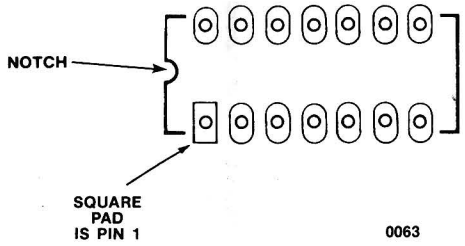
A number of the parts in your kit are polarized, that is, they must be installed in a certain direction. Polarized parts include the following:

- ■ Integrated Circuits
- ■ Diodes
- ■ Resistor Packs
- ■ Transistor Packs
- ■ Transistors
- ■ Tantalum Capacitors

INTEGRATED CIRCUITS

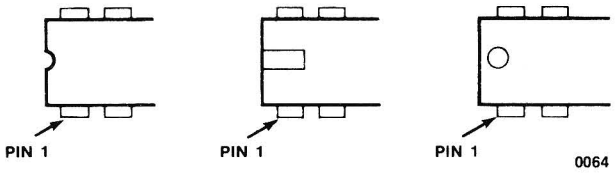
When installing an integrated circuit (abbreviated IC), align pin 1 of the IC with pad 1 of the circuit board location.

The silkscreened integrated circuit outlines on the top of the board indicate the location of pin 1 in two ways. First, the outline of the component has a notch on the end nearest pin 1; pin 1 is the pin to the left of the notch when the IC is viewed with the notch pointing upward. Second, the pad that receives pin 1 on the board is square rather than round.

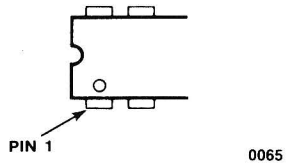


0063

Integrated circuits are manufactured with a notch in the end nearest pin 1. Depending on the manufacturer of the integrated circuit, the notch will look like one of the following:



Some manufacturers mark pin 1 with a small dot, dimple or bump.



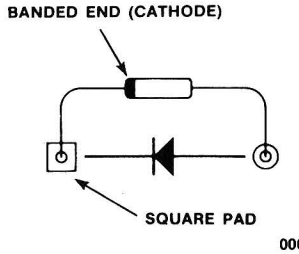
Whether or not pin 1 is marked, it is always in the same position with respect to the notch. Viewed from the top side of the component, with the notched end upward, pin 1 is the highest pin in the row to the left of the notch.

CAUTION

Be very careful to install integrated circuits correctly. The process of removing an integrated circuit typically destroys the component.

DIODES

Diodes are polarized and must be installed in the proper direction. Looking at one of the diodes, one end has a band to identify the cathode. The circuit board pad for the cathode is square. Also, the part location line silkscreened on the board includes the diode logic symbol. The banded end of the diode goes to the square pad in the direction of the arrowhead.



Light-emitting diodes (LEDs) have a flat edge on the cathode side. Install the LED so that the flat edge is toward the square pad.

RESISTOR PACKS

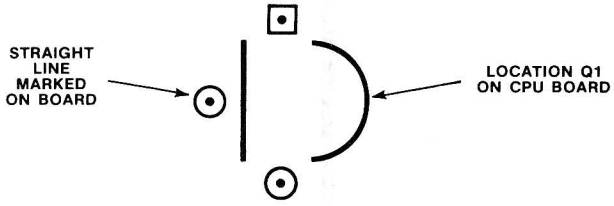
The kit includes single in-line resistor packs. Like integrated circuits, these devices must be oriented in a specific direction when they are installed in the circuit board. Depending on the manufacturer, a dot or the number "1" indicates pin 1 of the single in-line resistor packs. A square pad on the circuit board indicates pin 1 for these components.

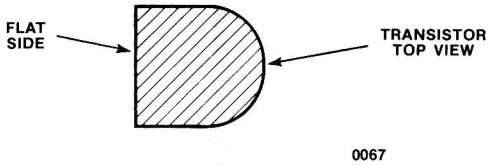
TRANSISTOR PACKS

Transistor packs are notched and marked like integrated circuits to show the location of pin 1. The board has a notched silkscreen for orientation, and a square pad indicating pin 1 for these components.

TRANSISTORS

The transistor in the kit is packaged in a cylindrical container with one side flattened to assist in orientation. Align the flat side on the transistor with the straight line on the board artwork.





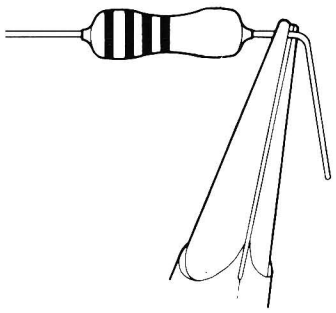
TANTALUM CAPACITORS

Tantalum capacitors are marked with a plus (+) sign to indicate their polarity. On the board, the positive terminal is marked with a correponding plus (+) and has a square pad.

LEAD BENDING

The leads of resistors, diodes, capacitors and crystals must be bent in order to insert the part into the circuit board. If you do not use a lead-bending jig, the correct way to bend a lead is to grip the lead with

the needle-nose pliers near the end of the component. Then, using the pliers to hold the lead (like a vise), bend the free end of the lead with your hand.



0068

CAUTION

Never bend a lead with the pliers; the stress can fracture the part.

Bend the leads so that when the part is inserted on the board, it is centered between the two pads. Also, when bending the leads of parts with values printed on them, bend the leads so that the value is visible when the part is installed.

Note that the boards typically use a 0.4 inch spacing for axial lead capacitors and diodes, and a 0.5 inch spacing for 1/4 Watt resistors.

The lead bending jig, listed as an optional tool at the beginning of this assembly manual, provides a convenient method of bending leads. This tool assures that the leads are spaced correctly and that the part is centered between the pads; it also prevents damage to components from lead bending stress.

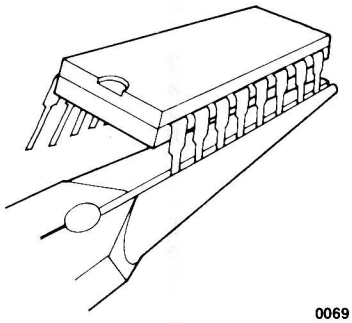
INSERTING PARTS

When inserting a part in the circuit board, check the following:

1. Check that you have the correct part.
2. Check that you are inserting it in the correct location.
3. If the part has a specified orientation, check that it is being inserted in the proper direction.

On the top (component) side of the circuit boards, the position and reference designator for each part is labeled on the board. For small (two-lead) parts, a line is silkscreened between its two associated pads. For larger (multi-pin) parts, the part outline and (for most integrated circuits) the integrated circuit part number is silkscreened on the board.

Before inserting an integrated circuit, socket, or resistor pack, check that all of the pins are straight. If necessary, straighten any bent pins with needle-nose pliers. Occasionally, the pins of an integrated circuit may be spread too far apart to be inserted easily into the board. If this happens, carefully grip the pins on one side, in mass, with needle-nose pliers and gently bend the pins inward. As an alternative, press the pins against the table top to bend them all inward slightly at the same time.



0069

If the integrated circuit still does not fit, bend the pins inward on the other side. After inserting an integrated circuit or resistor pack, carefully check again that:

1. The correct part has been inserted.
2. The part is facing the right direction.
3. There are no bent pins (all pins must be visible from the bottom of the board).

After checking these conditions, carefully solder the part in place.

NOTE

Although resistors can be inserted in either direction, it is good practice to insert all color-coded resistors so that the color bands are always read from the same direction (for instance, top-to-bottom or left-to-right). The resistor color coding scheme is discussed in Chapter 2.

HANDLING MOS INTEGRATED CIRCUITS

IMPORTANT

MOS integrated circuits are easily damaged by static electricity. When installing any of the large MOS integrated circuits, always observe the following

precautions before you remove the skin-wrap and pick up the circuit:

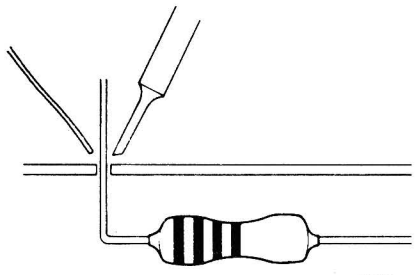
1. Touch the foam backing. Simply put your fingers on any exposed foam area.
2. Rub your fingers across the pads where you are going to insert the integrated circuit. If the circuit is to be inserted into a socket, touch the socket pins on the bottom of the board.
3. Avoid touching the pins of the integrated circuit as much as possible.
4. Avoid getting up and walking around (which could build up a static charge on your body) until you have finished installing the integrated circuit in the board or inserting it in its socket.

BASIC SOLDERING TECHNIQUES

The proper soldering pencil and solder are essential to good soldering. The soldering pencil (not soldering "iron" or soldering "gun") must be rated at no more than 30 watts, the tip must be small (1/16 inch or less), and small-diameter (0.05 inch) 60-40 solder must be used.

In addition to the right soldering equipment, proper care for the tip of the pencil is important. When soldering, the tip must be kept clean. If your pencil holder does not include a sponge and basin, dampen an old sponge with water and keep it on a plate or ashtray near the holder. When residue or excess solder builds up on the tip, draw the tip over the sponge a few times. When clean, "tin" the tip by melting a small amount of solder directly on the tip. A clean and properly tinned tip is very shiny. As a rough guide, clean the tip every eight to ten connections.

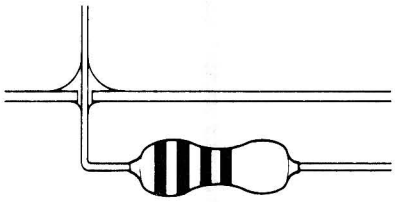
To solder a part, place the tip of the pencil on the pad and against the lead at the same time (this causes both the pad and lead to be heated evenly).



0070

Apply solder from the side opposite the tip, as shown in the illustration. Allow the solder to melt against the lead and pad, then remove both the solder and tip. Only a small amount of solder is needed for a good bond between the lead and pad.

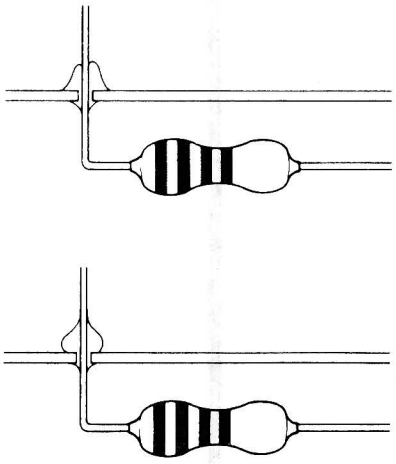
The following illustrations show a cross-section view of good and bad solder bonds or "joints." A good solder joint will be bright (shiny) and the solder around the lead and pad (referred to as the "fillet") will be distributed evenly. The shape of the fillet will range from being slightly concave to being slightly convex, and a small amount of solder usually will be drawn down through the hole and will be visible on the lead on the other side of the circuit board.



GOOD SOLDER JOINT

0071

The bad soldering joints shown are typical of "cold" solder joints and usually are caused by not heating both the pad and lead uniformly or by allowing the solder to melt directly on the tip before the lead and pad have been heated properly. Generally, a cold solder joint is dull gray in color and the bond at either the lead or pad will recede slightly.



BAD SOLDER JOINTS

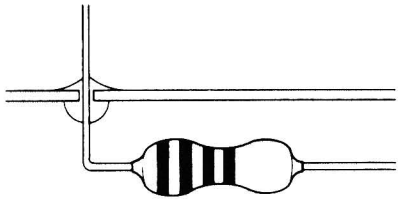
0072

To correct a cold solder joint, reheat the lead and pad until the solder flows into the joint. You may need to add a little more solder after the joint is properly heated.

CAUTION

It is essential that your soldering pencil has the correct wattage and tip size. Too much (or prolonged) heat can damage a part internally. When soldering, if the fillet

between the pad and lead tends to "flatten out" and if an a large bead of solder forms on the other side of the circuit board where the lead enters the hole, excessive heat may be indicated.



EXCESSIVE HEAT

0073

SOLDERING PARTS

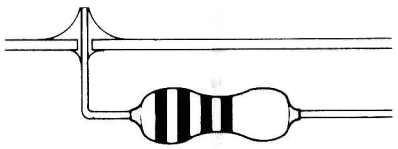
After a part or group of parts is inserted within an area, the board is turned over and the parts are soldered in place. To prevent parts from slipping or falling out when turning the board over, a piece of foam (about 1 foot square) can be placed over the parts to hold them in place or, if desired, parts can be taped down on the board with masking tape or the equivalent.

Small components (particularly the tiny capacitors) can be "tack" soldered on the top of the board; apply just enough solder to form a bond between one of the leads and its pad. Once tacked in place, the board can be turned over, and the leads can be soldered. When soldering from the bottom, be sure to solder the "untacked" lead first. Notice that even though the rubber "feet" raise the board above the work surface, the leads of many of the small parts that can be tack soldered still may be too long. When this is the case, the leads can be clipped to about 3/4 of an inch before the part is inserted.

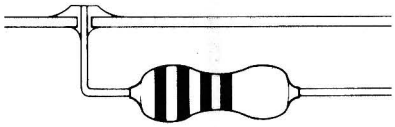
When soldering any of the multi-pin parts, first solder the pins at two diagonally opposite corners and then check to be sure that the part is all the way down on the board. If the part has slipped and is not down completely, remelt both solder joints while lightly pressing down on the component. Solder the remaining pins and then resolder the first two pins.

CLIPPING LEADS

After soldering, the leads of most of the small parts must be clipped using diagonal wire cutters. Care should be taken to avoid clipping the solder fillet (which could possibly "fracture" the solder joint). When properly soldered and clipped, a lead should extend from 1/16 to 1/8 of an inch above the board. The following examples picture correct and improper lead clipping.



CORRECT



IMPROPER

0074

Integrated circuit pins should not be clipped (the shock from clipping can cause an internal fracture).

WARNING

To avoid eye injury when clipping leads, hold the lead end so it can't fly into your face. If the lead is too short to hold while clipping, hold your hand over the lead to shield your eyes. *It is strongly recommended that you wear safety glasses or goggles while soldering and clipping leads.*

CLEANING SOLDER JOINTS

When you have completed all the required soldering, it is recommended that you clean the flux residue from all the solder joints. Flux has an acidity that eats into the solder and can eventually cause a poor connection. To clean the solder joints, use a standard flux solvent. Directions for cleaning are given with the solvent.

REMOVING PARTS

Although the assembly instructions have been prepared carefully, the possibility of error always exists. If you should happen to install a part incorrectly, it must be removed. Depending on the part itself, it either can be removed and reused or it should be cut out and replaced.

Small (two-lead) parts usually can be removed successfully from the board with little danger of damage, provided that the proper tools are used and care is taken. To remove a small part, find its leads on the bottom of the board. With your soldering pencil in one hand and the desoldering device in the other, heat one of the joints. When the solder melts, quickly move the pencil out of the way and remove the solder from the joint with the desoldering device. If done successfully, the hole in the pad will be visible.

If solder still remains in the hole, first add additional solder to the joint before repeating the operation (the additional solder helps to melt the remaining solder). After the solder has been removed from both joints, grasp each lead with your needle-nose pliers (from the bottom of the board) and wiggle the lead back and forth in order to break it loose from the hole. When both leads are free, remove the part. If a lead will not break free from its hole, resolder the lead and repeat the solder extraction operation.

While it is possible to remove an integrated circuit from the board without damaging the part, this practice is not recommended as the possibility of board damage (lifted pads or traces) is extremely high. When an integrated circuit must be removed, it is recommended that the circuit be clipped out and the pins then be desoldered individually. To remove an integrated circuit, follow the steps outlined below.

1. Using your diagonal wire cutters and working from the top of the board, carefully clip each lead of the integrated circuit near where the pin enters the case. Leave enough lead in the board to be grasped with the pliers.
2. While still working from the top of the board, carefully remove each individual lead using your soldering pencil and needle-nose pliers.
3. With your soldering pencil and solder, fill each hole with additional solder. (This will make it easier to remove all of the solder from the hole.)
4. Remove the solder from each hole using a desoldering device or solder wick. If solder still remains in the hole, add more solder and repeat this step.
5. Install the correct replacement integrated circuit and make sure that pin 1 is oriented correctly.
6. Turn the board over and, checking first to be sure that all of the pins are visible, solder the circuit in place.

CHAPTER 2
UNPACKING AND SORTING PARTS

The MCS-51 System Design Kit is shipped in a skin-wrapped, low-profile package that includes a conductive foam backing under the top template to protect the MOS integrated circuits from static charges. Do not remove an integrated circuit from the foam backing until you have read the precautions in Chapter 1 and until you have been instructed to do so.

The checklists in this chapter identify the parts and components in the kit, and indicate how many of each part to expect. After each part is identified and counted, put a checkmark in the box to the left of the part descriptions. As you inventory the parts in your kit, place them in your parts boxes, muffin tins, egg cartons, or whatever method of keeping parts separated that you have devised, and label them.

When unpacking and sorting parts, if a part is missing, contact the:

Intel Customer Support Department
3065 Bowers Avenue
Santa Clara, California 95051
(408) 987-8818

Using a sharp knife or razor blade, carefully slice and remove the skin-wrapping over the large, unlabeled template pocket that contains the three bags of small parts, the small integrated circuits, integrated circuit sockets, connectors, power cable, and display filter.

HARDWARE BAG

Open the Hardware bag containing the mounting hardware, headers, and miscellaneous parts. Check to be sure that the following items (and correct quantities) have been included.

MOUNTING HARDWARE

For CPU board supports:

- ☐ 11 rubber feet

0075

- ☐ 11 nylon spacers, 0.437 (7/16) inch long

0076

- ☐ 11 screws, 3/4 inch long, black, PHL

0077

- ☐ 22 nylon washers

0078

- ☐ 11 hex nuts

0079

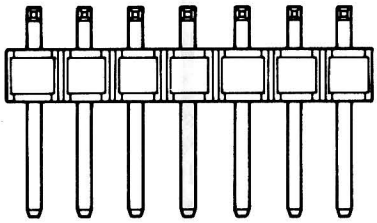
For mounting keyboard:

- ☐ 6 nylon spacers, 0.13 (1/8) inch long
- ☐ 6 screws, 1/2 inch long, black PHL
- ☐ 6 nylon washers
- ☐ 6 kepnuts (hex nuts with lock washers attached)

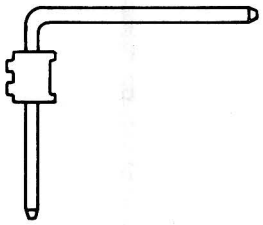
0080

HEADERS

- ☐ 1 power cable connector, 7-pin (male)

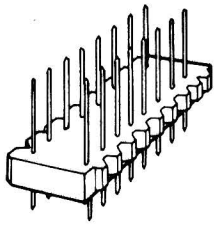


FRONT VIEW



SIDE VIEW 0137

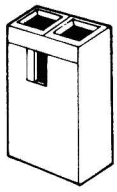
- ☐ 1 header, 4-pin (2 by 2)


0081

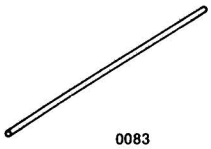
- ☐ 4 header, 8-pin (2 by 4)
- ☐ 1 header, 16-pin (2 by 8)
- ☐ 1 header, 18-pin (2 by 9)
- ☐ 3 header, 40-pin (2 by 20)

MISCELLANEOUS PARTS

- ☐ 21 shorting plugs


0082

- ☐ 1 bus wire, 6 feet long


0083

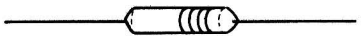
- ☐ 1 teflon tubing, 2-1/2 feet long


0084

COMPONENT BAG

Next, open the Component bag containing the resistors, single in-line resistor packs, capacitors, diodes, and crystals. Check to be sure that the following parts and quantities have been included. Refer to the resistor color code to determine the values of the resistors and to the capacitor value code to determine the values of the capacitors.

RESISTORS, 1/4 WATT, 5%


0085

- ☐ 2 100 ohms (brown-black-brown)
- ☐ 3 330 ohms (orange-orange-brown)
- ☐ 1 470 ohms (yellow-violet-brown)
- ☐ 3 680 ohms (blue-grey-brown)
- ☐ 1 1k ohms (brown-black-red)
- ☐ 2 2.2k ohms (red-red-red)
- ☐ 1 2.7k ohms (red-violet-red)
- ☐ 1 4.7k ohms (yellow-violet-red)
- ☐ 2 10k ohms (brown-black-orange)
- ☐ 3 15k ohms (brown-green-orange)
- ☐ 3 27k ohms (red-violet-orange)
- ☐ 2 33k ohms (orange-orange-orange)
- ☐ 1 100k ohms (brown-black-yellow)
- ☐ 1 200k ohms (red-black-yellow)

RESISTOR, 1/2 WATT, 5%

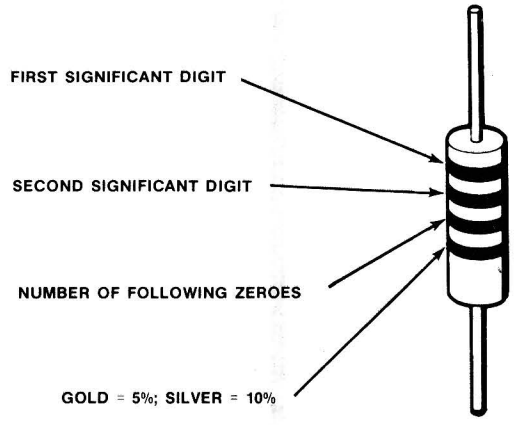
- ☐ 1 510 ohms (green-brown-brown)

RESISTOR COLOR CODE

Resistors commonly are identified by means of a code using color bands. Each color represents a number. The first three bands follow the color code below:

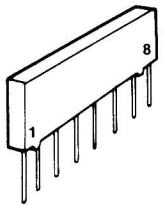
Black	0	Green	5
Brown	1	Blue	6
Red	2	Violet	7
Orange	3	Grey	8
Yellow	4	White	9

The fourth band indicates the percentage of tolerance for the resistor value. The tolerance color for all resistors in the kit is gold (5% tolerance).



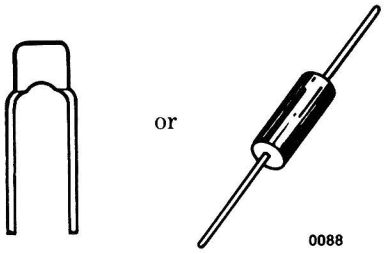
0086

SINGLE IN-LINE RESISTOR PACKS

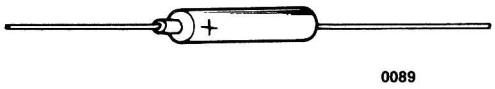


- ☐ 3 2.2k ohms, 8-pin (code 222)
- ☐ 1 3.3k ohms, 8-pin (code 332)

CAPACITORS



- ☐ 2 .001 μF, ceramic, axial lead (code 102)
- ☐ 1 .001 μF, ceramic, radial lead, 10% (code 102)
- ☐ 1 .01 μF, ceramic, radial lead, 10% (code 103)
- ☐ 30 0.1 μF, ceramic, axial lead (code 104)

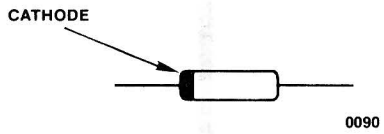


- ☐ 3 22 μF, tantalum, axial lead, 15V, 10%
- ☐ 2 20 pF, mica, 5%
- ☐ 1 680 pF, mica, 5%

CAPACITOR VALUE CODE

The capacitors supplied in your kit, depending on their manufacturer, are marked either with their value or with a value code. The code used to indicate the value of a capacitor consists of three numbers or three dots using the resistor color code. The first two numbers are the first and second significant digits, and the third number is the number of zeros that follow, the capacitance value being given in picofarads. For example, the 0.1 microfarad (0.1 μF) capacitors in your kit, if coded, would be marked with the digits "104". Applying the code, the value would be 10 with four zeros or 100,000 picofarads. Moving the decimal point six places to the left (to convert from picofarads to microfarads), the value is 0.100000 microfarad or simply 0.1 microfarad.

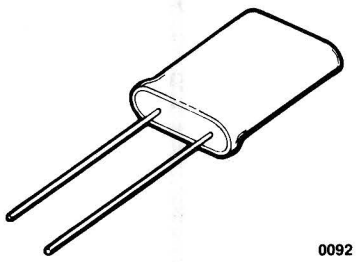
DIODES



- ☐ 5 1N4148 (or 914)

- ☐ 1 LED (red light-emitting diode lamp)

CRYSTALS



- ☐ 1 6 MHz
- ☐ 1 12 MHz

DISPLAY BAG

Now open the Display bag containing the hardware and electrical components used to assemble the display board. Check to be sure that the following parts and quantities have been included.

MOUNTING HARDWARE

☐ 4 nylon spacer, 1/4 inch long

0076

0077

☐ 2 screws, 1/4 inch long, black, PHL

☐ 8 screws, 1/2 inch long, black, PHL

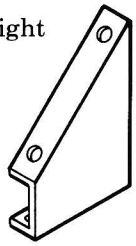
☐ 10 nylon washers

0078

☐ 6 kepnuts

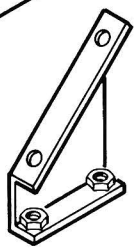
0080

☐ 1 mounting bracket, right



0096

☐ 1 mounting bracket, left



0097

RESISTORS, 1/4 WATT, 5%

0085

☐ 18 47 ohms (yellow-violet-black)

☐ 1 2.2k ohms (red-red-red)

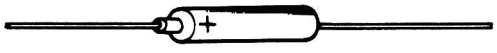
☐ 1 24k ohms (red-yellow-orange)

CAPACITORS

☐ 4 0.1 μF, ceramic, axial lead (code 104)

0139

☐ 1 22 μF, tant, axial lead, 15 V

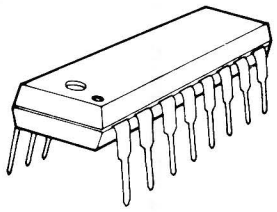


0089

INTEGRATED CIRCUITS AND OTHER PARTS

Now that you have identified and counted the parts in the three parts bags, check to see that the following parts are mounted on the foam pad in the pocket. Note that only the integrated circuit identifying numbers and letters are listed and that the prefix or suffix letters stamped on the part itself are omitted from the following list. For example, an SN74LS10N integrated circuit is identified only as a 74LS10 (the "SN" prefix and the "N" suffix are omitted). The integrated circuits in this area are *not* MOS devices and therefore can be handled (carefully). It will probably make your job easier, however, if you leave these parts in their foam backing until you are ready to install them.

INTEGRATED CIRCUITS



0099

☐ 1 2141-5

☐ 1 74LS02

☐ 1 74LS04

☐ 2 7416

☐ 1 74LS08

☐ 1 74LS10

☐ 1 74LS11

☐ 1 74LS14

☐ 3 74LS32

☐ 2 74LS85

☐ 1 74LS138

☐ 1 74S138

☐ 1 74LS139

☐ 4 74LS161

☐ 3 74LS164

☐ 2 74LS244

- ☐ 1 74LS279
- ☐ 2 74LS367
- ☐ 2 74LS373
- ☐ 1 8304 (or 8286)
- ☐ 1 75188 (some kits may substitute 1488)
- ☐ 1 75189 (some kits may substitute 1489)
- ☐ 1 Bipolar PROM (marked U63)
- ☐ 1 LM324
- ☐ 1 9602
- ☐ 1 AC5947

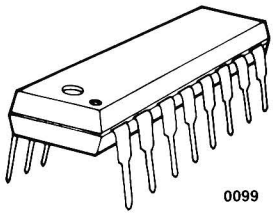
TRANSISTOR

- ☐ 1 2N3906

0100

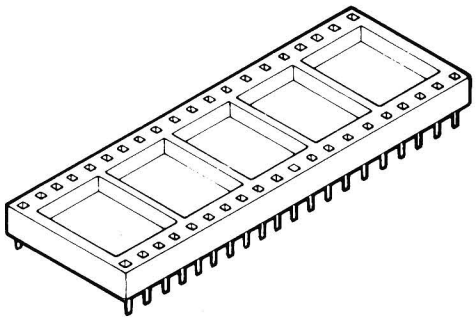
TRANSISTOR PACK

- ☐ 4 2003A



0099

INTEGRATED CIRCUIT SOCKETS



40-PIN SOCKET SHOWN

0101

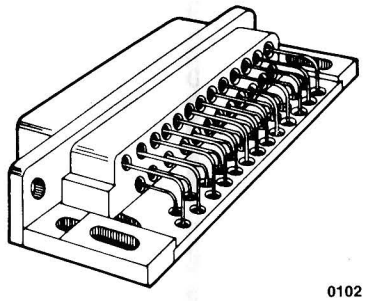
- ☐ 2 24 pin (for the two 2732As)
- ☐ 3 40 pin (for the 8031, 8155, and UPI-41A)

NOTE

You may wish to provide additional sockets for some of the larger integrated circuits. Examples are: 8251A (28 pins), 8243 (24 pins), 8304 (20 pins), 74LS373 (20 pins), 2114A-1 (18 pins), 2141-5 (18 pins), 3622A-2 (16 pins). To ensure reliability, you should obtain "machined-contact" sockets like the ones provided with the kit. Installation of these optional sockets will be mentioned where appropriate in the assembly procedures.

CONNECTOR

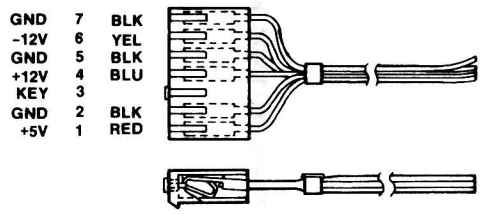
- ☐ 1 25-pin



0102

POWER CABLE

- ☐ 1 6 wires, 7-pin connector (female)



0140

DISPLAY FILTER

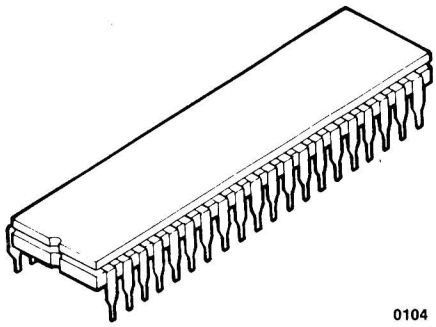
- ☐ 1 red display filter

0103

PARTS UNDER SKIN-WRAP

Without removing the skin-wrapping that covers the individual parts in the other areas of the package, check to be sure that the following parts are included.

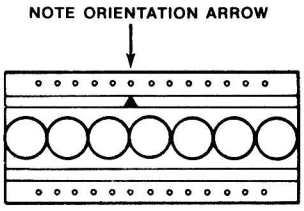
INTEGRATED CIRCUITS



0104

- ☐ 2 2114
- ☐ 2 2732A (marked E000H and F000H)
- ☐ 1 8031
- ☐ 1 UPI-41A (marked 8041A, 8741A, or 8641A)
- ☐ 1 8155-2
- ☐ 1 8243
- ☐ 1 8251A

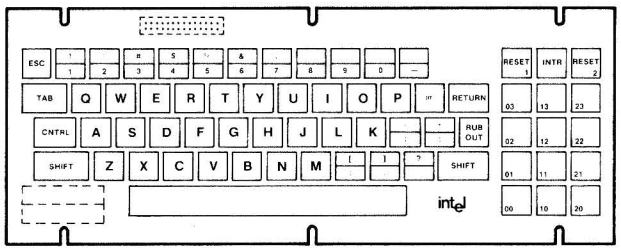
DISPLAY DEVICES



0141

- ☐ 3 LED, 8 character

KEYBOARD



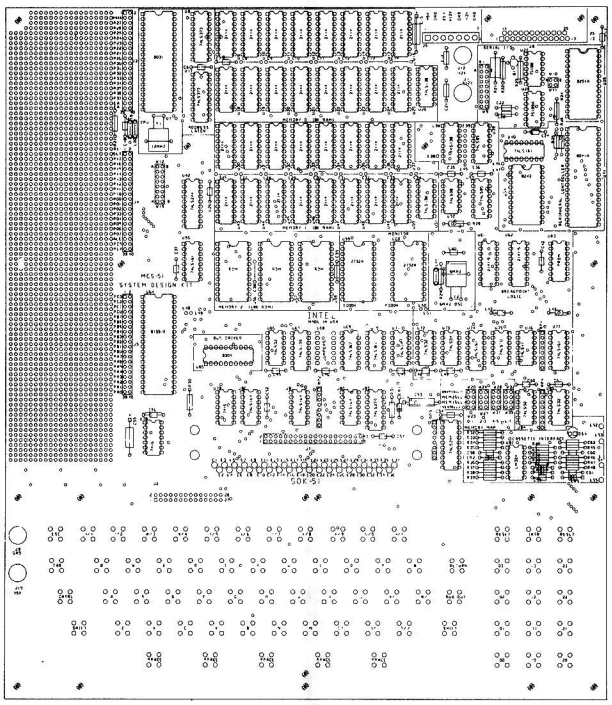
0142

- ☐ 1 membrane switch keyboard, typewriter layout

CIRCUIT BOARDS

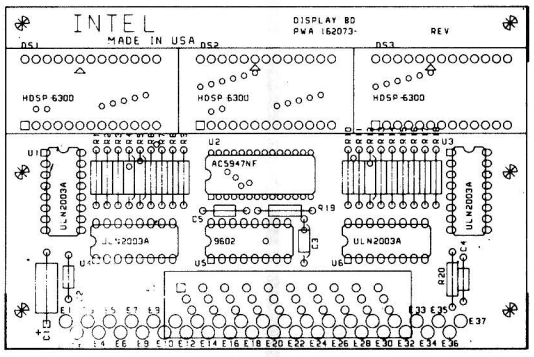
Carefully slice the skin-wrapping around the perimeter of the template and remove the circuit boards from between the foam backing and the bottom cardboard. Check for the following:

- ☐ 1 CPU board



0106

- ☐ 1 display board



0105

CAUTION

Be very careful not to cut the circuit board while slicing around the template.

CHAPTER 3
ASSEMBLING YOUR KIT

INTRODUCTION

Now that you have familiarized yourself with the general assembly information in Chapter 1 and inventoried the parts in your kit as listed in Chapter 2, you are ready to assemble your kit. The step-by-step assembly instructions in this chapter are organized so that you install all of the parts in a functional area before moving on to the next area. For most areas to be assembled, there are two pictures. The shaded portion of the small picture shows the board location of the area to be assembled, and the large picture identifies the parts that you are to install within the area.

Intermediate electrical checks of the operation of the board are provided at various points within the procedure. These checks not only assure proper operation of the finished kit, but also help isolate any malfunctions that might occur in specific areas of the board.

Each step in the assembly procedures is marked with a small box in the left margin. AS YOU COMPLETE EACH STEP, PUT A CHECKMARK IN THE BOX!

Remember to take your time and work carefully. After completing a procedure, take a break and read over the next procedure before starting to work again.

PRELIMINARY CHECK

Plug in your soldering pencil and, while you are waiting for it to heat up, check the CPU and display boards for shorts between power and ground.

CPU BOARD

☑ Using the volt-ohm-milliammeter (VOM), measure the resistance between pin 1 (+5-volts) and pin 7 (ground) of J6 of the CPU board (Figure 3-1). The resistance should be infinite. If a low resistance is read (1 megohm or less), check the following:

1. Check that the board is not touching any conducting surface (metal object or the conductive foam backing).
2. Check that the board is clean (no liquids or any conducting material are sticking to the board).
3. Check that the board is not damaged (nicked, scratched or gouged).

If you still measure a low resistance after making these checks, contact the Intel Technical Support Center.

DISPLAY BOARD

☑ Measure the resistance between point E29 (+5 volts) and point E13 (ground) of the display board (Figure 3-2). Check for an infinite resistance as described in the previous procedure.

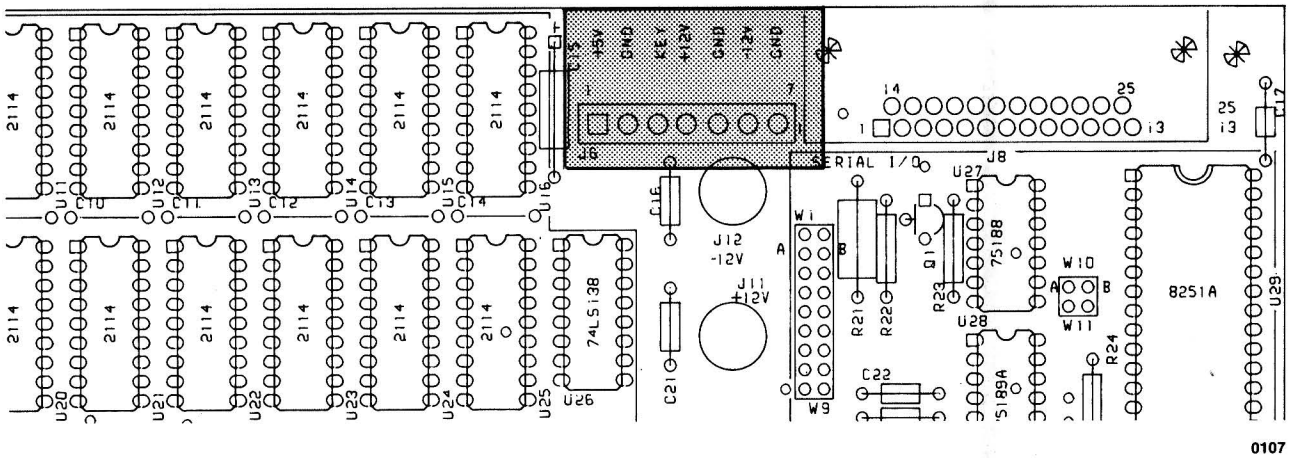


Figure 3-1. Power Connector J6, CPU Board

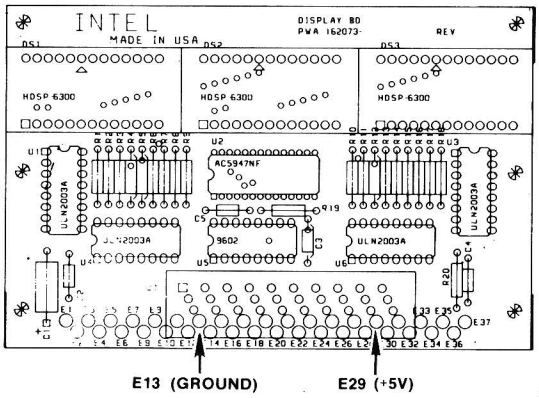


Figure 3-2. Display Board With Check Points

ASSEMBLY OF THE DISPLAY BOARD

Refer to Figure 3-2.

Place the display board on the work surface, top side (silkscreened side) up.

☑ Insert the 22 μF capacitor at C1. Check that the (+) marking on the capacitor is aligned with the corresponding (+) and square pad on the board.

■ Insert 0.1 μF capacitors (Code 104) at the following four locations:

- ☑ C2
- ☐ C3
- ☑ C4 (watch the holes).
- ☐ C5

☐ Turn the board over, solder the five capacitors in place and clip their leads.

WARNING

While clipping leads, hold the end of the lead with your fingers to avoid possible injury to your eyes, or hold your hand over the operation to shield your eyes.

■ Insert 47 ohm resistors (yellow-violet-black) at the following eighteen locations:

- ☑ R1
- ☑ R2
- ☐ R3
- ☐ R4
- ☐ R5
- ☐ R6
- ☐ R7
- ☐ R8
- ☐ R9
- ☑ R10
- ☑ R11
- ☑ R12
- ☑ R13
- ☑ R14
- ☐ R15
- ☑ R16
- ☑ R17
- ☑ R18

☑ Insert the 24k ohm resistor (red-yellow-orange) at R19.

☐ Insert the 2.2k ohm resistor (red-red-red) at R20.

☑ Solder the twenty resistors in place and clip their leads.

☑ Insert the AC5947 integrated circuit at U2.

☐ Insert the 9602 integrated circuit at U5.

■ Insert 2003A transistor packs at the following four locations:

- ☑ U1
- ☑ U3
- ☐ U4
- ☐ U6

☑ Check the orientation of the integrated circuits and transistor packs. The notch of each component should match the silkscreen and pin 1 should be aligned with the square pad on the board.

☑ Solder the two integrated circuits and four transistor packs in place.

☐ Clean the solder side with flux remover.

■ Slice the skin-wrap from around the three display devices and insert them at the following locations:

- ☑ DS1
- ☐ DS2
- ☐ DS3

☑ Check the orientation of the display devices with respect to the board. To assure correct orientation of the display devices, match the direction of the arrow on the device with the direction of the arrow silkscreened on the board.

☑ Solder the three display devices in place.

Set the assembled display board aside until it is time to install it.

INSTALL FEET ON CPU BOARD

☑ Insert a nut into the recessed hole in the bottom of each of the 11 rubber feet. The eraser on the end of a pencil can be used to push the nut down into the rubber foot.

☐ Place the CPU board on your work surface, with top side (silkscreened side) up and the

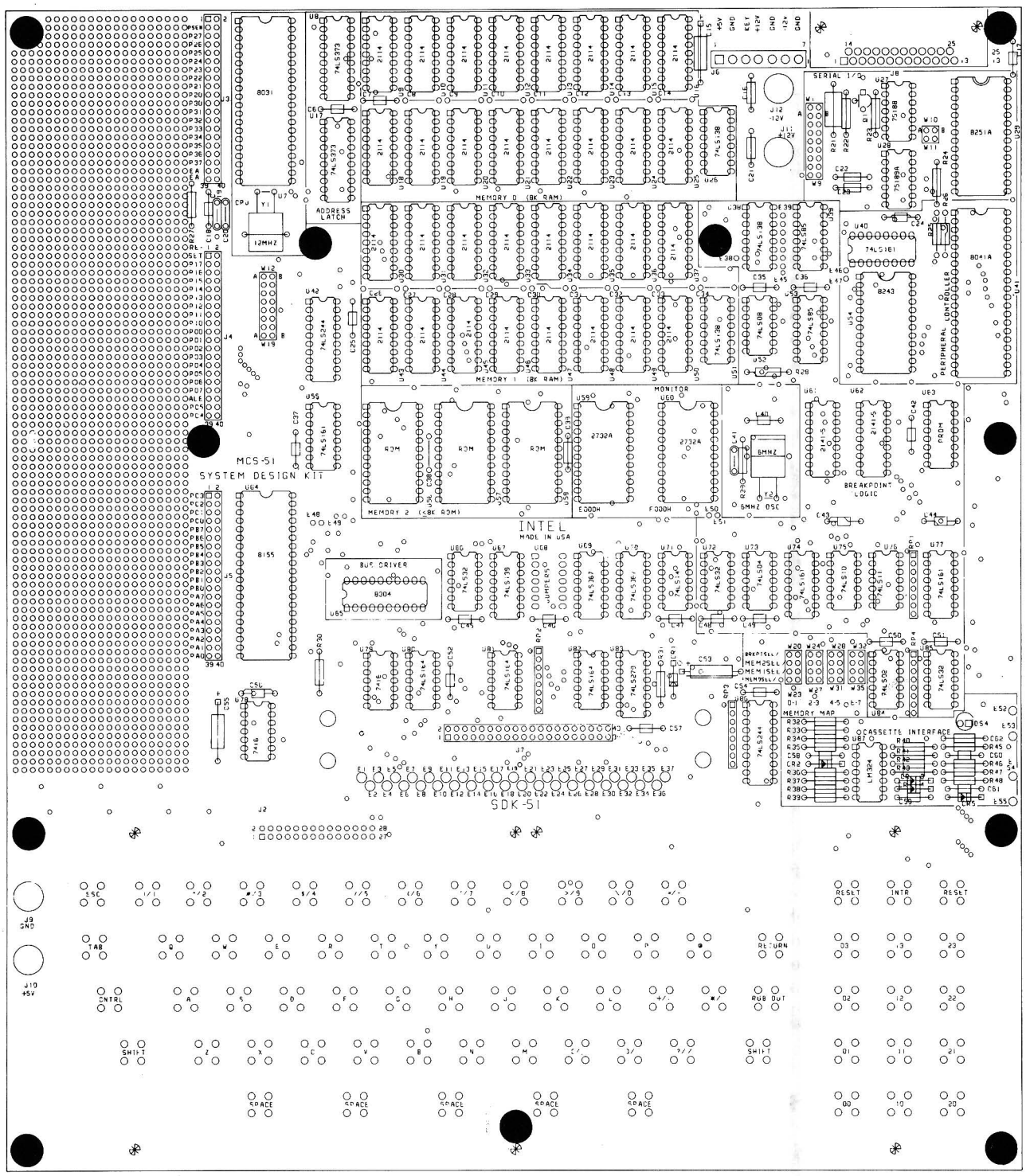


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Figure 3-3. Rubber Foot Locations, CPU Board

keyboard area toward you. The locations for the rubber feet are marked on the drawing of the board with solid circles (Figure 3-3). At each of the 11 locations, slide a nylon washer onto a screw and insert the screw through the hole from the top of the board. In order, place a .437 (7/16) inch long nylon spacer and another nylon washer on the screw from the bottom of

the board, and twist a rubber pad onto the screw (Figure 3-4). With your screwdriver, tighten the screw just enough to hold the pad and leg firmly in place.

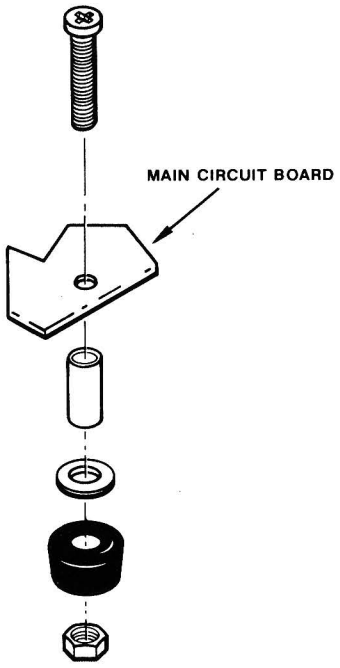

Figure 3-4. Installing Rubber Feet

NOTE

Do not install the feet in the holes meant for the keyboard. In particular, the foot at the lower center edge of the board (near the location of the spacebar on the keyboard) is very close to a keyboard mounting hole. Of the two adjacent holes, the hole closer to the edge is for the keyboard installation. Install the foot through the hole that is farther from the edge.

ASSEMBLY OF THE POWER SUPPLY AREA

Refer to Figures 3-5 and 3-6.

- Insert 22 μF capacitors at the following two locations:
  - ☑ C15
  - ☑ C55

  Make sure the (+) mark on each capacitor is aligned with the corresponding (+) and square pad on the board.

- Insert 0.1 μF ceramic capacitors (code 104) at the following thirty locations:
  - ☑ C6
  - ☑ C7
  - ☑ C16
  - ☑ C17 (at the upper right edge of the board)
  - ☑ C18
  - ☑ C21
  - ☑ C22
  - ☑ C23
  - ☑ C24
  - ☑ C25
  - ☐ C35
  - ☑ C36
  - ☑ C37
  - ☑ C39
  - ☑ C40
  - ☑ C42
  - ☑ C43
  - ☑ C44
  - ☑ C45
  - ☑ C46
  - ☑ C47
  - ☑ C48
  - ☑ C49
  - ☑ C50
  - ☑ C51
  - ☑ C52
  - ☑ C54
  - ☑ C56
  - ☑ C57
  - ☑ C59

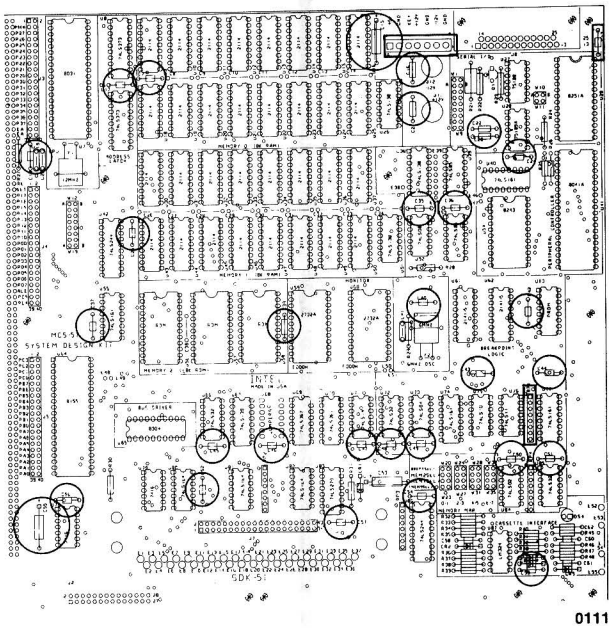

Figure 3-5. Power Supply Components

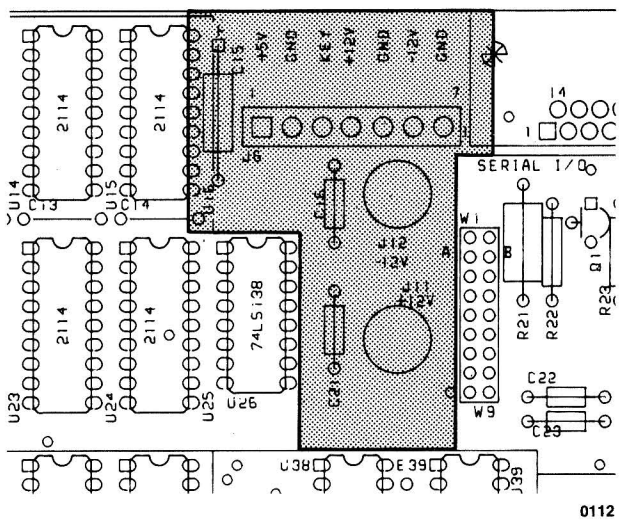

Figure 3-6. Power Supply Area, Detail

- ☑ Solder the leads of these 32 capacitors and clip their leads.
- ☑ Insert a 2.2k ohm, 8-pin, single in-line resistor pack at RP1. Check that pin 1 of the resistor pack is aligned with pad 1 (the square pad) of the board and solder the resistor pack in place.
- ☑ Insert the right-angle power connector at J6. The prongs of the connector must point away from the board. Solder the connector in place. Solder all terminals except the 'KEY' terminal (pin 3).
- ☑ With a pair of pliers, gently remove the prong from the 'KEY' position on the connector by pulling straight up from the board. To gain leverage, press down on the connector with the point of a screwdriver while pulling up on the prong. (Instead, you may cut the KEY prong off flush with the plastic, especially if you soldered it by mistake.)

ASSEMBLY OF THE RESET AREA

Refer to Figures 3-7 and 3-8.

- ☑ Insert a 200k ohm (red-black-yellow) resistor at R31.
- ☑ Insert a 1N4148 diode at CR1. The band on the diode must be adjacent to the square pad.
- ☑ Insert a 22 μF capacitor at C53. Check that the (+) mark on the capacitor is aligned with the corresponding (+) and square pad on the board.
- ☑ Solder the resistor, diode, and capacitor in place and clip the leads.
- ☑ Insert a 74LS14 integrated circuit at U71.
- ☑ Insert a 74LS279 integrated circuit at U83.
- ☑ Check the orientation of pin 1 of the integrated circuits and solder them in place.

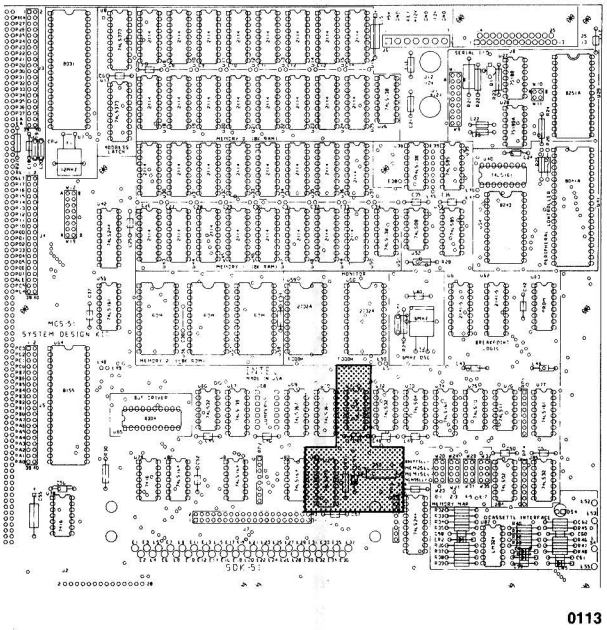

Figure 3-7. Reset Area

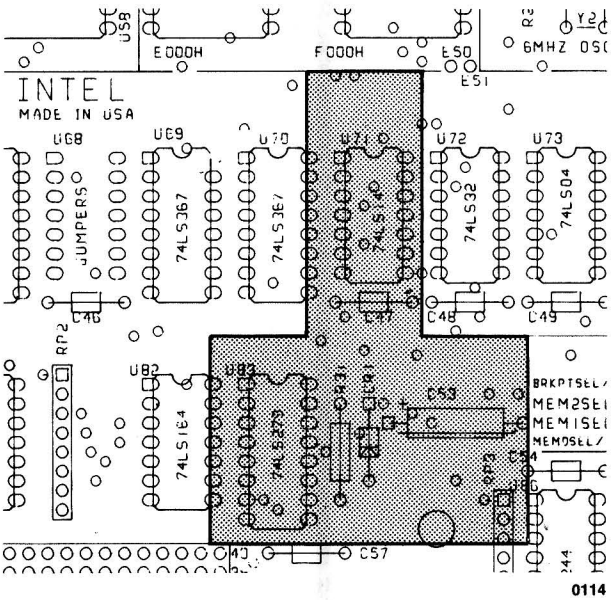

Figure 3-8. Reset Area, Detail

ASSEMBLY OF THE 6 MHZ TIMING AND UPI CONTROLLER AREAS

Refer to Figures 3-9 and 3-10.

- ☑ Insert a 680 pF mica capacitor (code 681) at C41.
- ■ Insert 680 ohm (blue-grey-brown) resistors at the following two locations:
  - ☑ R25 (watch the holes!)
  - ☑ R26
- ■ Insert 330 ohm (orange-orange-brown) resistors at the following two locations:
  - ☑ R28
  - ☑ R29.
- ☑ Solder the capacitor and the four resistors in place and clip the leads.
- ☑ Insert the 6 MHz crystal at Y2. Bend the leads so that the crystal is directly over its silk-screened outline.
- ☑ Solder the crystal in place and clip the leads.
- ☑ Cut a piece of bus wire 1-1/2 inches long (or use a clipping from one of the leads). With needle-nosed pliers, form the bus wire into a U-shaped strap to hold the crystal in place.
- ☑ Insert the strap over the crystal and solder it in place so that the crystal is held snugly to the board. Clip the leads.
- ☑ Insert a 3.3k ohm, 8-pin, single in-line resistor pack (code 332) at RP2. Check that pin 1 of the resistor pack is aligned with pad 1 (the square pad) of the board and solder the resistor pack in place.
- ☑ Insert a 74LS161 integrated circuit at U40.

NOTE

Instead of the following step, you may wish to install a 24-pin (machined-contact) socket at U54, then insert the 8243 in the socket.

- ☑ Insert an 8243 integrated circuit at U54.
- ☑ Insert a 74LS367 integrated circuit at U70.
- ☑ Insert a 74LS04 integrated circuit at U73.
- ☑ Check the orientation of pin 1 of the four integrated circuits and solder them in place.
- ☑ Insert a 40-pin integrated circuit socket at U41. Note that while a socket can be inserted in either direction, some sockets are marked with a pin 1 reference. When marked (usually with a "notch" or "sliced" corner), pin 1 of the socket should be aligned with pad 1 (the square pad) on the board.
- ☑ Check that all the pins of the socket are through the board and solder the socket in place.
- ☑ Remove the skin-wrap from the Intel UPI-41A integrated circuit. Following the precautions for handling MOS integrated circuits, insert the UPI-41A in socket U41. Be sure that pin 1 of the integrated circuit is inserted into pin 1 of the socket.

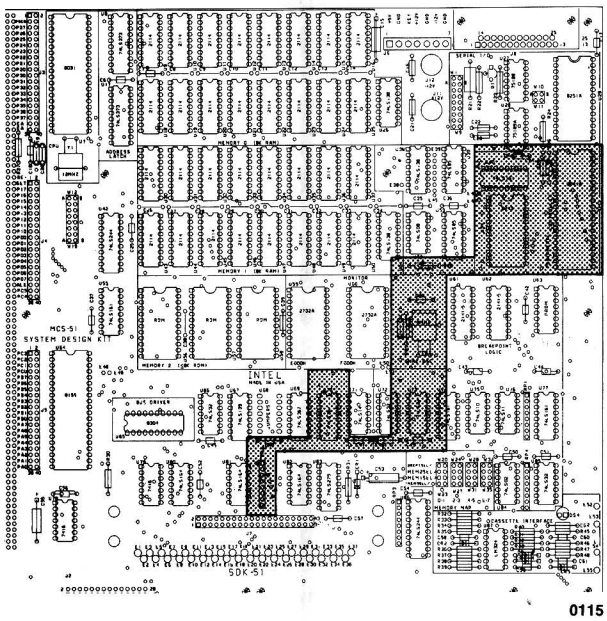

Figure 3-9. 6MHz Timing and UPI Control Areas

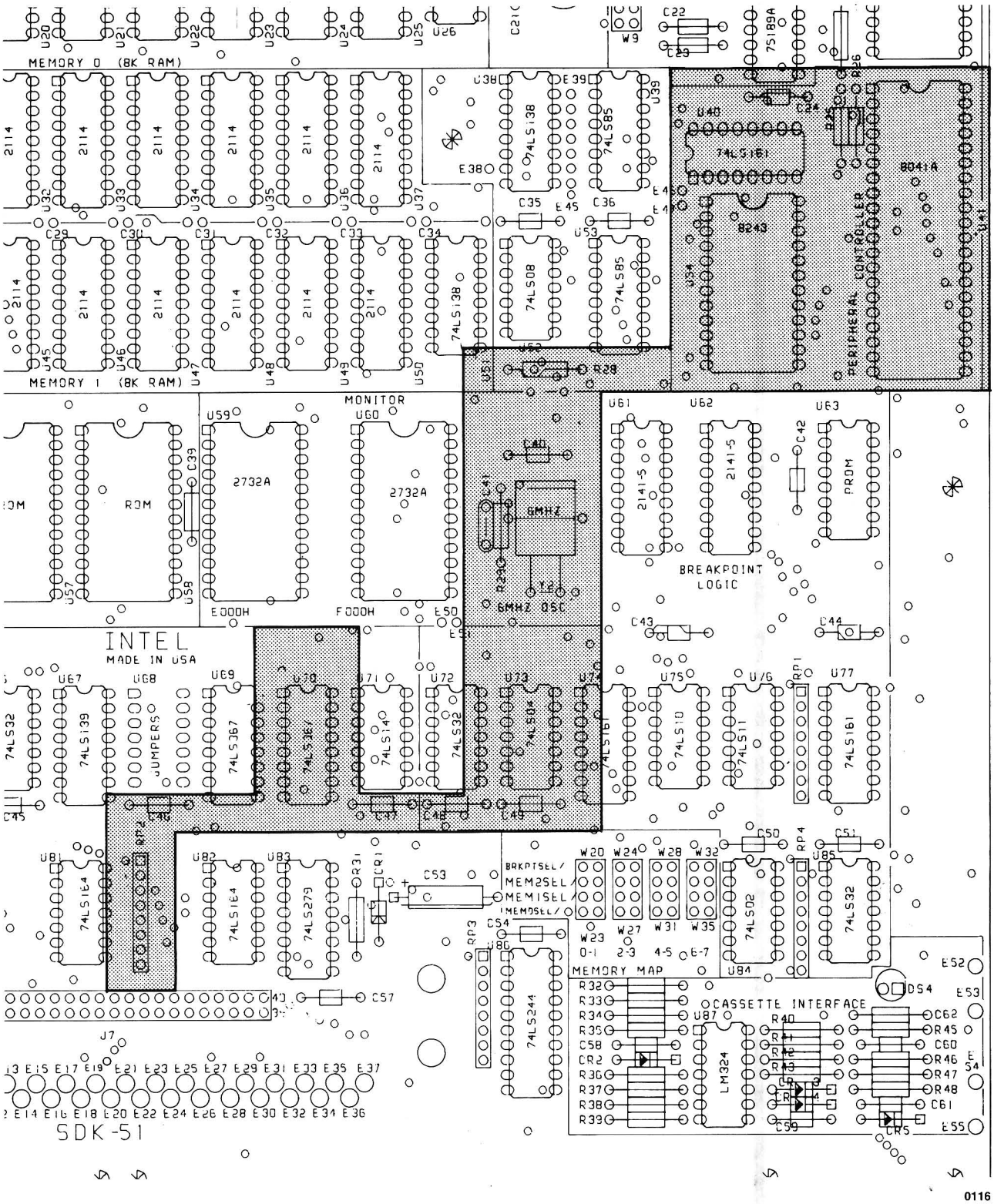

Figure 3-10. 6MHz Timing and UPI Control Areas, Detail

CHECK THE RESET AND UPI AREAS OF THE BOARD

- ☐ Adjust the external power supply for +5 volts ±0.25 volts; adjust the current limit of the supply for 3 amperes maximum.
- ☐ Turn off the power supply.
- ☐ Connect the +5-volt supply wires from the power cable to the power supply outputs: +5 volts (red); ground (black).

CAUTION

Applying reverse polarity to the power input terminals will damage system components.

- ☐ Check the connections to the power supply: red wire to plus output; black wire to 5 volt return.
- ☐ Connect the power cable to J6. The 'KEY' space indicates the proper orientation of the connector.

CAUTION

MAKE SURE THE BOARD IS NOT IN CONTACT WITH THE CONDUCTIVE FOAM OR ANY CONDUCTING MATERIAL BEFORE APPLYING POWER.

- ☐ Set the oscilloscope controls for the following:

Triggering	External, DC, Normal, + slope
Vertical Sensitivity	1 Volt/Division
Sweep Rate	50 Milliseconds/ Division

- ☐ Connect a probe between the oscilloscope's external trigger input and the + side of the power supply. (This allows the oscilloscope sweep to be triggered on the leading edge of the power supply voltage during power-up).
- ☐ Connect another probe to the oscilloscope's vertical input.
- ☐ Connect the ground lead for both probes; a reasonable ground point is the restraining strap on crystal Y2.
- ☐ Check the power-on reset pulse using the following procedure:

  1. Using the probe connected to the vertical input of the oscilloscope, probe pin 4 of U71.
  2. While observing the oscilloscope display, turn on the power supply. A pulse should occur with a leading edge (high-to-low transition) not less than 3 divisions (150 ms) from the left of the display screen. You may have to switch the power supply on and off several times and adjust the oscilloscope's triggering to verify this signal.

- ☐ Switch scope trigger to automatic.
- ☐ With power on steady, check pin 4 of U41 is high (i.e., RESET has returned to inactive.)
- ☐ Disconnect the probe connected to the power supply both from the power supply and the oscilloscope.
- ☐ Set the oscilloscope for internal triggering (on one channel), negative slope.
- ☐ Check the display clock signal using the following procedure:

  1. Set the sweep rate for 200 microseconds/ division.
  2. Probe terminal E20 on the CPU board (alternately, pin 38 of U41). The display should show several narrow low-going pulses with approximately 715 microseconds between pulses.
  3. Set sweep rate to 1 microsecond/division.
  4. The display should show the low-going pulses, each pulse about 5 microseconds wide).

- ☐ Set the oscilloscope to 50 nanoseconds per division.
- ☐ Observe the UPICLK signal at pin 2 of U41. UPICLK is a 6 MHz clock (50/50 alternating pulse with a cycle time of 166 ns). Note that pin 3 of U41 shows the same signal.
- ☐ Set sweep rate to 100 nanoseconds/division.
- ☐ Probe pin 3 of U64 (empty location) for the SYSCLK signal. SYSCLK should be an alternating pulse with approximately 500 nanoseconds cycle time (3 times 166 nanoseconds). The first third of each cycle is low for 166 nsec.

- Set the oscilloscope to trigger on the negative edge of DSPLYCLK (pin 38 of U41). Set sweep rate to 0.5 microseconds/division.
- Probe the following points for the values shown (representing ASCII "space", value 20H):
  - ☐ E11 low
  - ☐ E21 low
  - ☐ E10 low
  - ☐ E9 low
  - ☐ E23 low
  - ☐ E22 high
- Turn power off.

ASSEMBLY OF THE KEYBOARD AREA

Refer to Figures 3-11 and 3-12.

- Insert 2.2k ohm, 8-pin, single in-line resistor packs at the following two locations:
  - RP3
  - RP4

  Be sure that pin 1 of each pack is aligned with pad 1 on the board.
- Solder the resistor packs in place and, if necessary, clip their leads.
- Insert 7416 integrated circuits at the following two locations:
  - U78
  - U79
- Insert 74LS164 integrated circuits at the following three locations:
  - U80
  - U81
  - U82
- Insert a 74LS244 integrated circuit at U86.
- Check the orientation of pin 1 on the six integrated circuits and solder them in place.
- Place the keyboard assembly on the CPU board, inserting the 2- by 14-pin header mounted on the back of the keyboard partway into J2.
- At each of the six keyboard mounting screw locations, insert a 0.13 (1/8) inch nylon spacer between the keyboard and the CPU board. Then insert a nylon washer on a 1/2 inch long screw and insert the screw through the slotted keyboard hole, through the spacer and through the board. Secure the screw on the backside of the board with a kep-nut.
- When all the keyboard securing screws have been installed, solder the J2 keyboard connector in place.

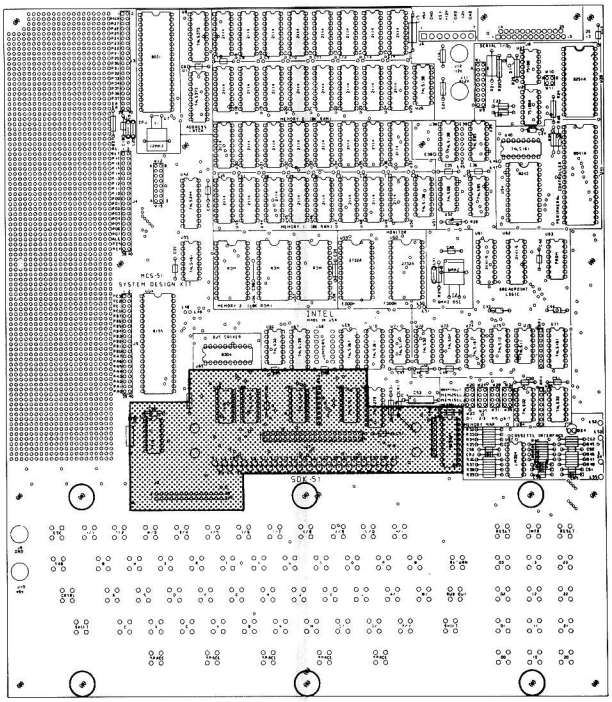

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Figure 3-11. Keyboard Area

CHECK KDTIME SIGNALS AND KEYBOARD OUTPUT

- Connect the power cable and apply power to the board.
- Adjust the oscilloscope sweep rate for 2 milliseconds/division, 2 volts/division, automatic mode, and positive edge triggering.
- Probe terminal E20 on the CPU board. Twenty-four or more display clock pulses should be visible on the oscilloscope display.

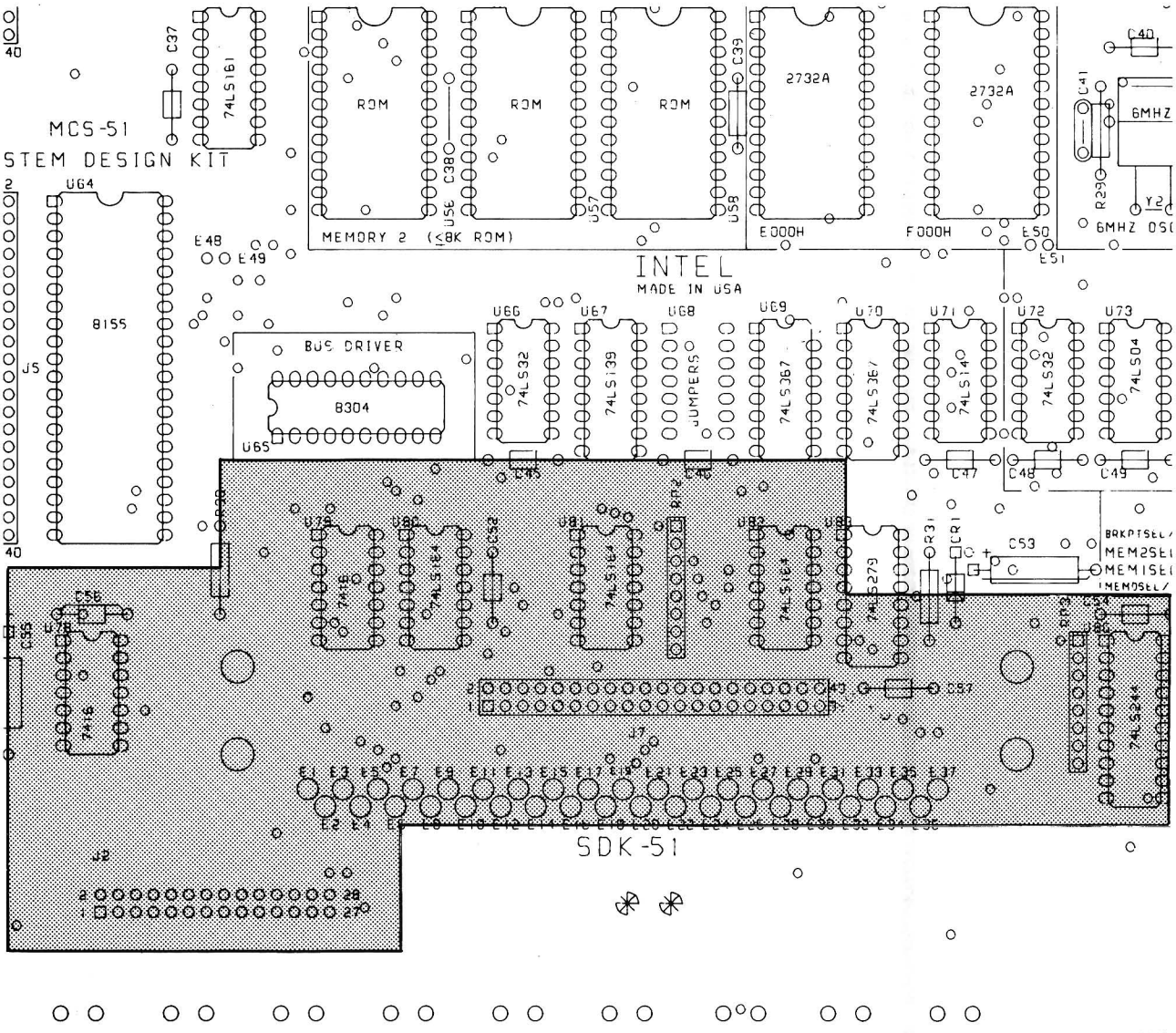

Figure 3-12. Keyboard Area, Detail

- ☐ Check the KDTIME 0 through KDTIME 23 signals using the following procedure:

1. Probe the following terminals:

- ☐ E1
- ☐ E2
- ☐ E3
- ☐ E4
- ☐ E5
- ☐ E6
- ☐ E7
- ☐ E8
- ☐ E12
- ☐ E15
- ☐ E16
- ☐ E17
- ☐ E18
- ☐ E19
- ☐ E24
- ☐ E25
- ☐ E27
- ☐ E28
- ☐ E30
- ☐ E32
- ☐ E33
- ☐ E34
- ☐ E35
- ☐ E36

2. At each terminal, check the display for a pair of positive-going pulses that have a width of approximately 700 microseconds and a period (interval between the pulses) of approximately 16 milliseconds. Pay particular attention to the width of the pulses. The width should be the same for all test points.

3. If any pulse is absent, check integrated circuits U80, U81, U82 and U86 for solder bridges.

WARNING

Do not install the display board until all the KDTIME pulses exhibit the specified width and period.

- [ ] Set the oscilloscope for 10 microseconds per division, and to trigger on the positive edge of E17 (KDTIME0), using external triggering.

- [ ] Probe U86 (74LS244), pin 1 to check that it is being enabled by the UPI. Look for a low-going pulse approximately 55 microseconds from the beginning of the trace. The pulse should be about 17 microseconds in width.

- [ ] Still triggering on E17, probe U86, pin 18 (KR7). Press the RETURN key on the keyboard. You should observe a negative-going pulse corresponding to the pulse observed on pin 1 of U86 earlier. Moreover, *no other key except RETURN should produce a pulse.*

- [ ] Move the trigger to E12 (KDTIME1). Probe U86, pin 3 (KR6). Press the &/6 key on the keyboard to obtain the low-going pulse. No other key should produce a pulse.

- [ ] Move the trigger to E2 (KDTIME2). Probe U86, pin 16 (KR5) and press the ?// key.

- [ ] Move the trigger to E3 (KDTIME3); probe U86, pin 5 (KR4); press the E key.

- [ ] Move the trigger to E1 (KDTIME4; probe U86, pin 14 (KR3); press the L key.

- [ ] Move the trigger to E16 (KDTIME5); probe U86, pin 7 (KR2); press the S key.

- [ ] Move the trigger to E19 (KDTIME6); probe U86, pin 12 (KR1); press the Z key.

- [ ] Leave the trigger on E19; probe U86, pin 9 (KR0); press the Y key.

- [ ] Turn power off.

INSTALLATION OF THE DISPLAY BOARD

Refer to Figures 3-13, 3-14, and 3-15.

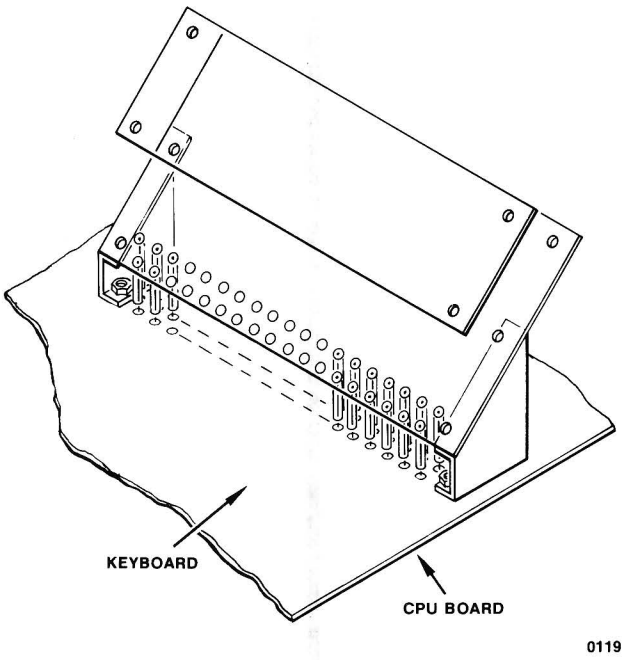

Figure 3-13. Connecting Display Board

Figure 3-13 shows an overall sketch of how the display board, filter, mounting brackets, connecting bus wires, and protective tubing are oriented when the display board is installed on the CPU board.

- [ ] Cut thirty-seven, 1-1/2 inch long pieces of bus wire.

- [ ] Turn the assembled display board so that the component side is down and lay the board on your work surface.

- [ ] Place a piece of bus wire in each of the thirty-seven plated-through holes, E1 through E37, on the board. Allow each piece of bus wire to go through the hole and rest on the work surface below, slanting away from the center of the board. The longer end of the wire should be on the side away from the components, so that they will connect to the main board with the component side of the display board facing up.

- [ ] Solder each piece of bus wire in place and clip the leads on the component side of the board.

☐ Mount the filter on the display board (Figure 3-14). Peel off the protective plastic sheet on the back of the filter. (If necessary, punch out the extra plastic from the four corner holes.) Orient the filter so that the printing on the filter reads right-side up when mounted as shown in the figure. Fasten the filter to the board with the top two screws (1/2 inch). Each screw goes through the filter, through a nylon spacer, and through the board; then it is fastened with a washer and kep-nut.

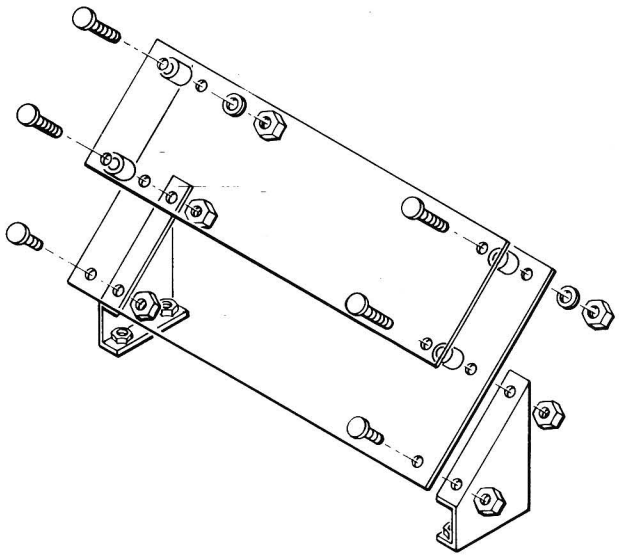

Figure 3-14. Display Board Installation

☐ Mount the display board on the brackets. Place the display board on the brackets. Orient the brackets so that the flanges on the brackets point inward toward each other. Install the two 1/4 inch screws in the lower mounting holes of the display board. The screws go through the board and the bracket, and are secured with kepnuts. (Don't tighten the screws all the way; leave a little "play" to help in mounting the brackets to the CPU board.)

☐ Install and secure the two remaining mounting screws in the filter. These screws go through the filter, through 1/8 inch nylon spacers, through the display board, through the bracket, and are secured with kepnuts.

☐ Using an xacto knife, cut thirty-seven 5/8-inch pieces of teflon tubing.

☐ Slip a piece of teflon tubing on each of the 37 bus wires. With the tubing flush against the display board, put a right-angle bend in each wire to hold the tubing in place. The bend should angle toward the edge of the board, away from the red filter.

☐ Separate the wires into two rows, the evens (E2 through E36) and the odds (E1 through E37), by bending them slightly away from each other where they meet the display board.

☐ Using the needle-nose pliers, insert the even-numbered wires one at a time into their corresponding holes in the CPU board. When the entire row has been inserted, turn the CPU board over and crimp the ends of the wires to hold them temporarily (but DO NOT SOLDER THE WIRES YET).

☐ In a similar manner, insert the odd-numbered wires in their corresponding holes. When the entire row has been inserted, crimp the ends to hold them temporarily.

☐ Attach the mounting brackets to the CPU board (Figure 3-15). Place a nylon washer on each of four 1/2 inch screws, insert the screws through the four mounting holes, and place another washer on the top side. Align the pemnuts on each bracket with the screw, and tighten the screws into the brackets.

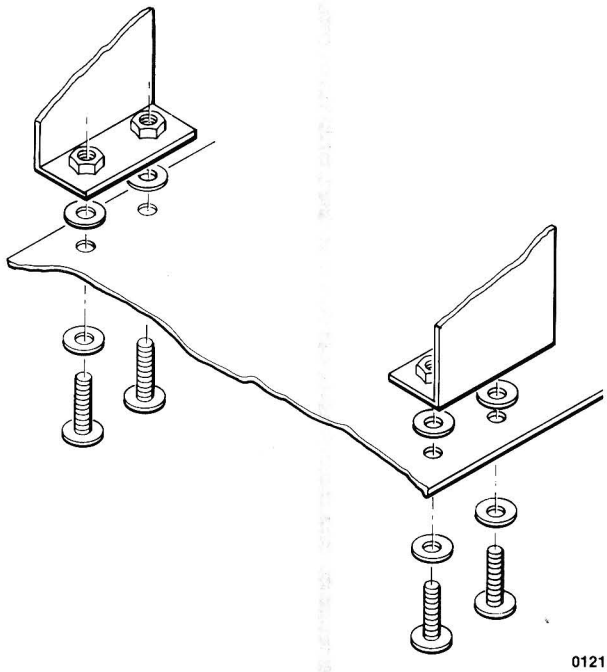

Figure 3-15. Display Board Mounting Bracket Installation

☐ Tighten the screws holding the display board to the brackets.

☑ *Check the bus wires to make sure there are no crossovers.* Pull each wire tight from the bottom of the board. Solder the bus wires in place and clip the excess wire (on the bottom side of the board).

ASSEMBLY OF ADDRESS AND DATA BUS CONTROL AREAS

Refer to Figures 3-16 and 3-17.

NOTE

Instead of the next step, you may wish to install (solder) 20-pin (machined-contact) sockets at U8 and U17, and insert the 74LS373's in the sockets.

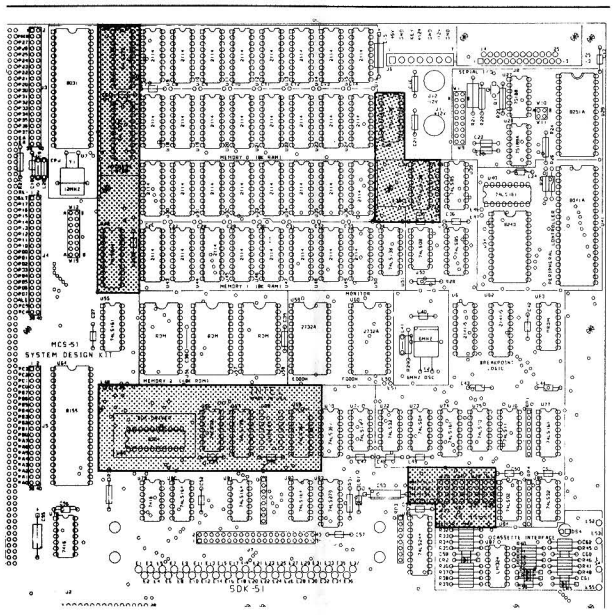

Figure 3-16. Address Bus and Data Bus Areas

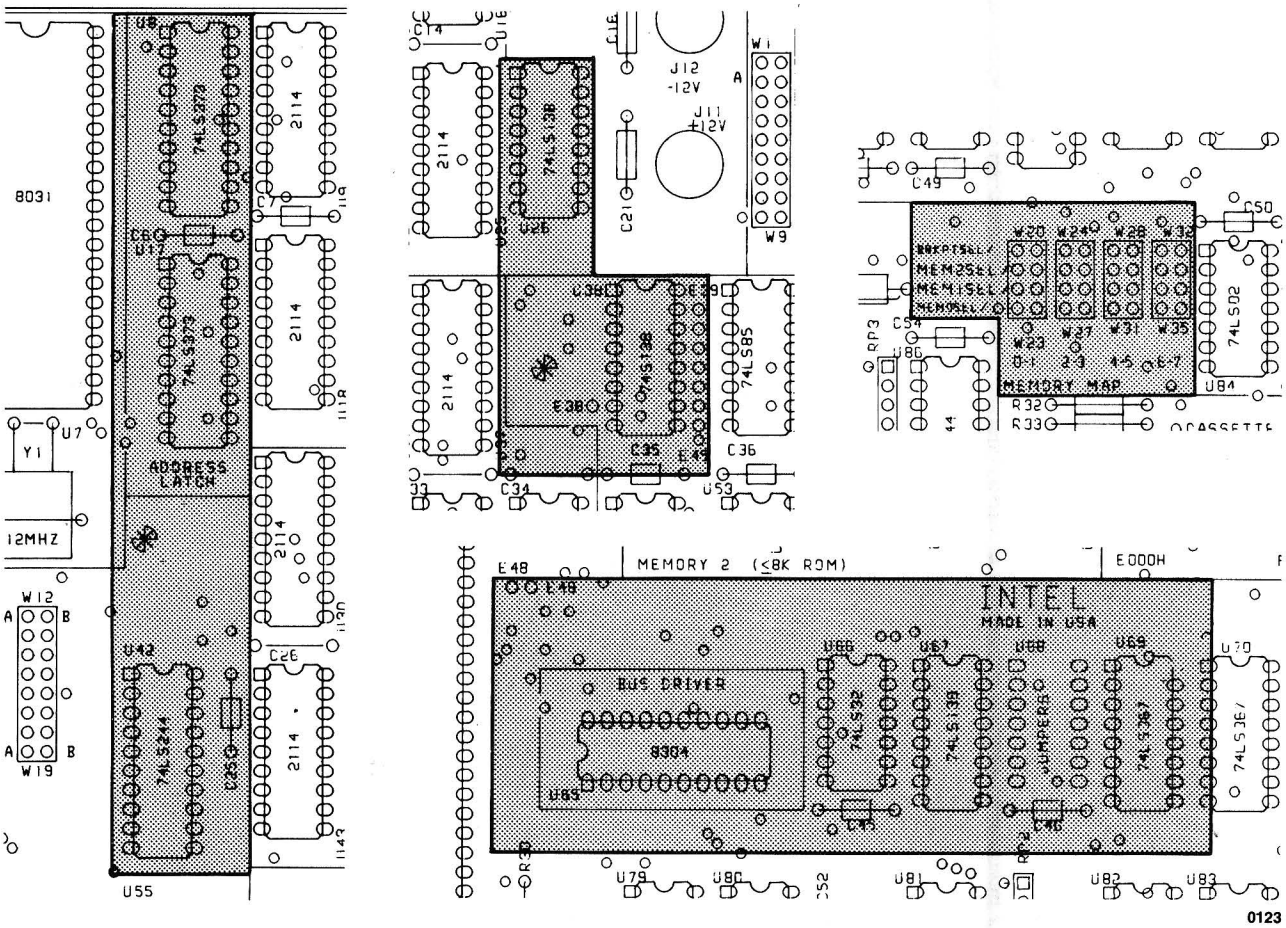

Figure 3-17. Address Bus and Data Bus Areas, Details

- Insert 74LS373 integrated circuits at the following two locations:
  - ☑ U8
  - ☑ U17
- ☑ Insert an 74LS138 integrated circuit at U26.
- ☑ Insert a 74S138 integrated circuit at U38.
- ☑ Insert a 74LS244 integrated circuit at U42.

NOTE

Instead of the next step, you may wish to install (solder) a 20-pin (machined-contact) socket at U65, and insert the 8304 in the socket.

- ☑ Insert an 8304 integrated circuit at U65.
- ☑ Insert a 74LS139 integrated circuit at U67.
- ☑ Insert a 74LS367 integrated circuit at U69.
- ☑ Check the orientation of pin 1 of all eight integrated circuits and solder them in place.
- Insert 8-pin (2 by 4) headers at the following locations (the shorter pins are inserted into the board).
  - ☑ W20 through W23.
  - ☑ W24 through W27.
  - ☑ W28 through W31.
  - ☑ W32 through W35.
- ☑ Solder the four headers in place.

ASSEMBLY OF THE TOP OF PROGRAM MEMORY AREA

Refer to Figures 3-18 and 3-19.

- Insert 74LS85 integrated circuits at the following two locations:
  - ☑ U39
  - ☑ U53
- Insert 74LS32 integrated circuits at the following two locations:
  - ☑ U66
  - ☑ U72
- ☐ Check the orientation of pin 1 of all four integrated circuits and solder them in place.

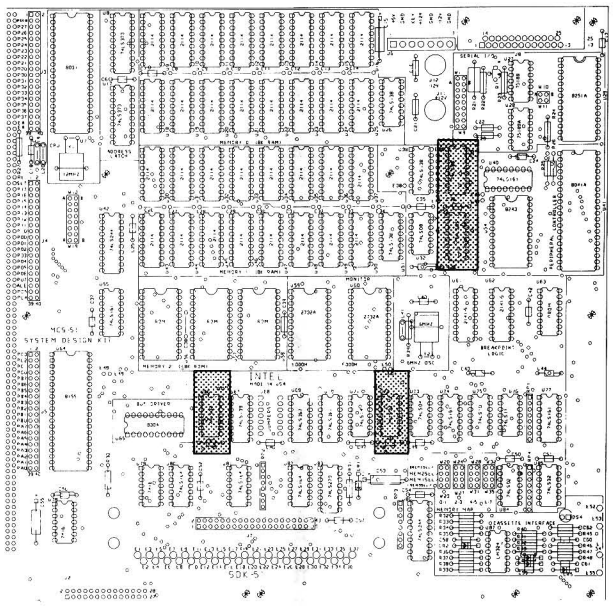

Figure 3-18. Top of Program Memory Area

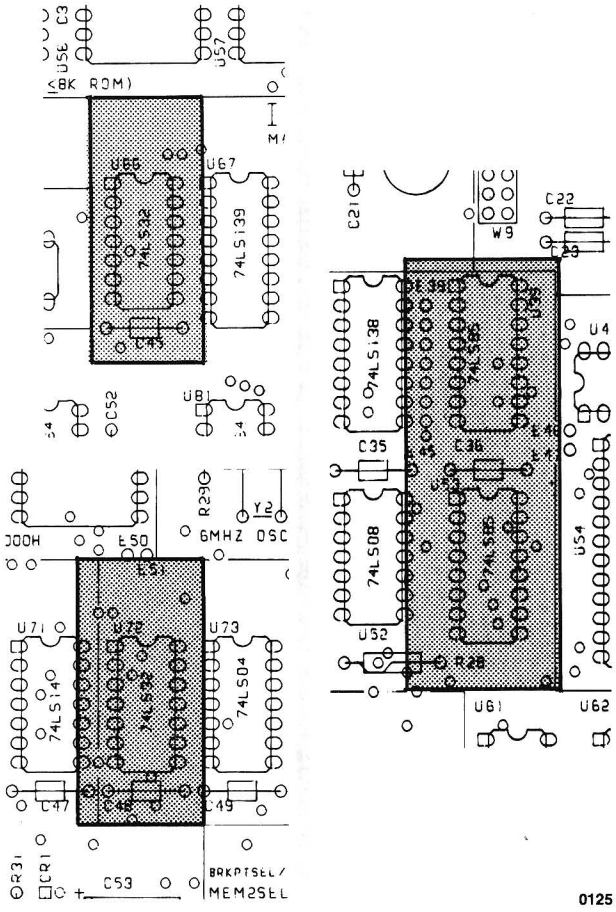

Figure 3-19. Top of Program Memory, Details

ASSEMBLY OF THE BREAKPOINT LOGIC AREA

Refer to Figures 3-20 and 3-21.

- ☑ Insert a 2.2k ohm resistor (red-red-red) at R30, solder it in place, and clip the leads.
- ☑ Insert a 74LS08 integrated circuit at U52.
- ■ Insert 74LS161 integrated circuits at the following three locations:
  - ☑ U55
  - ☑ U74
  - ☑ U77

NOTE

Instead of the next step, you may wish to install an 18-pin (machined contact) socket at U61, and insert the 2141A-5 in the socket. U62 (optional breakpoint RAM expansion) may also be socketed at user option.

- ☑ Insert a 2141-5 integrated circuit at U61.

NOTE

Instead of the next step, you may wish to install a 16-pin (machined contact) socket at U63, and insert the 3622A in the socket.

- ☑ Insert the bipolar PROM (labeled U63) at U63.
- ☑ Insert a 74LS10 integrated circuit at U75.
- ☑ Insert a 74LS11 integrated circuit at U76.
- ☑ Insert a 74LS02 integrated circuit at U84.
- ☑ Insert a 74LS32 integrated circuit at U85.
- ☑ Check the orientation of pin 1 of all ten integrated circuits and solder them in place.
- ■ Insert 40-pin (2 by 20) headers at the following two locations (the shorter pins are inserted into the board):
  - ☑ J3
  - ☑ J4
- ☑ Solder the two headers in place. If a header is bent so that all pins do not insert equally, solder one end first, then press the remaining pins in place and resume soldering from the other end.

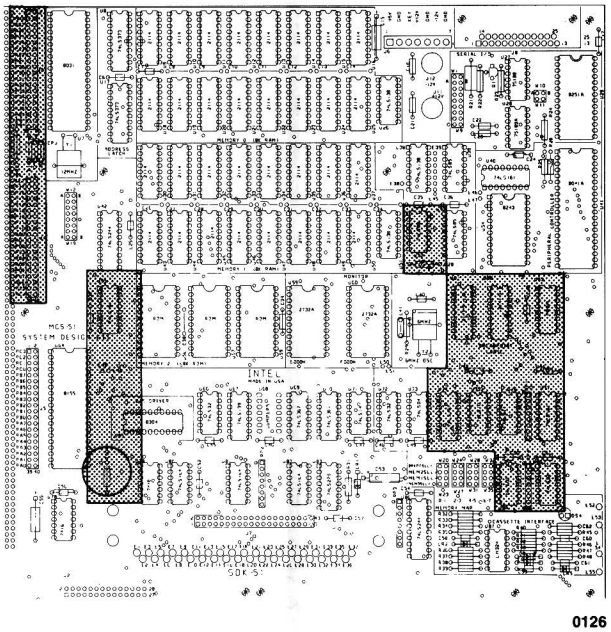

Figure 3-20. Breakpoint Logic Area

CHECK DATA BUS AND BREAKPOINT LOGIC

- ☑ Install shorting-plugs at the following locations (placing value 00H on data bus lines and low on WR/):

  P00 (J4 pins 19 and 20)
  P01 (J4 pins 21 and 22)
  P02 (J4 pins 23 and 24)
  P03 (J4 pins 25 and 26)
  P04 (J4 pins 27 and 28)
  P05 (J4 pins 29 and 30)
  P06 (J4 pins 31 and 32)
  P07 (J4 pins 33 and 34)
  P36 (J3 pins 35 and 36)

- ☑ Apply power to the board.

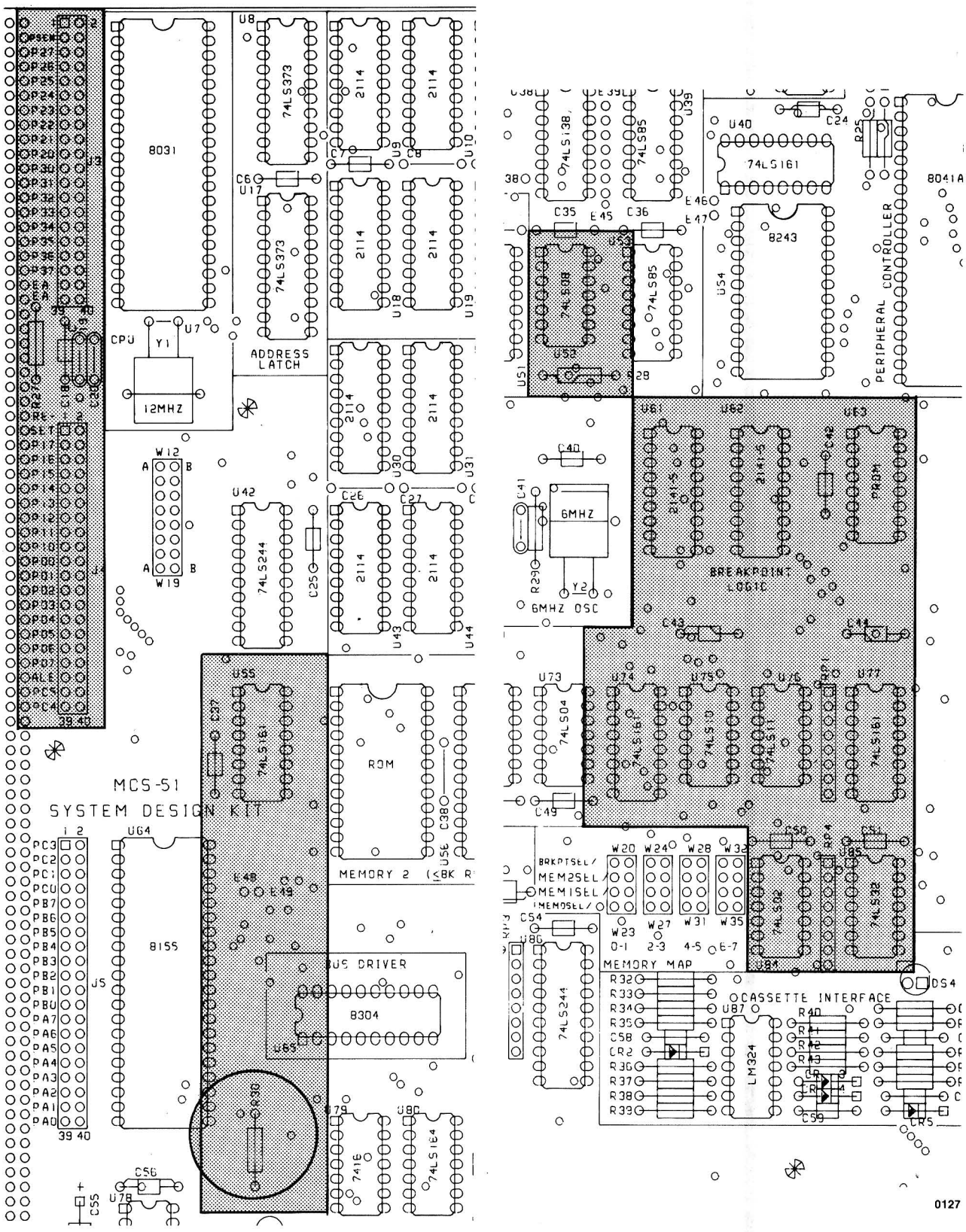

Figure 3-21. Breakpoint Logic, Details

- Check the logic levels at the following locations using a voltmeter (high = 2.4 V to +5 V; low = 0.0 V to 0.7 V):

Integrated Circuit	Pin	Level	Check if Correct
U65 (8304)	9	low	✓
	11	low	✓
	1	low	✓
	2	low	✓
	3	low	✓
	4	low	✓
	5	low	✓
	6	low	✓
	7	low	✓
	8	low	✓
U63 PROM	10	high	✓
	11	high	✓
	12	high	✓

☑ Remove the shorting-plugs from P07 (J4 pins 33 and 34) and P05 (J4 pins 29 and 30); this places value A0H on the data bus.

- Check the logic levels at the following locations:

Integrated Circuit	Pin	Level	Check if Correct
U65 (8304)	9	low	✓
	11	low	✓
	1	low	✓
	2	low	✓
	3	low	✓
	4	low	✓
	5	low	✓
	6	high	✓
	7	low	✓
	8	high	✓
U63 PROM	10	low	✓
	11	high	✓
	12	low	✓

☑ Remove the shorting-plug from P02 (J4 pins 23 and 24); this places value A4H on the data bus.

- Check the logic levels at the following locations:

Integrated Circuit	Pin	Level	Check if Correct
U65 (8304)	9	low	✓
	11	low	✓
	1	low	✓
	2	low	✓
	3	high	✓
	4	low	✓
	5	low	✓
	6	high	✓
	7	low	✓
	8	high	✓
U63 PROM	10	low	✓
	11	low	✓
	12	low	✓

☑ Momentarily ground PSEN/ (J3 pins 3 and 4), then remove ground.

☑ Press the two RESET keys on the keyboard. *Do not press any other keys!*

☑ Check that the logic level at U84 pin 9 is a high.

☑ Remove the shorting plug from P36 (J3 pins 35 and 36).

- Check the logic levels at the following locations:

Integrated Circuit	Pin	Level	Check if Correct
U77	1	high	✓
	12	low	✓
	13	low	✓
	14	low	✓

Check that the logic level at P32 (J3 pin 25) is high.

☑ Press the "A" key on the keyboard. Check that the logic level at jumper location P32 (J3 pin 25) is low.

☑ Check that the level at U79 pin 11 (GUARD-EDACC) is low.

☑ Momentarily ground pin 6, then pin 15 of U83. Check that the logic level at U79 pin 11 is high.

☑ Remove the remaining shorting-plugs from J4.

☑ Turn power off.

ASSEMBLY OF THE MICROCONTROLLER, MONITOR, AND RAM AREAS

Refer to Figures 3-22 and 3-23.

- ☑ Insert a 22k ohm (red-red-red) resistor at R27.
- ■ Insert 20 pF mica capacitors at the following two locations:
  - ☑ C19
  - ☑ C20
- ☑ Solder the resistor and two capacitors in place and clip their leads.
- ☑ Insert the 12 MHz crystal at Y1. Bend the leads so that the crystal is directly over its silkscreened outline. Solder the crystal in place and clip the leads.
- ☑ Cut a piece of bus wire 1-1/2 inches long. With your needle-nosed pliers, form the bus wire into a U-shaped strap to hold the crystal in place. Insert the strap over the crystal and solder it in place so that the crystal is held snugly to the board. Clip the leads.
- ☑ Insert a 40-pin integrated circuit socket at U7.
- ■ Insert 24-pin integrated circuit sockets at the following two locations:
  - ☑ U59
  - ☑ U60
- ☑ Solder the three sockets in place.
- ☑ Remove the skin-wrap from the 8031 microcontroller circuit. Following the precautions for handling MOS integrated circuits, insert the 8031 in socket U7.
- ☑ Remove the skin-wrap from the two 2732A PROM integrated circuits. Following the precautions for handling MOS integrated circuits, insert the 2732A labeled E000H in socket U59 and the 2732A marked F000H in socket U60.

NOTE

Instead of the next step, you may wish to install 18-pin (machined-contact) sockets at U9 and U18, and insert the 2114A's in the sockets. The same option may be applied to all the RAM locations.

- ■ Insert 2114A integrated circuits at the following two locations:
  - ☑ U9
  - ☑ U18
- ☑ Check the orientation of pin 1 on the two integrated circuits and solder them in place.
- ☑ Insert a 40-pin (2 by 20) header at J5 and solder it in place. The shorter pins go in the board. If the header is bent so that all pins do not insert equally, solder one end first, then press the remaining pins in place and resume soldering from the other end.
- ☑ Insert a 16-pin (2 by 8) header at W12 through W19 and solder it in place. (The shorter pins are inserted into the board.)

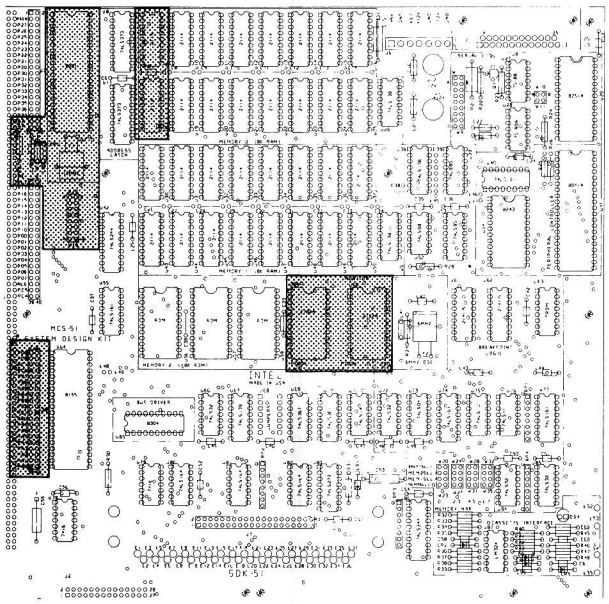

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Figure 3-22. Microcontroller, Monitor and RAM Areas

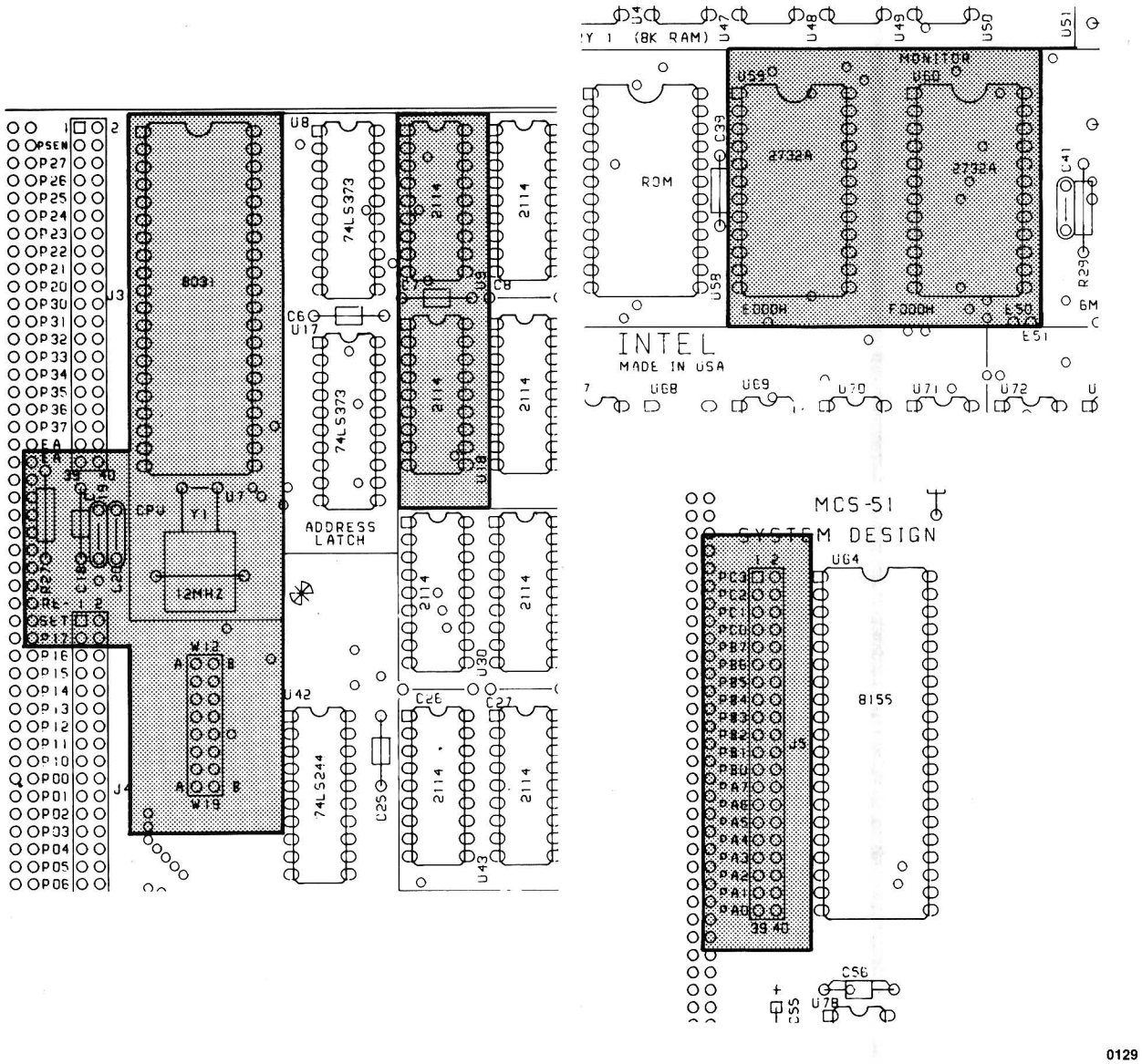

Figure 3-23. Microcontroller, Monitor and RAM Areas, Details

ASSEMBLY OF THE PARALLEL I/O AREA

Refer to Figure 3-24.

- ☑ Insert a 40-pin integrated circuit socket at U64 and solder it in place.
- ☑ Remove the skin-wrap from the 8155-2 Parallel I/O integrated circuit. Follwing the precautions for handling MOS integrated circuits, insert the 8155 in socket U64.

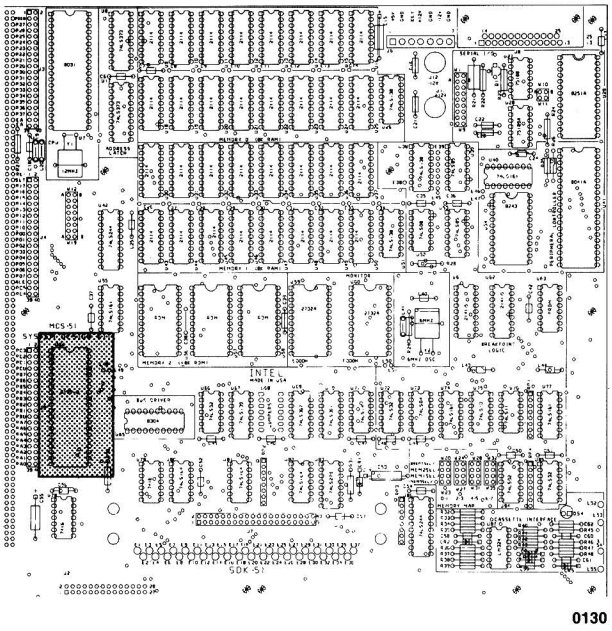

Figure 3-24. Parallel I/O Controller

ASSEMBLY OF THE SERIAL I/O PORT AREA

Refer to Figures 3-25 and 3-26.

- □ Insert the 510 ohm, 1/2 watt (green-brown-brown) resistor at R21.
- □ Insert a 680 ohm (blue-grey-brown) resistor at R22.
- □ Insert a 15k ohm (brown-green-orange) resistor at R23.
- □ Insert a 330 ohm (orange-orange-brown) resistor at R24.

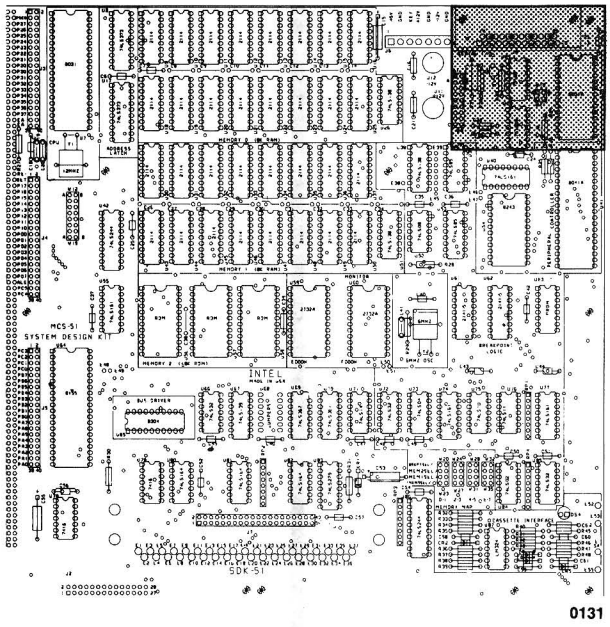

Figure 3-25. Serial I/O Port Area

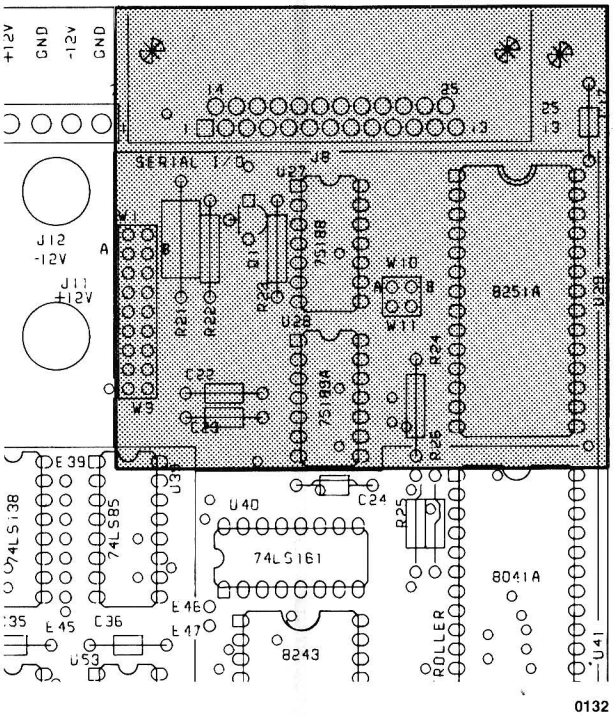

Figure 3-26. Serial I/O Port Area, Detail

- ☐ Insert the 2N3906 transistor at Q1, aligning the flat side with the straight line marked on the board. When installed, the transistor stands approximately 1/4 inch above the board.
- ☐ Solder the four resistors and the transistor in place and clip the leads.
- ☑ Insert a 75188 (or, in some kits, a 1488) integrated circuit at U27.
- ☑ Insert a 75189A (or, in some kits, a 1489) integrated circuit at U28.

NOTE

Instead of the following step, you may wish to install a 28-pin (machined-contact) socket at U29, then insert the 8251A in the socket.

- ☑ Insert a 8251A integrated circuit at U29.
- ☑ Check the orientation of pin 1 of the three integrated circuits and solder them in place.
- ☑ Insert the 25-pin connector at J8 and solder it in place.
- ☑ Insert an 18-pin (2 by 9) header at W1 through W9 and solder it in place. (The shorter pins are inserted into the board.)
- ☑ Insert a 4-pin (2 by 2) header at W10 through W11 and solder it in place. (The shorter pins are inserted into the board.)

NOT DONE

ASSEMBLY OF THE CASSETTE INTERFACE

Refer to Figures 3-27 and 3-28.

- ☐ Insert a .001 μF 10% radial lead capacitor (code 102) at C58.
- ■ Insert .001 μF axial lead capacitors (code 102) at the following two locations.
  - ☐ C60
  - ☐ C62 (just above R45)
- ☐ Insert 1 .01 μF ±10% radial lead capacitor (code 103) at C61.
- ☐ Solder the four capacitors in place and clip the leads.

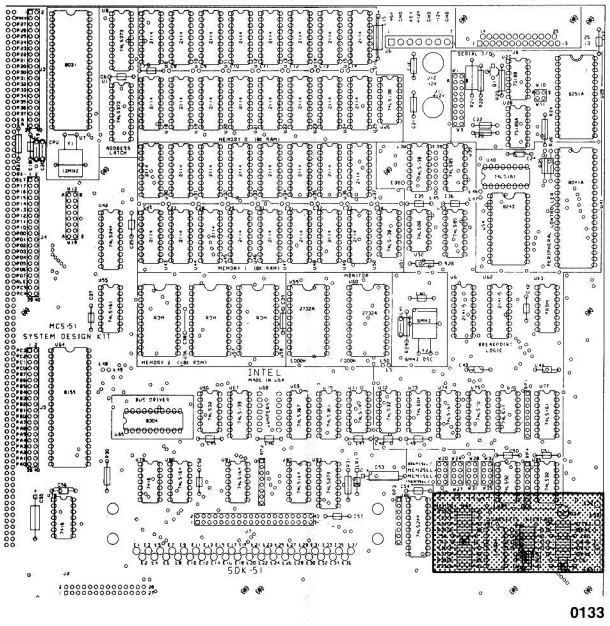

Figure 3-27. Cassette Interface

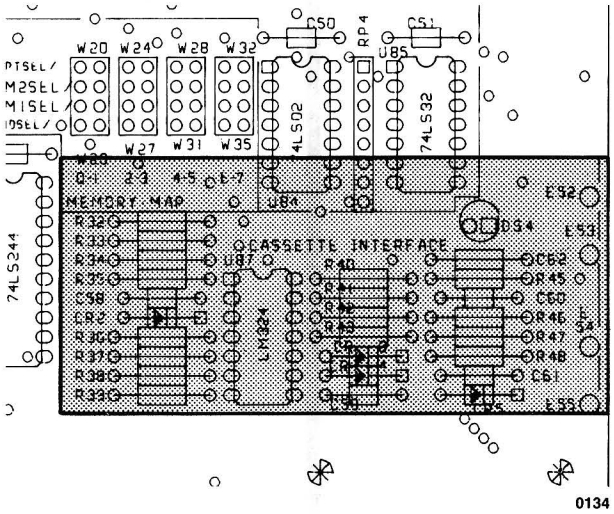

Figure 3-28. Cassette Interface, Detail

- ■ Insert 33k ohm resistors (orange-orange-orange) at:
  - ☐ R32
  - ☐ R40
- ■ Insert 15k ohm resistors (brown-green-orange) at:
  - ☐ R33
  - ☐ R42

- Insert 27k ohm resistors (red-violet-orange) at:
  - ☐ R34
  - ☐ R46
  - ☐ R48
- Insert 100 ohm resistors (brown-black-brown) at:
  - ☐ R35
  - ☐ R47
- Insert 10k ohm resistors (brown-black-orange) at:
  - ☐ R36
  - ☐ R38

☐ Insert the 470 ohm resistor (yellow-violet-brown) at R37.

☐ Insert a 2.7k ohm resistor (red-violet-red) at R39.

☐ Insert a 100k ohm resistor (brown-black-yellow) at R41.

☐ Insert a 1k ohm resistor (brown-black-red) at R43.

☐ Insert a 4.7k ohm resistor (yellow-violet-red) at R45.

☐ Solder the 16 resistors in place and clip the leads.

- Insert 1N4148 (or 914) diodes at the following four locations:
  - ☐ CR2
  - ☐ CR3
  - ☐ CR4
  - ☐ CR5

☐ Check that the bands on the diodes are aligned with the square pads on the board, then solder the four diodes in place and clip the leads.

☐ Insert the red LED at DS4, aligning the flat edge with the square pad. Solder the LED in place and clip the leads.

☐ Insert an LM324 integrated circuit at U87, check the orientation of pin 1, and solder it in place.

INITIAL POWER UP

- Place shorting plugs to connect the two pins on the following four jumpers:
  - ☐ W20 (Assigns breakpoints to low memory addresses)
  - ☐ W23 (Assigns Memory 0 to low addresses)
  - ☐ W26 (Assigns Memory 1 to next lowest addresses)
  - ☐ W29 (Assigns Memory 2 to next lowest addresses)

  Refer to the User's Manual for details on the memory select system.

- Place shorting plugs on the following jumpers to select RS-232 mode. Note that each of these jumpers has labels A and B on its two pins; some shorting plugs are placed to connect adjacent jumpers (A to A or B to B) rather than A to B on the same jumper.
  - ☐ W2A - W2B
  - ☐ W3A - W3B
  - ☐ W4A - W4B
  - ☐ W5A - W5B
  - ☐ W6A - W6B
  - ☐ W7A - W8A (adjacent jumpers)
  - ☐ W10B - W11B (adjacent jumpers on the 2-pin by 2-pin header)

☐ Insert power cord and apply power.

☐ The message SDK-51 MONITOR VER. *xxxx* should appear on the display. (The field *xxxx* contains the version number of the Monitor.)

☐ Press the RETURN key; the sign-on message is replaced by the hyphen prompt (blinking). Please refer to the SDK-51 User Guide for operating instructions.

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