

88-VLCT

Documentation

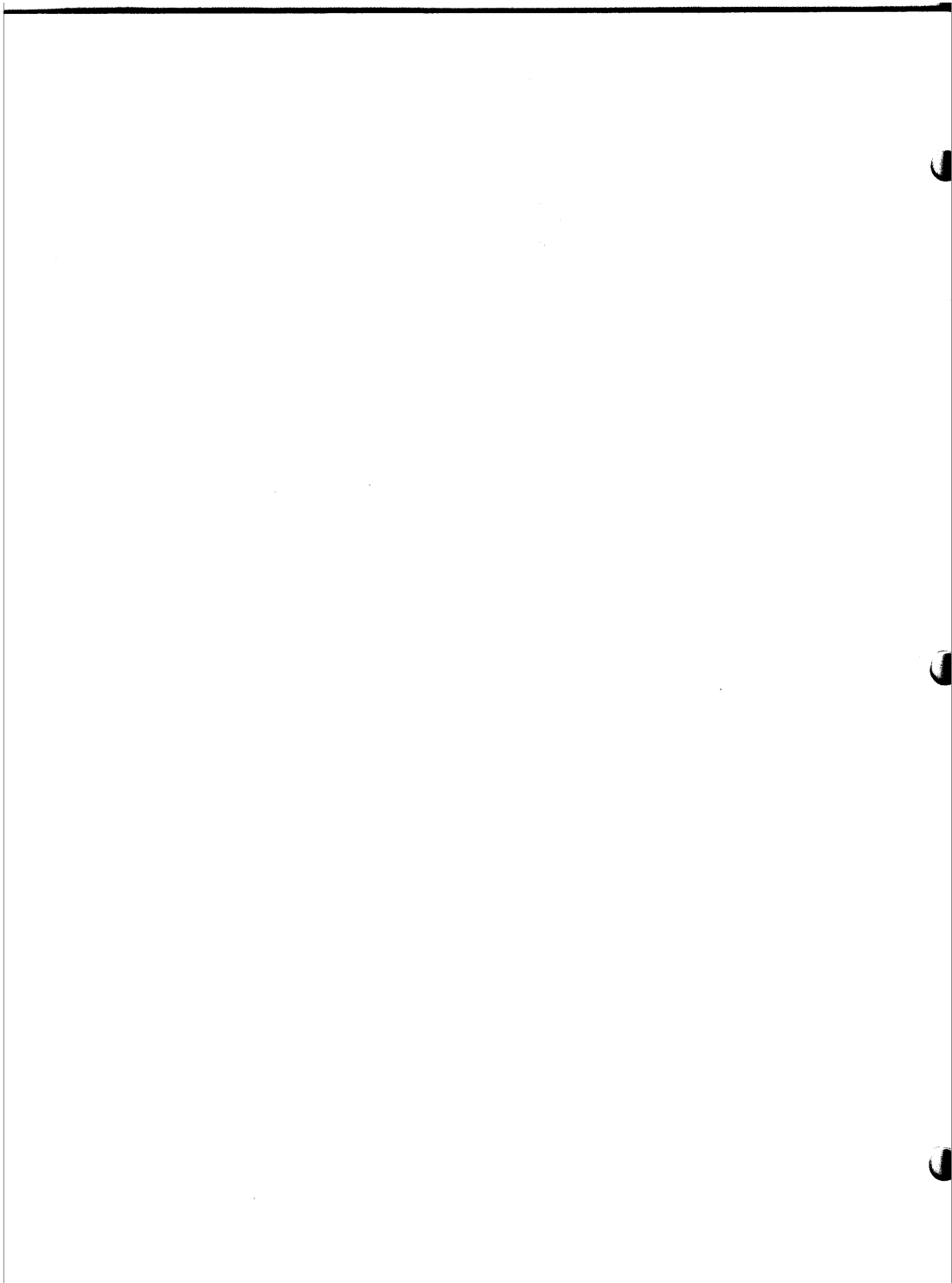
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88-VLCT
Parts List
June, 1975

BAG 1

3	7400	101020
1	7410	101024
2	N7420A	101038
3	7447	101025
1	7473	101027
4	74L74	101063
2	N7475	101041
2	74123	101060
1	MA7805	101074

BAG 2

1	15 ohm 1/2w	101920
1	56 ohm 1w	101953
following may be 1/2w or 1/4w:		
1	47 ohm	101922
1	100 ohm	101924
9	330 ohm	101926
2	470 ohm	101927
4	2.7K ohm	101929
5	10K ohm	101932

BAG 3

1	50pF 10v	100920
2	.001uF 10v	100329
2	.01uF 200v or more	100305
2	.1uF 10v	100327
1	4.7uF 10v or 5mF 10v	100309
1	33uF 10v	100326
1	1500uF 10v	100319

BAG 4

4	IN4004	100718
9	RL-50	100704
3	DL-707R	100716

BAG 5

13	6" blue wire	103017
2	14" blue wire	103051
1	6' 25-conductor cable	103057

BAG 6

6	4-40x3/8" screw	100908
2	4-40x5/16" screw	100912
2	6-32x5/8" screw	100916
2	6-32x1/2" screw	100918
1	6-32x1" screw	100919
4	8-32x5/8" screw	100926
2	8-32x1" screw	100927
8	4-40 nut	100932
5	6-32 nut	100933
2	PAL nut (for switch bezel)	100934
8	#4 lock washer	100941
5	#6 lock washer	100942
2	60° LED bracket	101716
2	Fuse clip	101726
1	Heat sink - large	101870

BAG 7

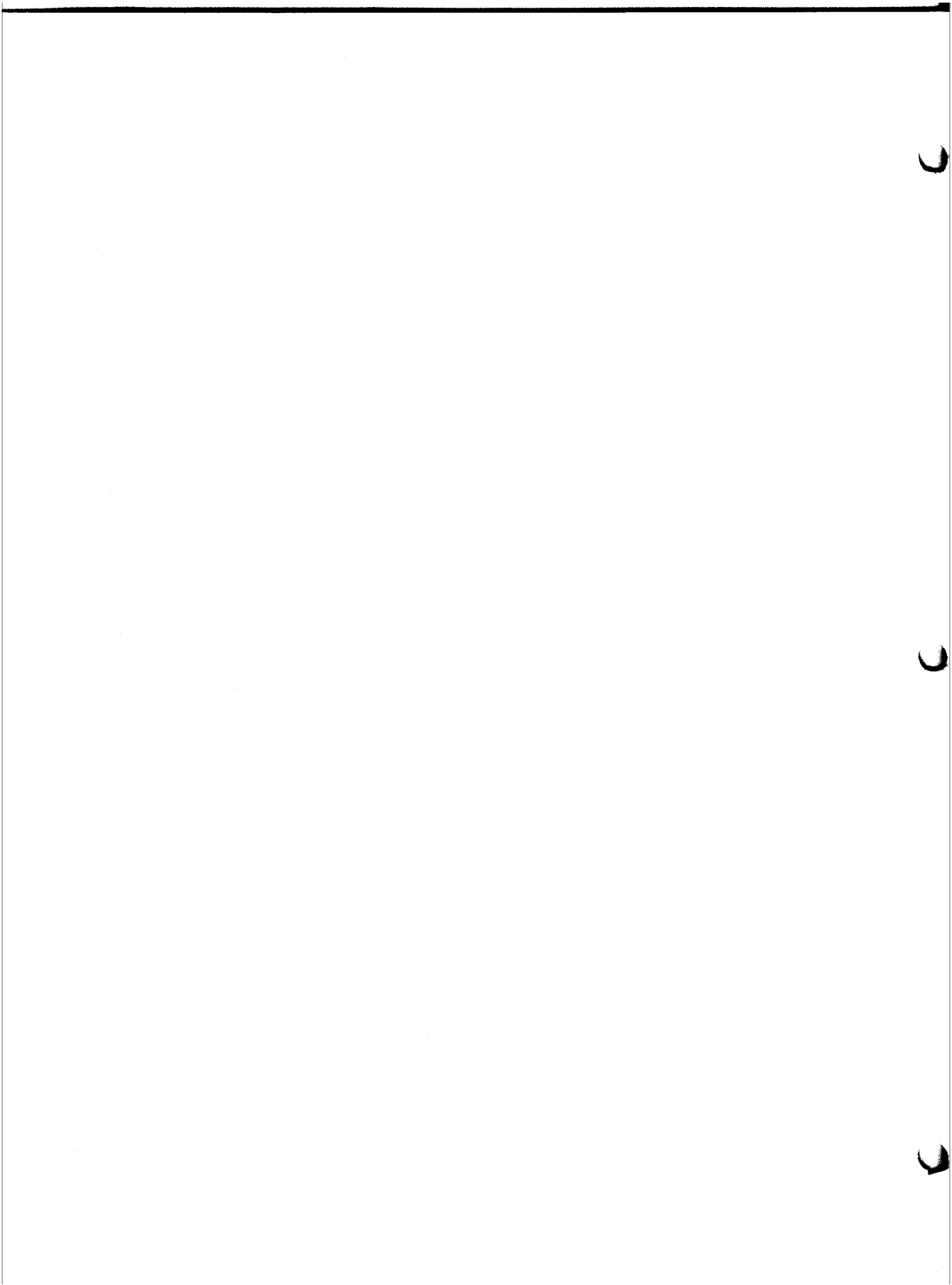
4	Rubber feet - large	101752
1	Fuse - 1 amp	101773
1	25-pin connector	102111
1	Rocker switch	102354
1	Switch bezel	102350
2	Keyswitch (4 keys-663)	102301
1	Keyswitch (3 keys-663 mod)	102301
1	Connector cover	101739
1	Small strain relief	101719
1	Large strain relief	101774

BAG 8

1	Gray key top #0	101290
1	Gray key top #1	101231
1	Gray key top #2	101232
1	Gray key top #3	101233
1	Gray key top #4	101234
1	Gray key top #5	101235
1	Gray key top #6	101236
1	Gray key top #7	101237
1	Gray key top "R"	101291
1	Red double key top "C"	101216

MISCELLANEOUS

1	Case top	100540
1	Base	101706
1	Power cord	101742
1	133P-3 transformer	102607
1	Red filter	101760
1	Cover plate	101785
1	Filter bezel	101709
6	Insert (with case top)	100947
1	PC board (main)	100177
1	PC board (display)	101176
1	Assem & Oper Manual	101513



88-VLCT

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ASSEMBLY HINTS

Before beginning the construction of your unit, it is important that you read the "Kits Assembly Hints" booklet. Pay particular attention to the section on soldering because most problems in the 88-VLCT occur as the result of poor soldering. Failure to heed the warnings in the "Kits Assembly Hints" booklet may cause you to void your warranty.

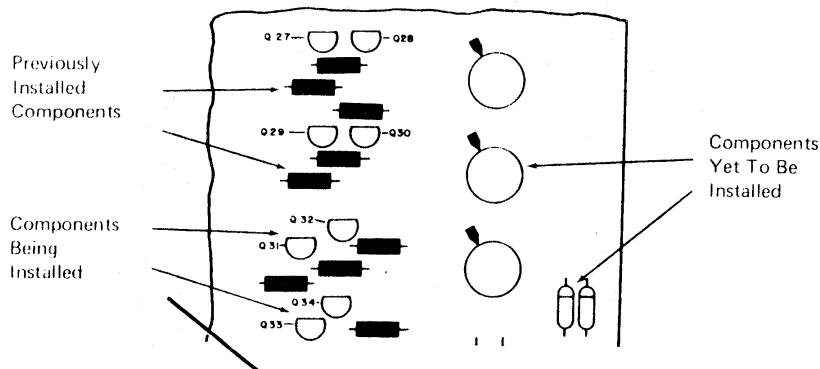
The type of soldering iron used is critical. Use a 30-40 watt iron with a chisel tip, such as an Ungar 776 with a 7155 tip. The delicate soldering necessary for this unit precludes using a blunt-tipped iron.

Each component should be installed in the order presented in the assembly instructions. Each component must be placed in its correct position on the board. There are drawings throughout the assembly instructions which will aid you in installing the components correctly. Some components (diodes, integrated circuits, some capacitors, and transistors) have special orientations on the board. These special orientations are called out in the assembly instructions; it is important that you note them carefully before installing the components.

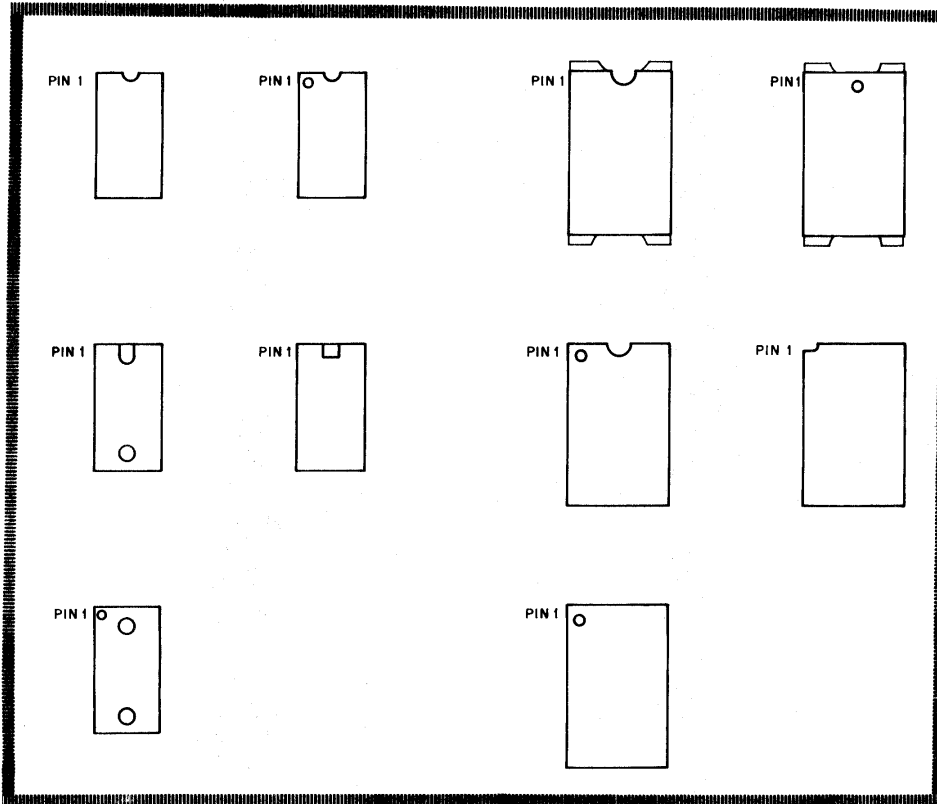
After a component has been soldered to the board, check it off in the space provided on the page. Before going on to a new page, check to make sure all the components on that page have been installed.

Check the contents of your kit against the enclosed parts list to make sure you have all the required components, hardware and parts. The components are in plastic envelopes; do not open them until you need the components for an assembly step. You will need the tools called for in the "Kits Assembly Hints" booklet.

To assist you in assembling your unit, a coding system is used to identify the components already installed, components being installed, and components to be installed later. Compare each page with your circuit board to ensure that all components are installed before going on to a new page.

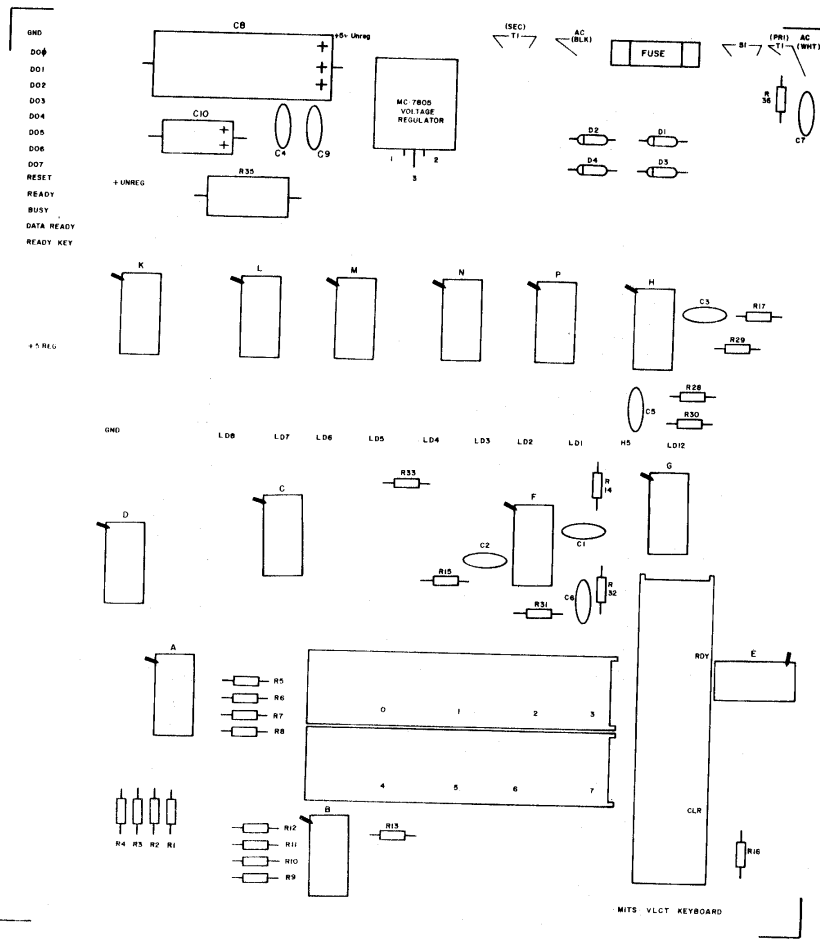


IC ORIENTATION CHART



INTEGRATED CIRCUITS (IC's) CAN COME WITH ANY ONE OF, OR A COMBINATION OF, SEVERAL DIFFERENT MARKINGS. THESE MARKINGS ARE VERY IMPORTANT IN DETERMINING THE CORRECT ORIENTATION FOR INSTALLATION. REFER TO THE ABOVE DRAWING TO DETERMINE THE POSITION OF PIN 1 OF THE IC AND USE THIS INFORMATION TO ORIENT IT AS DESCRIBED IN THE ASSEMBLY MANUAL.

WARNING: IF THE IC's ARE NOT PROPERLY ORIENTED DURING INSTALLATION, IT MAY RESULT IN PERMANENT DAMAGE TO YOUR UNIT.



KEYBOARD COMPONENT LAYOUT

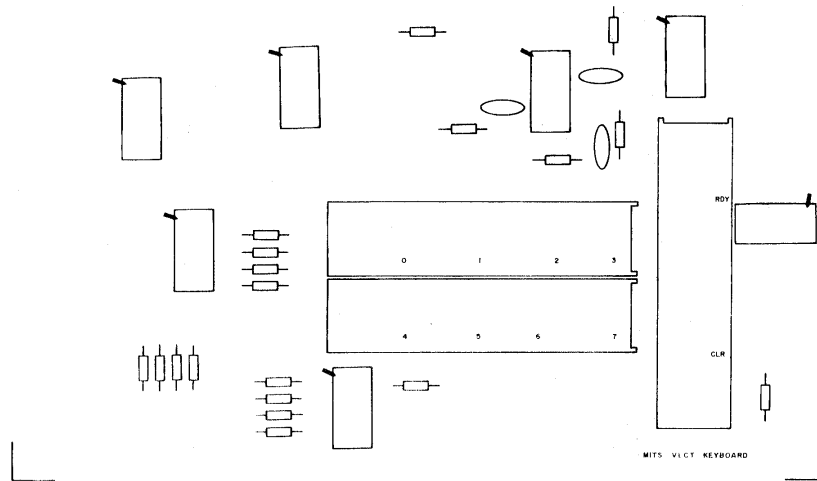
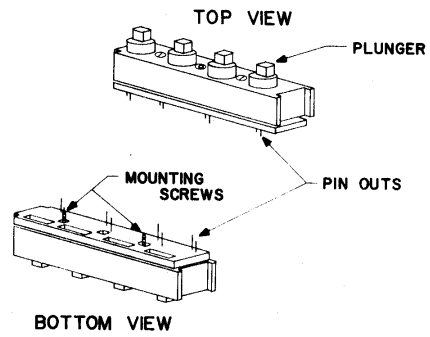
ASSEMBLY MANUAL

KEYBOARD ASSEMBLY

Key Block Installation

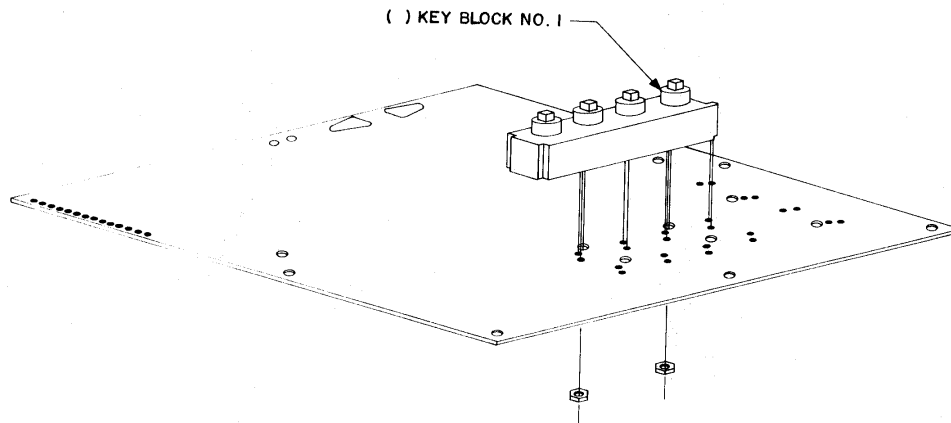
There are 3 key blocks to be installed on the 88-VLCT keyboard.

The key blocks must be oriented so that the tabbed end corresponds with the printed tabs on the silk-screened side of the board. (see component layout)



() Align key block number 1 so that the tabbed end corresponds with the printed tabs on key block position 1 on the circuit board. Take care that the mounting screws and pins on the key block align with their respective holes on the circuit board.

WARNING: If the key block pins are bent, it will be necessary to straighten them before inserting them into the holes. If the pins are straight but you encounter resistance in getting them into the holes, guide each pin into place with the point of a pencil or a circle compass.



() Insert the key block into the circuit board.

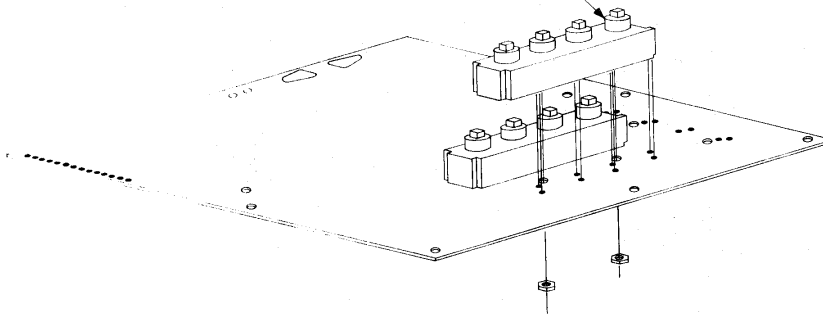
() While holding the key block in place, turn the circuit board over and place two #2-56 nuts on the mounting screws. Turn the nuts only until the key block is held loosely to the board. **DO NOT SOLDER THE PINS IN PLACE.** This will be done in a later assembly step.

() Install key blocks numbers 2 & 3 in this manner. Make sure that the tabbed ends of the keyblocks correspond to the printed tabs on the board.

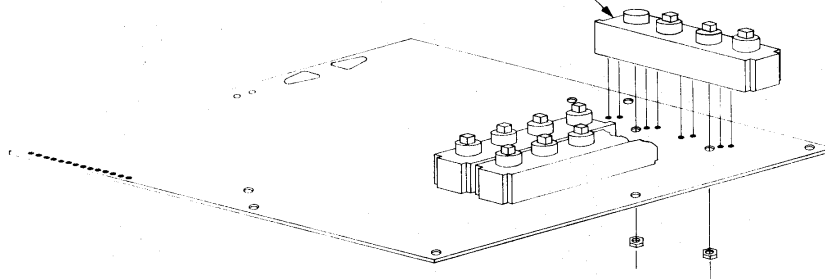
NOTE: Key block number 3 will have the top removed from the fourth plunger (closest to the tabbed end).

() After double checking the positioning of each key block, tighten the mounting nuts and then solder the key block pins to the foil pattern on the back side of the board.

() KEY BLOCK NO. 2



() KEY BLOCK NO. 3



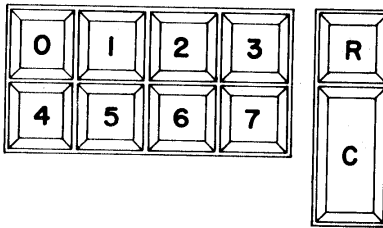
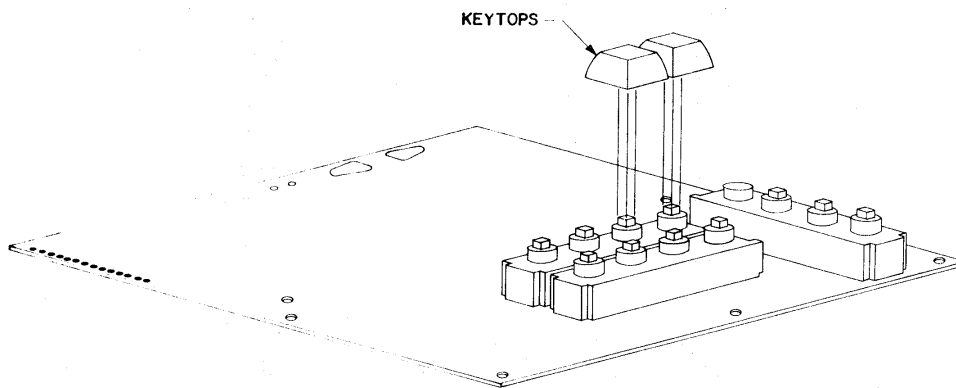
Keytop Installation

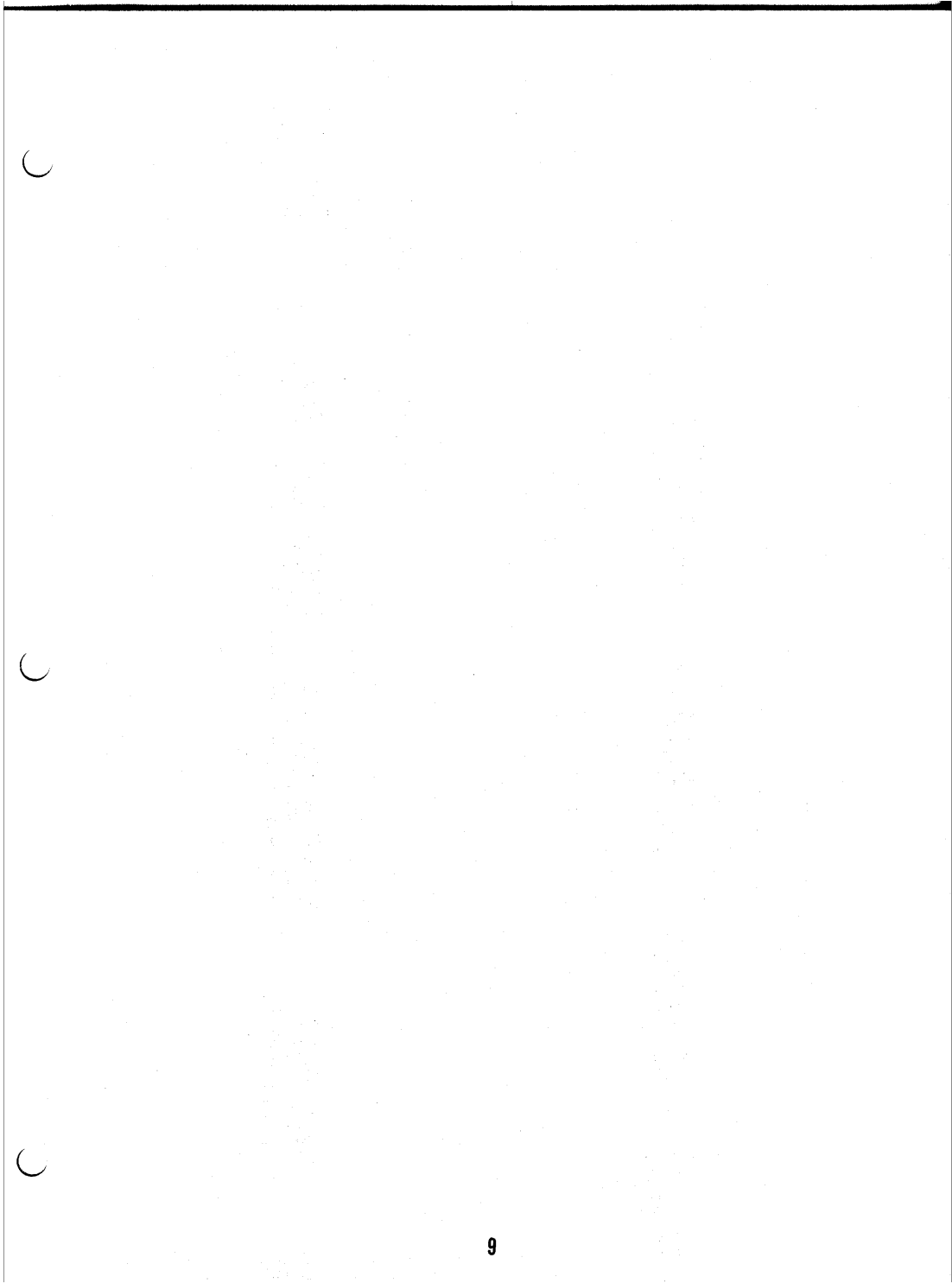
Refer to the diagrams below and the component layout to install the keytops in the positions shown.

() Press the keytops onto the white key block plungers.

The CLEAR key will occupy the two plungers farthest from the tabbed end of key block 3.

Your keyboard should be identical to the one printed below.





Integrated Circuit Installation

There are 13 integrated circuits (IC's) to be installed on the 88-VLCT keyboard. Be certain that you choose the IC with the correct part number as you install each one.

- () Beginning with IC A -- part number 7420 -- remove the IC from its holder. If there are any bent pins, straighten these using needle-nose pliers.
- () Orient the IC so that the notched end is toward the end with the arrowhead printed on the PC board. Pin 1 of the IC should correspond with the pad marked with the arrowhead.

NOTE: If the IC does not have a notch on one end, refer to the IC Orientation Chart included with your manual for the identification of pin 1.

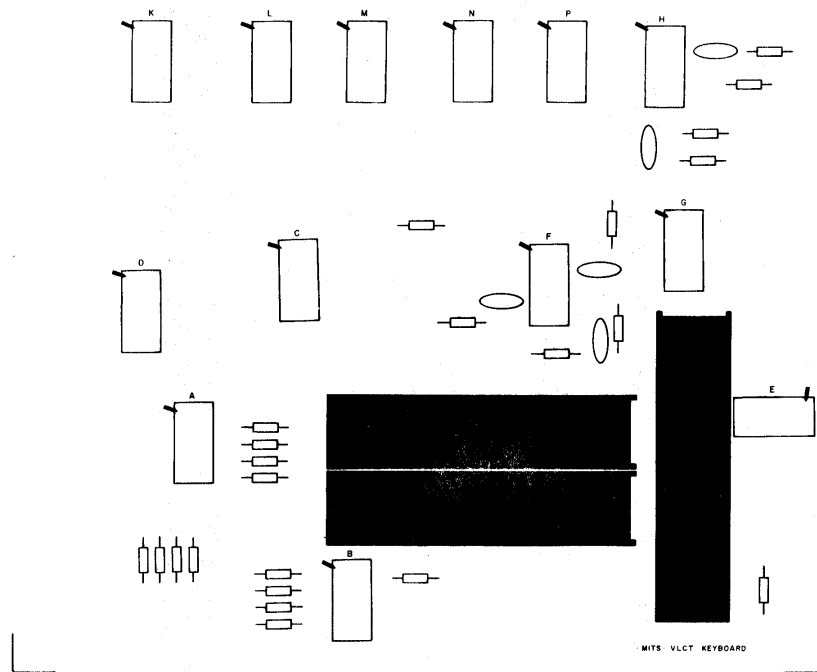
- () When you have the correct orientation, start the pins on one side of the IC into their respective holes on the silk-screened side of the PC board. DO NOT PUSH THE PINS IN ALL THE WAY. If you have difficulty getting the pins into the holes, use the tip of a small screwdriver to guide them.

- () Start the pins on the other side of the IC into their holes in the same manner. When all of the pins have been started, set the IC in place by gently rocking it back and forth until it rests as close as possible to the board. Make sure that the IC is perfectly straight and as close as possible to the board; then tape it in place with a piece of masking tape.

- () Turn the board over and solder each pin to the foil pattern on the back side of the board. Be sure to solder each pin and be careful not to leave any solder bridges.
- () Turn the board over again and remove the piece of masking tape.

Referring to the component layout, use the same procedure to install each of the IC's. Be sure that you have the correct part number and the correct orientation as you install each one.

- () A & B are 7420's
- () C, D & E are 7400's
- () F & H are 74123's
- () G is a 7473
- () K is a 7410
- () L, M, N & P are 74L74's



Resistor Installation

There are 25 resistors to be installed on the 88-VLCT keyboard.

NOTE: Resistors are color-coded according to their value. The resistors in your kit will have four or possibly five bands of color. The fourth band in both cases will be gold or silver, indicating the tolerance. In the following instructions we will be concerned only with the three bands of color to one side of the gold or silver band. Be sure to match these three bands of color with those called for in the instructions as you install each resistor.

Using needle-nose pliers, bend the leads of the following resistors at right angles to match their respective holes on the PC board. (see component layout)

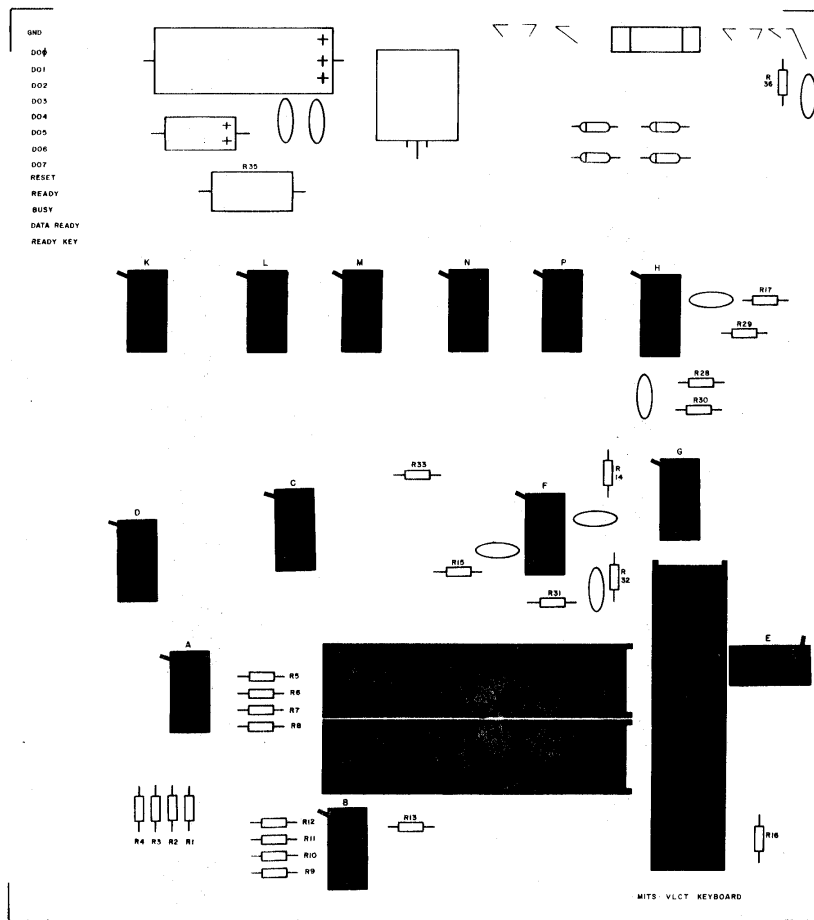
NOTE: All of the resistors on the keyboard may be 1/2W or 1/4W except R35, which is 1W.

- () Install resistor R1 (2.7K ohm, red-violet-red) into the correct holes on the silk-screened side of the PC board.
- () Holding the resistor in place with one hand, turn the board over and bend the two leads slightly outward.
- () Solder the leads to the foil pattern on the back side of the board; then clip off any excess lead lengths.

Referring to the component layout, install the remaining resistors in the same manner. Be sure you have the correct color-coding for each one as you install them.

- () R1 through R13 and R16 are all 2.7K-ohm (red-violet-red)
- () R14, R15, R17, R30 and R32 are all 10K-ohm (brown-black-orange)
- () R28 and R29 are 470-ohm (yellow-violet-brown)

- () R31 is 47-ohm (yellow-violet-black)
- () R33 is 100-ohm (brown-black-brown)
- () R35 is 56-ohm, 1W (green-blue-black)
- () R36 is 15-ohm (brown-green-black)



Capacitor Installation

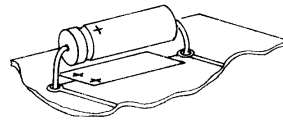
There are 7 ceramic disk and 3 electrolytic capacitors to be installed on the 88-VLCT keyboard.

Refer to the component layout and install the ceramic disk capacitors (C2 through C7 and C9) according to the following procedure.

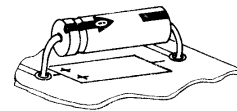
- () Choose the capacitor with the correct value as called for in the instructions. Straighten the two leads and bend them as necessary to fit their respective holes on the PC board.
- () Insert the capacitor into the correct holes from the silk-screened side of the board. Push the capacitor down until the ceramic insulation almost touches the foil pattern.
- () Holding the capacitor in place, turn the board over and bend the leads slightly outward.
- () Solder the two leads to the foil pattern on the back side of the board; then clip off any excess lead lengths.

Install all of the ceramic disk capacitors in this manner. Be sure that you have the correct value capacitor as you install each one.

The 3 electrolytic capacitors have polarity requirements which must be noted before installation. The capacitors contained in your kit may have one or possibly two of three types of polarity markings. To determine the correct orientation, look for the following (see drawing):



ELECTROLYTIC CAPACITOR



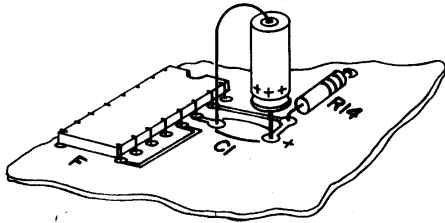
One type will have plus (+) signs on the positive end; another will have a band or a groove around the positive side in addition to the plus signs. The third type will have an arrow on it; in the tip of the arrow there is a negative (-) sign and the capacitor must be oriented so the arrow points to the negative polarity side.

Referring to the component layout, install the electrolytic capacitors C10 and C8 on the board.

- () Bend the two leads of capacitor C10 (35uF) at right angles to match their respective holes on the board. Insert the capacitor into the holes on the silk-screened side of the board. Be sure to align the positive polarity side with the "+" signs printed on the board.
- () Holding the capacitor in place, turn the board over and bend the two leads slightly outward. Solder the leads to the foil pattern and clip off any excess lead lengths.
- () Install capacitor C8 (1500uF) in the same manner.

C1 is a 5uF electrolytic capacitor that is installed with the positive end mounted directly to the board.

NOTE: There are no polarity markings on the board for C1. Make sure you orient C1 as shown in the diagram below, with the positive end down and the negative lead mounted closest to IC "F".



() Referring to the drawing above, hold capacitor C1 vertically as shown and bend the negative lead at a right angle and again at another right angle so that the leads match their respective holes on the PC board.

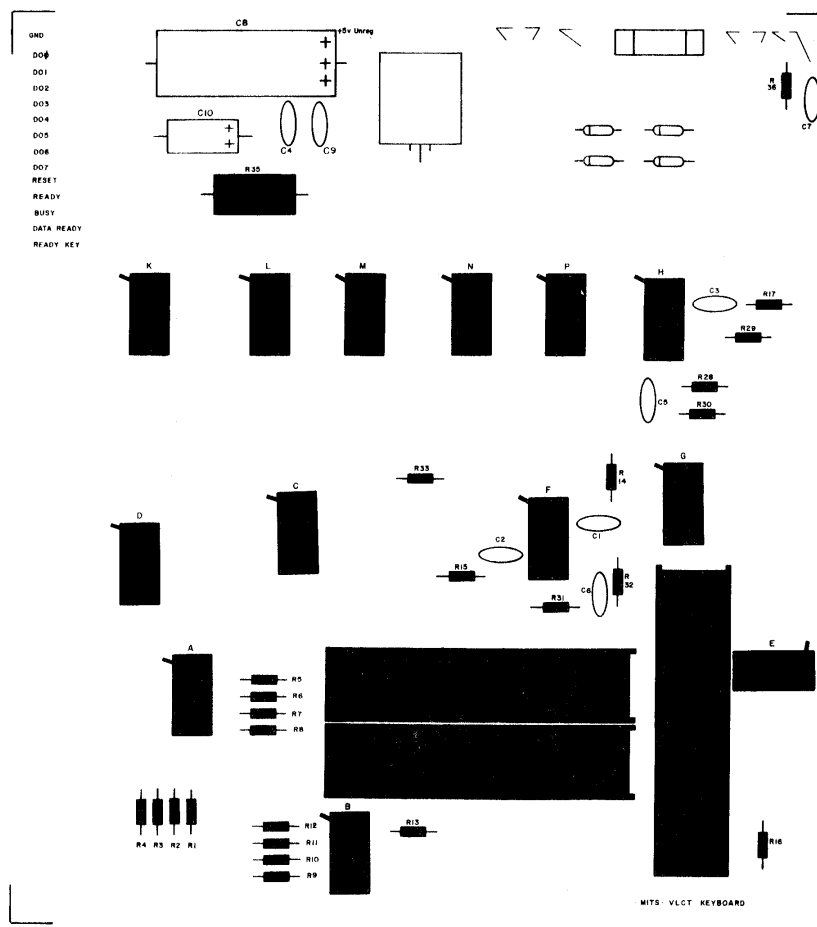
() Insert C1 vertically into its respective holes on the silk-screened side of the board and push it down until the positive end is as close as possible to the board.

() Holding the capacitor in place, turn the board over and bend the two leads slightly outward. Clip off the positive lead so that 1/4 inch remains and bend this flat against the board along the land connected to its respective hole.

() Solder the two leads to the foil pattern on the back side of the board, and clip off the excess lead length on the negative side. Be sure to solder the entire 1/4 inch length of the positive lead to the land, and be careful not to leave any solder bridges.

C2 and C3 are .001uF
 C4 and C9 are .1uF
 C5 is 50pF
 C6 and C7 are .01uF

C10 is 35uF
 C8 is 1500uF
 C1 is 5uF



Diode Installation

There are 4 diodes to be installed on the 88-VLCT keyboard.

NOTE: Diodes are marked with a band on one end indicating the cathode end. The diode must be oriented so that the end with the band is towards the band printed on the board when being installed.

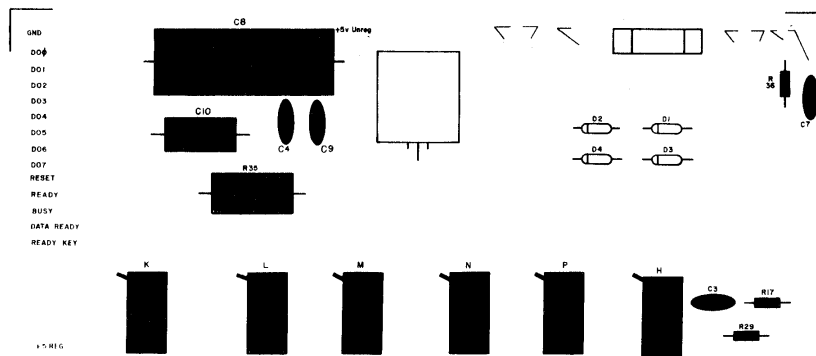
- () Referring to the component layout, bend the leads of diode D1 at right angles to match the correct holes on the board.
- () Insert the diode into the correct holes from the silk-screened side of the board. Turn the board over and bend the two leads slightly outward.

- () Solder the two leads to the foil pattern on the back side of the board; then clip off any excess lead lengths.

Install the remaining 3 diodes in the same manner. Be sure that you have the band on the diode aligned with the band printed on the board as you install each one. Failure to orient these diodes correctly may result in permanent damage to your unit.

D1 through D4 may be 1N4004 or 1N4003 diodes.

- () D1 () D2 () D3 () D4



Voltage Regulator Installation

There is one MC7805 5-volt regulator to be installed on the 88-VLCT keyboard.

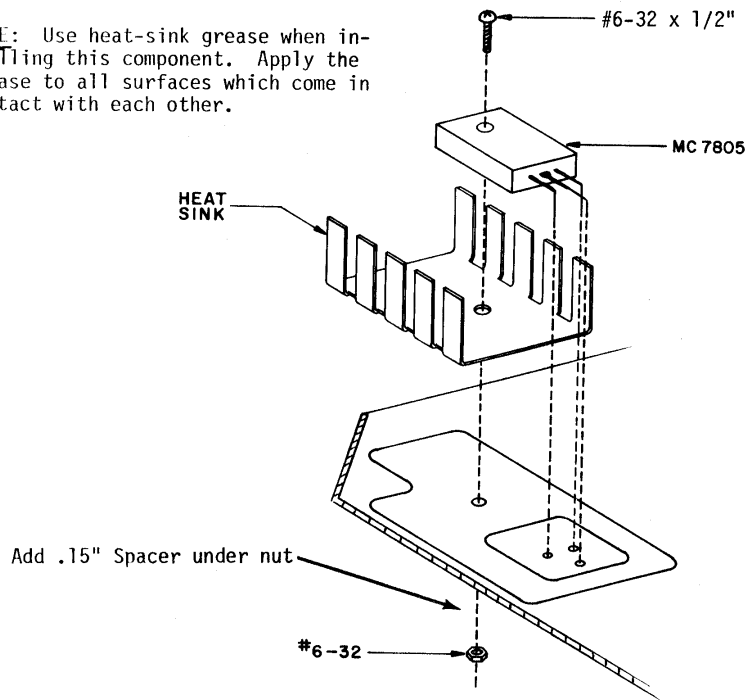
- () Set the MC7805 in place on the board and align the mounting holes. (see drawing)
- () Use a pencil to mark the point on each of the three leads where they line up with their respective holes on the board.
- () Use needle-nose pliers to bend each of the three leads at a right angle on the points where you made the pencil marks.

() Referring to the drawing, set the regulator and heat sink in place on the silk screened side of the board. Secure them to the board using a #6-32 x 1/2" screw, .15" spacer and #6-32 nut. Hold the regulator in place as you tighten the nut to keep from twisting the leads.

() Turn the board over and solder the three leads to the foil pattern on the back side of the board. Be sure not to leave any solder bridges.

() Clip off any excess lead lengths.

NOTE: Use heat-sink grease when installing this component. Apply the grease to all surfaces which come in contact with each other.

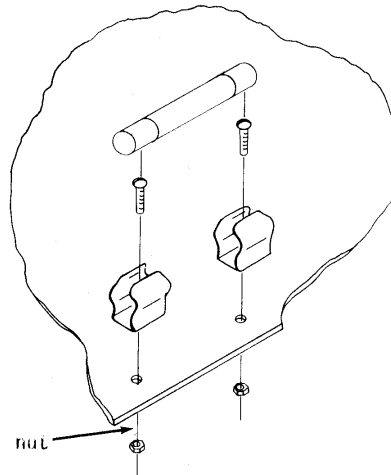


Fuse and Fuse Clip Installation

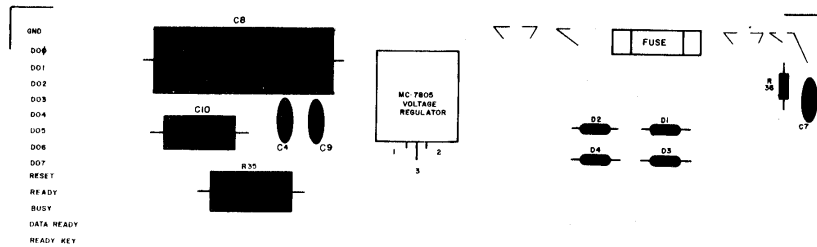
There are two fuse clips and a fuse to be installed on the 88-VLCT keyboard.

- () Spread one of the fuse clips apart slightly and insert a #4-40 X 5/16 inch screw. (see drawing)
- () Align the clip and screw over the correct hole on the silk-screened side of the board and insert the screw into the hole.
- () Holding the clip and screw in place with a screwdriver, place a #4-40 lockwasher and nut onto the screw on the foil side of the board and tighten them securely.
- () Install the second clip in the same manner; then push the clips back together so they will hold the fuse.

- () Carefully insert the fuse into the clips. Be sure that the clips hold the fuse securely in place.



Add #4 lockwasher under nut





KEYBOARD WIRE CONNECTIONS

KEYBOARD WIRE CONNECTIONS

There are 21 wire connections to be made on the 88-VLCT keyboard. Thirteen of these are display board interconnect wires, four are transformer connections, two are from the power cord and two are from the ON/OFF switch.

All wire connections are made by inserting the wire from the silk screened side of the board and soldering the leads on the foil side. Make sure you do not push any insulated portion of the wire into the hole.

NOTE: All wires installed on the PC board should have 1/4" of insulation removed from the ends. Exposed leads should be tinned by applying a thin layer of solder. Some leads may be pre-tinned.

Interconnect Wires

There are thirteen 6-inch interconnect wires to be installed in the holes labeled +UNREG, +5 REG, GND, LD1 through LD8, LD12 and H5. (see component layout)

() Insert the first 6-inch wire into the hole marked "GND" on the silk screened side of the board. Turn the board over and solder the wire to the foil pattern on the back side of the board. Clip off any excess lead length.

() Install the 12 remaining interconnect wires in this manner.

() +UNREG () LD5

() +5 REG () LD6

() LD1 () LD7

() LD2 () LD8

() LD3 () LD12

() LD4 () H5

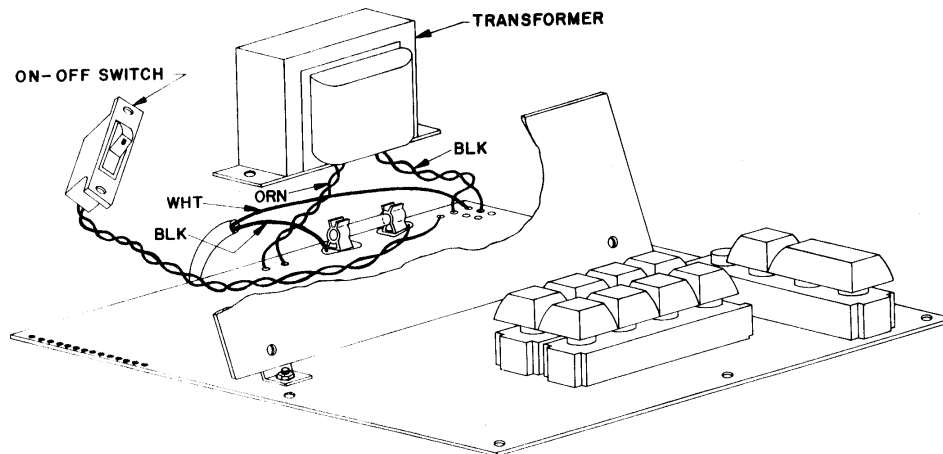
Transformer Wiring

The transformer is wired onto the keyboard using the two black (primary) and the two orange (secondary) transformer wires.

NOTE: The yellow, red and green wires on the transformer will not be mounted and should be clipped off as close to the transformer as possible before it is installed.

() Orient the transformer as shown in the drawing and install the black transformer wires into the correct holes, labeled T1 (PRI) on the PC board. After you insert each wire into the correct hole, turn the board over and solder the wire lead to the foil pattern on the back side of the board. Trim excess lead lengths.

() Install the orange transformer wires, T1 (SEC), in this same manner.



ON/OFF Switch Wiring

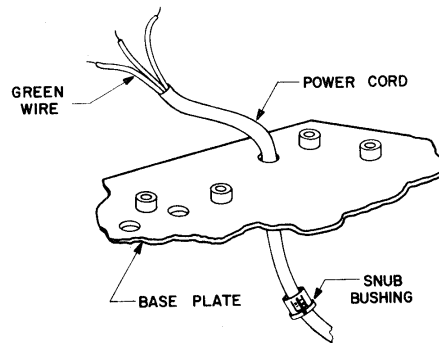
There are two 14" wires to be used in the installation of the ON/OFF switch onto the 88-VLCT keyboard. (see drawing, preceding page)

- () Insert one of the 14" wires into one of the holes labeled S1 on the PC board. Turn the board over and solder the lead to the foil pattern. Clip excess lead length.
- () Install the second 14" wire using this same procedure. Twist the wires together to within 1 1/2" of the unattached ends. Solder these ends to the two terminals extending from the back of the ON/OFF switch.

NOTE: If the ON/OFF switch in your kit has three terminals extending from the back, solder the wires to the terminals labeled "2" and "3."

Power Cord Installation

- () Referring to the drawing below, slip the snub bushing onto the power cord. Slide the snub bushing down the cord until there is 7 inches between the bushing and the exposed ends of the power cord.
- () Insert the exposed wire end of the power cord through the larger hole at the top right-hand corner of the case bottom (base plate). Pull the power cord through and snap the snub bushing in place.
- () Clip off the exposed portion of the green wire, as it will not be used in mounting the power cord.



The power cord is mounted to the board by installing the white and black wires into the holes marked AC (WHT) and AC (BLK) respectively.

- () Insert the white power cord wire into the hole marked AC (WHT) on the silk screened side of the PC board. Turn the board over and solder the lead to the foil pattern. Clip off any excess lead length.
- () In the same manner install the black power cord wire into the hole marked AC (BLK).

DISPLAY BOARD ASSEMBLY

Integrated Circuit Installation

There are 5 integrated circuits (IC's) to be installed on the 88-VLCT display board. Be certain that you choose the IC with the correct part number as you install each one.

- () Beginning with IC R -- part number 7475 -- remove the IC from its holder. If there are any bent pins, straighten these using needle-nose pliers.
- () Orient the IC so that the notched end is toward the end with the arrowhead printed on the PC board. Pin 1 of the IC should correspond with the pad marked with the arrowhead.

NOTE: If the IC does not have a notch on one end, refer to the IC Orientation Chart included with your manual for the identification of pin 1.

- () When you have the correct orientation, start the pins on one side of the IC into their respective holes on the silk-screened side of the PC board. DO NOT PUSH THE PINS IN ALL THE WAY. If you have difficulty getting the pins into the holes, use the tip of a small screwdriver to guide them.

- () Start the pins on the other side of the IC into their holes in the same manner. When all of the pins have been started, set the IC in place by gently rocking it back and forth until it rests as close as possible to the board. Make sure that the IC is perfectly straight and as close as possible to the board; then tape it in place with a piece of masking tape.

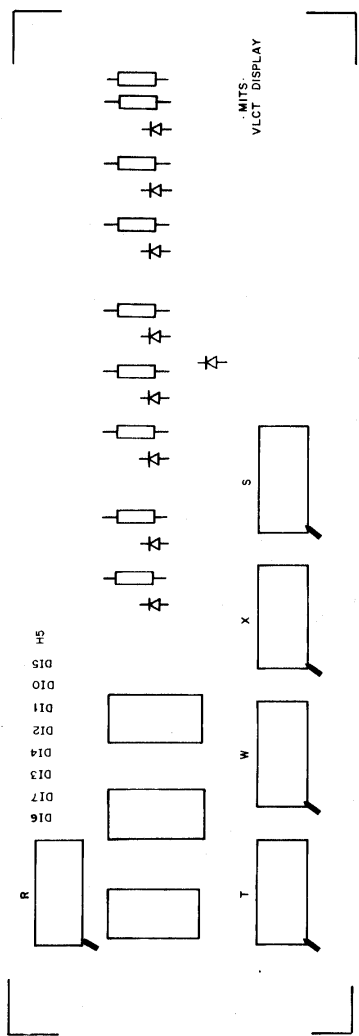
- () Turn the board over and solder each pin to the foil pattern on the back side of the board. Be sure to solder each pin and be careful not to leave any solder bridges.

- () Turn the board over again and remove the piece of masking tape.

Referring to the component layout, use the same procedure to install each of the IC's. Be sure that you have the correct part number and the correct orientation as you install each one.

- () R and S are 7475's

- () T, W and X are 7447's



Resistor Installation

There are 9 resistors to be installed on the 88-VLCT keyboard.

NOTE: Resistors are color-coded according to their value. The resistors in your kit will have four or possibly five bands of color. The fourth band in both cases will be gold or silver, indicating the tolerance. In the following instructions we will be concerned only with the three bands of color to one side of the gold or silver band. Be sure to match these three bands of color with those called for in the instructions as you install each resistor.

NOTE: All of the resistors on the display board are 330-ohm (orange-orange-brown) and all may be 1/2W or 1/4W.

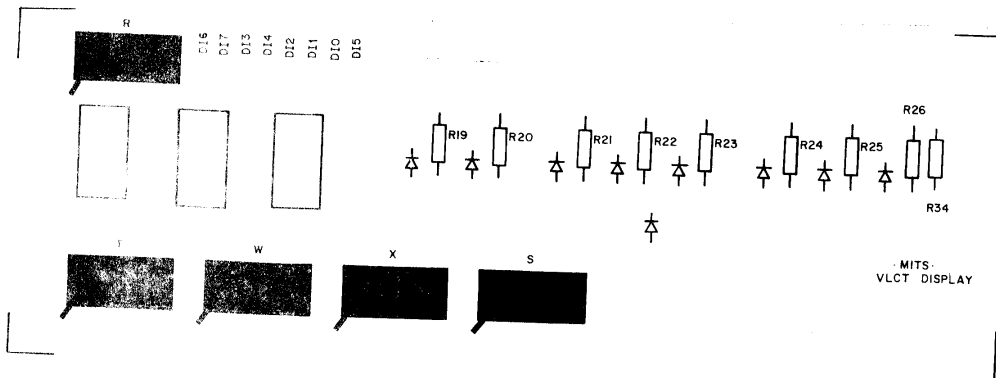
() Using needle-nose pliers, bend the leads of the resistor R19 at right angles to fit the proper holes and insert the resistor on the silk screened side of the PC board.

() Holding the resistor in place with one hand, turn the board over and bend the two leads slightly outward.

() Solder the leads to the foil pattern on the back side of the board; then clip off any excess lead lengths.

Referring to the component layout, install the remaining resistors in the same manner. Be sure you have the correct color coding as you install them.

- | | |
|---------|---------|
| () R20 | () R24 |
| () R21 | () R25 |
| () R22 | () R26 |
| () R23 | () R34 |



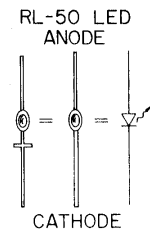
LED Installation

There are three DL-707R display LED's and 9 RL-50 LED's to be installed on the 88-VLCT display board.

LD9, LD10 and LD11 are 7-segment display LED's (DL-707R). These must be inserted so that the "L" on the top of the display is towards the top of the PC board.

- () Insert the three DL-707R's into the correct holes on the silk screened side of the PC board and push them all the way to the board. **DO NOT SOLDER YET!**
- () When all three LED's have been inserted, carefully align them so that the tops are in a perfectly straight line. Use a ruler as a guide. If they are not straight, the display on the completed unit will be wavy. Don't neglect this step! Once the LED's have been soldered, it will be extremely difficult to straighten them.
- () When you are certain the LED's are correctly oriented and perfectly aligned, tape them in place with a piece of masking tape before turning the board over.
- () Solder all the pins on the three displays to the foil pattern on the back of the board. Clip all the excess lead lengths. Remove the masking tape.

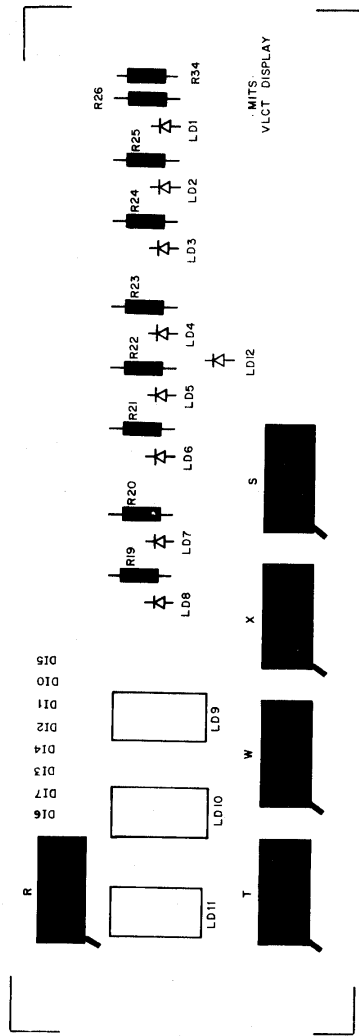
Observe that each RL-50 LED has two leads, an anode lead and a cathode lead. The cathode lead can be identified in one of two ways: it will either have a cross bar on it or it will be much wider than the anode lead. (see drawing below)



NOTE: RL-50 LED's are extremely heat-sensitive. The following solder connections should be made as quickly as possible, applying a minimum amount of heat. If you apply too much heat, you will risk destroying the LED.

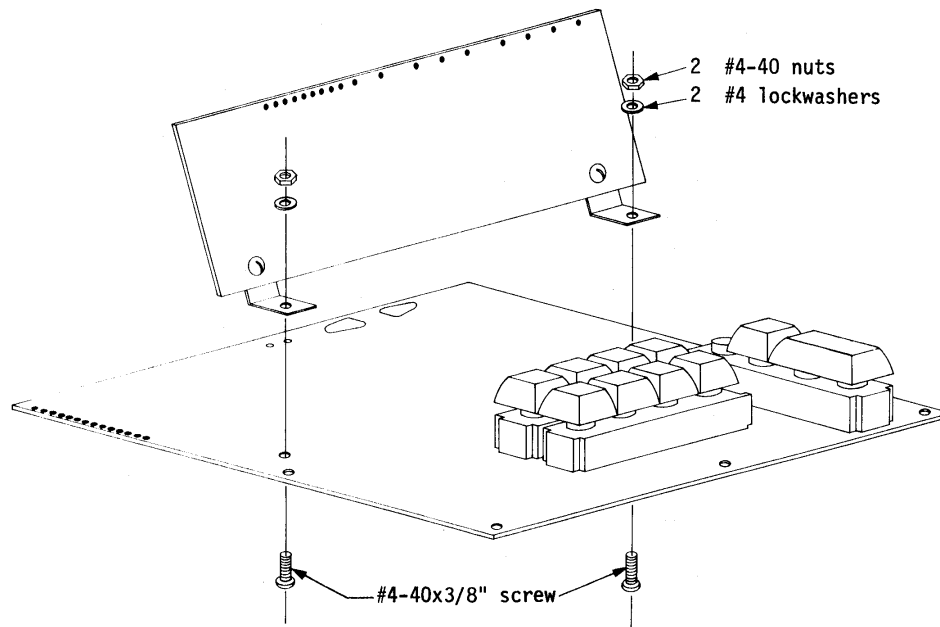
- () Using needle nose pliers, bend the leads of one RL-50 LED to fit the holes labeled LD1 on the PC board. Rest the board on a flat surface and insert the leads into the proper holes so that the cathode lead is towards the top of the board. **DO NOT** push the LED in all the way to the board. The LED should be installed so that it sits at least 1/8" or more above the surface of the board after the leads have been soldered. In this way the LED's will not only be at the correct height for the display panel, but there will also be some "give" with which to align them after they are soldered.

- () Solder the leads on the silk screened side of the board, while the board rests on a flat surface.
- () Repeat this procedure for each of the 8 remaining RL-50 LED's (LD2 through LD8 and LD12). Align the LED's as straight as possible as you install each one.
- () When all the LED's have been installed, adjust LD1 through LD8 so that they are in a perfectly straight line. Use a ruler as a guide.



DISPLAY BOARD--KEYBOARD INTERCONNECT

- () Attach the mounting brackets to the display board, using #4-40x3/8 inch screws, lockwashers and #4-40 nuts. Orient the boards as shown in the drawing.
- () Mount the display board to the keyboard as shown, using two #4-40x3/8 inch screws and #4-40 nuts and #4 lockwashers.



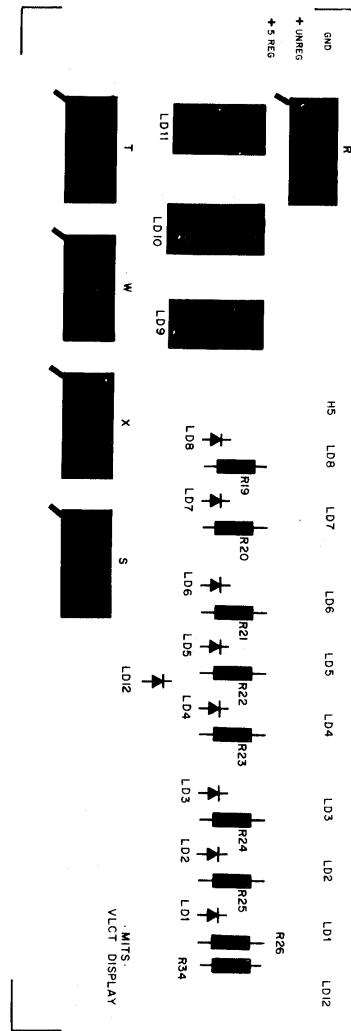
Interconnect Wiring

The boards will be interconnected by means of the 13 6-inch wires that have been attached to the keyboard. These wires will be connected to their corresponding holes on the display board. The wires will be inserted from the back (foil) side of the board and soldered on the silk screened side.

- () Insert the free end of the wire mounted to "GND" into the "GND" hole on the display board. Insert the wire from the back (foil) side of the board and be sure not to push any of the insulated portion into the hole.
- () Solder the wire on the silk screened side of the board.
- () Clip off any excess lead length.

Complete the 12 remaining wire connections using this procedure.

- | | |
|-------------|----------|
| () + UNREG | () LD5 |
| () +5 REG | () LD6 |
| () LD1 | () LD7 |
| () LD2 | () LD8 |
| () LD3 | () LD12 |
| () LD4 | () H5 |

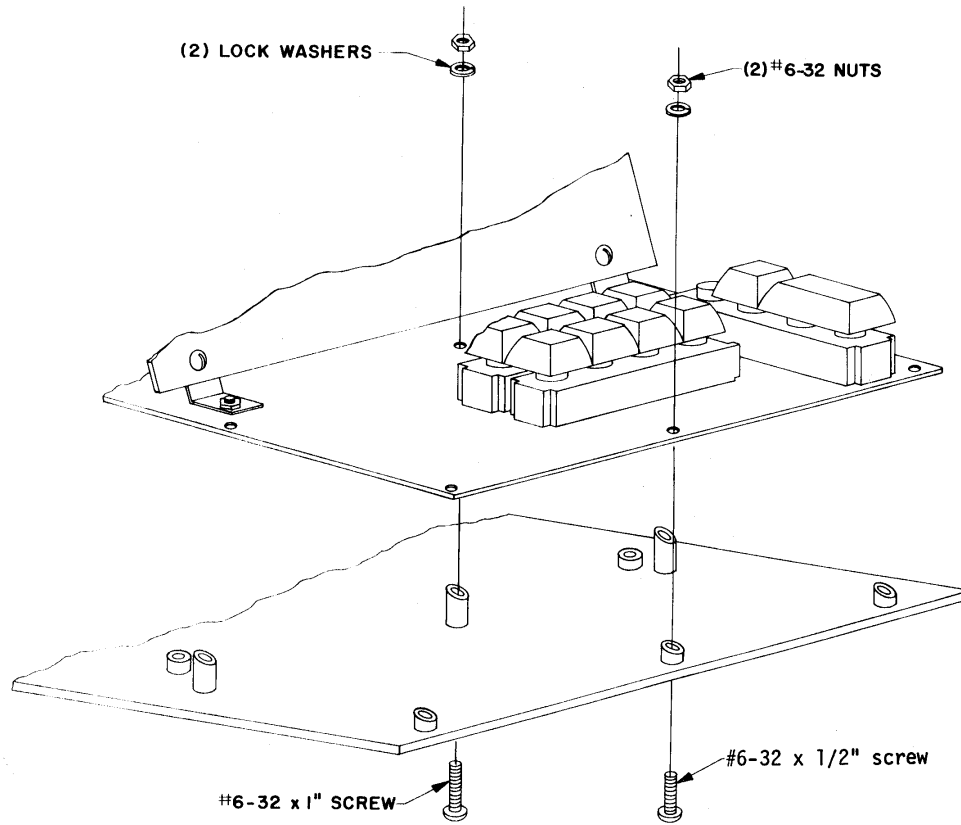


Mount Boards and Transformer to Case Bottom

- () Align the mounting holes on the keyboard over the mounting bosses on the case bottom as shown in the illustration.
- () Fasten the center front hole to the mounting boss, using a 6-32x1/2 inch screw, 6-32 nut and lockwasher.
- () Attach the rear center mounting hole and boss in the same way, using a 6-32x1 inch screw.

NOTE: Only hand tighten these two screws so that the keyboard can be shifted.

- () Mount the transformer to the case bottom onto the two holes on either side of the power cord. Use two 6-32x5/8 inch screws, two lockwashers and two 6-32 nuts.



25 CONDUCTOR CABLE INSTALLATION

Cable Preparation

- () Take the 6 foot length of 25 conductor cable provided in your kit and, with a small sharp knife, cut a circle around the cable sheath approximately 3 inches from one end. Cut another circle approximately 8 inches from the other end. Be very careful not to cut through the insulation on the wires inside the cable.
- () Pull the cut portions of cable sheath off each end to expose the 25 wires.
- () Very carefully strip about 1/2 inch of insulation from both ends of each of the 25 wires.
- () Take one of the wires that you have just stripped and be sure the exposed strands are twisted together as tightly as possible.
- () Tin the end of the wire by applying a thin coat of solder to the now un-insulated portion.

Tin both ends of all 25 wires in this manner. Be sure that you have the strands of each wire twisted together as tightly as possible.

Male Connector Wiring

NOTE: The 25 wires in the cable are identified by their colors, which correspond to the IPCEA Color Code System. When a wire has more than one color, the first color named is the general background color of the wire. The second, or second and third colors named, appear as stripes or dots on the background. For instance, a white/black wire is a white wire with a black stripe or black

dots on it; while a black/white wire is a black wire with a white stripe or white dots on it. A green/black/white wire is a green wire with both black and white stripes (or dots) on it. The first color is always the background and the other colors appear as stripes or dots on the background.

As you connect each of the wires to the pins in the connector, label the other end of that same wire with a piece of masking tape. On the label write the number of the pin to which that wire is connected.

- () Prepare the ends of the 3-inch exposed wires by trimming the tinned ends to 1/8 inch with a clean sharp cut. Try not to distort the shape of the wire.
- () Prepare the connector by very carefully heating each pin with your soldering iron and filling the hollow space with solder.

NOTE: These procedures must be done carefully with close attention to detail. You may wish to prop the connector between blocks of wood (or in a vice) so that you will have both hands free while working with the connector.

- () Connect one of the wires to pin 1 by re-melting the solder in the pin, inserting the wire up to the insulation, and removing the heat from the pin while holding the wire in place until the solder cools. Do not melt any of the insulation.

Try to make the connection in one smooth operation. If this is done correctly, you will end up with a smooth, neat connection with no excess solder or melted insulation.

- Label the opposite (8-inch) end of the same wire "Pin 1."
- Connect and label all of the wires to the connector in this manner--omitting Pins 11, 12 and 24.
 - Pin 2 Pin 15
 - Pin 3 Pin 16
 - Pin 4 Pin 17
 - Pin 5 Pin 18
 - Pin 6 Pin 19
 - Pin 7 Pin 20
 - Pin 8 Pin 21
 - Pin 9 Pin 22
 - Pin 10 Pin 23
 - Pin 13 Pin 25
 - Pin 14

Inspect the connector very closely for solder bridges or poor connections. If you are unsatisfied with the job, re-heat each pin one at a time and remove the wires. Clip off the ends of the wires and go back and start the entire operation over again. There is plenty of cable to do this so make sure that you have a good solid connection between the cable and the connector.

NOTE: Do not clip off the three extra wires until after the unit has been tested.

Display Board Wiring

The 8-inch exposed wire lengths labeled Pin 14 through Pin 21 will be connected to the pads at the upper left-hand side of the display board (labeled DI0 through DI7). The wires will be inserted from the back (foil) side of the board and soldered on the silk screened side.

- Connect the wire labeled "Pin 19" to the pad on the display board labeled "DI6." Insert the wire from the back of the board and solder it to the silk screened side. Make sure you don't push any of the insulated portion of the wire into the hole.
- Trim any excess lead length.

Use this procedure to make the remaining connections on the display board:

- Pin 18 to DI7
- Pin 17 to DI3
- Pin 21 to DI4
- Pin 16 to DI2
- Pin 15 to DI1
- Pin 14 to DI0
- Pin 20 to DI5

Keyboard Wiring

The remainder of the 8-inch labeled wires will be connected to the pads at the top, left-hand corner of the keyboard (labeled GND, D00 through D07, RESET, READY, BUSY, DATA READY and READY KEY). These connections will be made by inserting and soldering the wires on the silk screened side of the board.

- () Connect the wire labeled "Pin 13" to the pad labeled "GND" on the keyboard. Insert and solder the wire on the silk screened side of the board. While the solder is flowing, push the exposed end of the wire into the hole until the insulation almost touches the solder. DO NOT push any of the insulated portion into the hole and DO NOT MELT any of the insulation.
- () Clip off any excess lead length on the under side of the board.

Use this procedure to make the remaining wire connections of the keyboard:

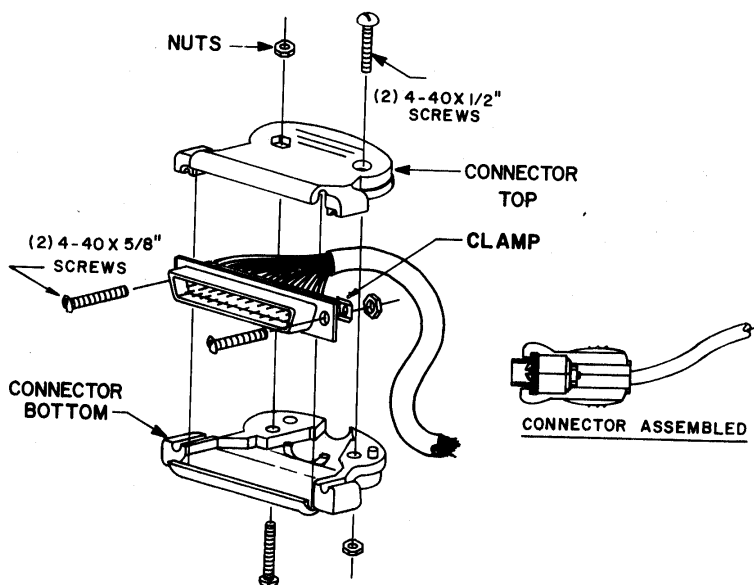
- () Pin 5 to D00
- () Pin 6 to D01
- () Pin 7 to D02
- () Pin 8 to D03
- () Pin 1 to D04
- () Pin 2 to D05
- () Pin 3 to D06
- () Pin 4 to D07
- () Pin 9 to RESET
- () Pin 10 to READY
- () Pin 25 to BUSY
- () Pin 22 to DATA READY
- () Pin 23 to READY KEY

- () Remove the labels from the wires.

Do not clip off the three extra wires until after the unit has been tested.

Connector Cover Installation

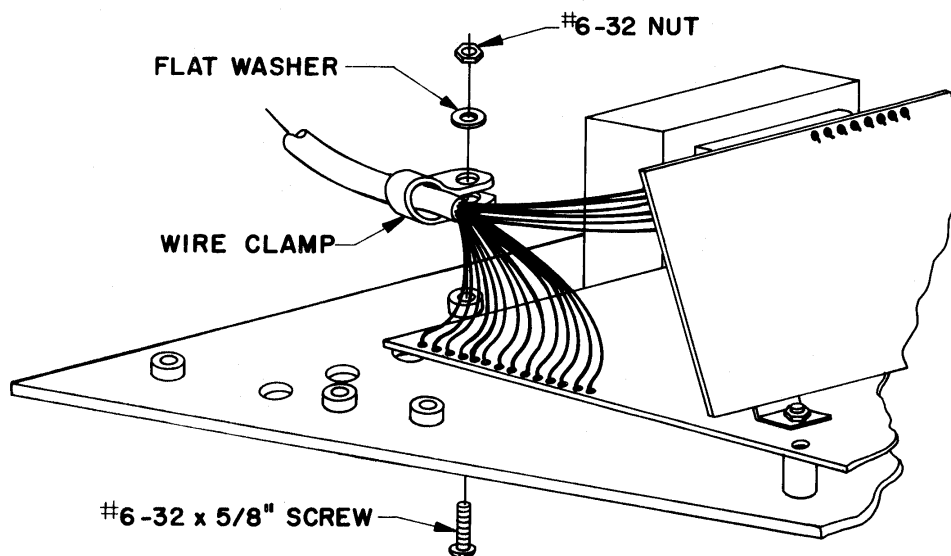
- () Remove the gray connector cover and associated hardware from your parts and set the connector in place inside one half of the cover. (see drawing below)
- () Note that there is a hex-shaped recess on each half of the connector cover. Place a nut in this recess and insert a screw from the opposite side through the round hole.
- () Be sure all the wires run between the two posts in the center of the cover and that none of the wires will be pinched along any of the edges.
- () When both of these screws have been installed, tighten them down.
- () Place the other half of the cover over the first half and hold the two pieces together with one hand.
- () Install the two retaining screws and clamps as shown in the drawing. Be sure that the clamps have been installed correctly. A mispositioned plastic cover may crack under stress.



Wire Clamp Installation

- () Secure the other end of the cable in place with the wire clamp, as shown in the illustration. Make sure that the clamp is on the cable sheath (not on the wires) and that the screw is tightened down completely.

NOTE: If the clamp does not give a tight fit, add pieces of insulation between the cable and the clamp until the cable is held tightly in place.



CASE ASSEMBLY

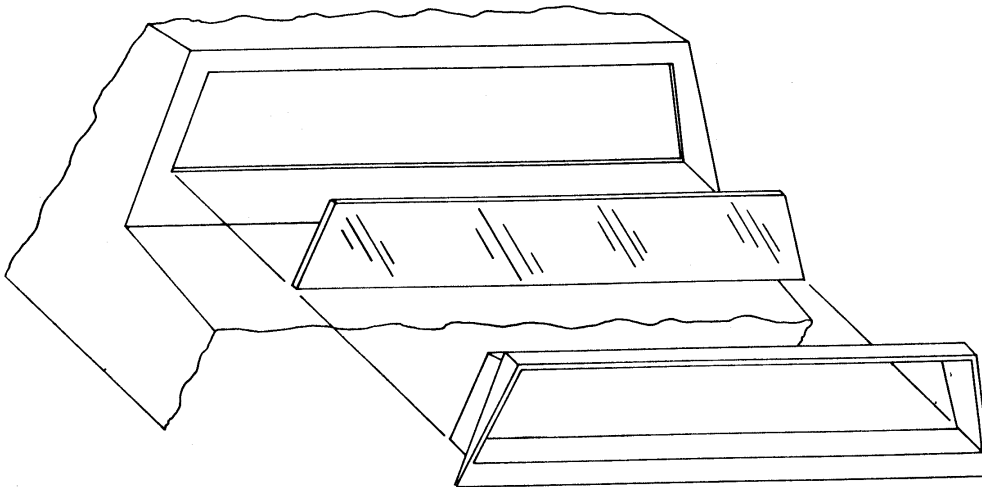
Bezel and Filter

To begin final assembly of the case, the bezel and filter must be installed in the case top as shown in the illustration below.

- () Remove the protective coating from the back of the red filter
- () Insert the filter into the rear side of the bezel with the silk screening facing outward. Take care not to scratch the filter. Secure the filter in place with a small drop of rubber cement at each of the four corners. Be careful not to smear any cement across the filter.

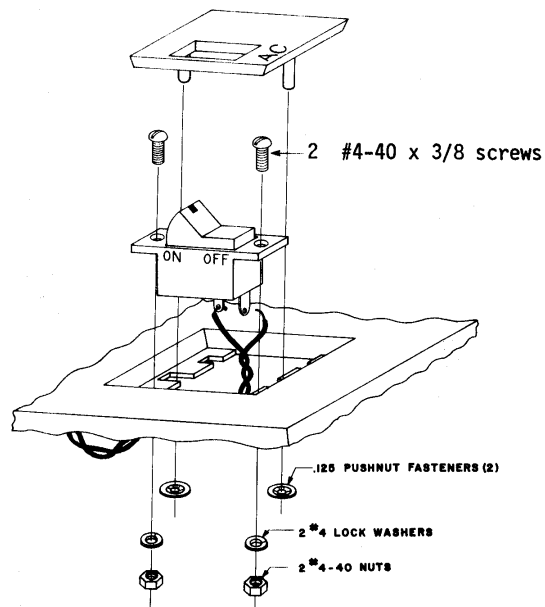
NOTE: An alternate method of securing the filter is to carefully touch the four corners (at the inner edge only) of the bezel with the tip of a hot soldering iron. This deforms the plastic of the bezel slightly at the corners to hold the filter in place.

- () Place the bezel in the window opening of the case as shown in the diagram. Center the bezel and secure it to the case with a few drops of cement applied from the rear of the window opening. Use only a small amount of cement so that the bezel can be removed later if necessary. Use care to avoid getting cement on external portions of the case, bezel and especially the filter.



Install ON/OFF Switch to Case Top

- () Bring the ON/OFF switch up through the hole in the molded depression in the case top.
- () Orient the switch as shown in the drawing, with the "ON" position toward the rear of the case and the two mounting holes aligned over the outside mounting slots in the case top.
- () Secure the switch to the case top with two 4-40x3/8 inch screws, two #4 lockwashers and two 4-40 nuts.
- () Set the switch cover in place over the switch as shown and attach it with the two pushnut fasteners.

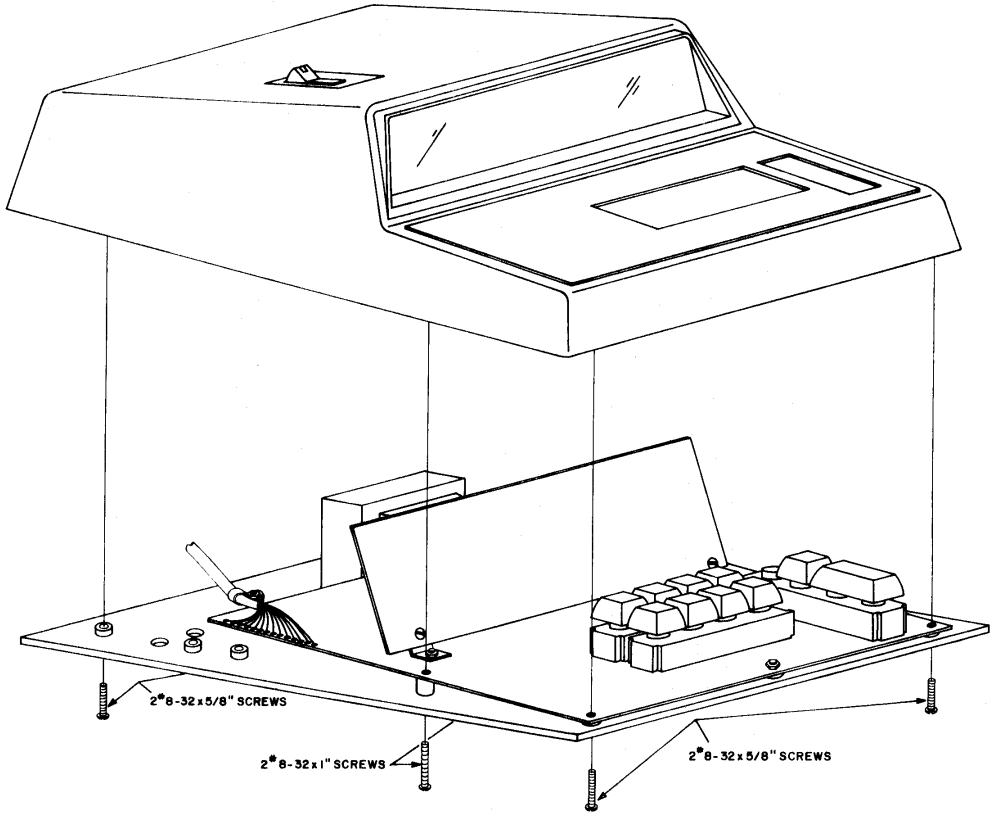


Final Case Assembly

- () Carefully shift the keyboard until the four corner mounting holes are aligned with their mounting bosses on the case bottom.
- () Using a nut driver or a pair of pliers, tighten the two center hold down nuts. Take care to preserve the alignment of the other four holes while the nuts are being tightened.
- () Install the two 8-32x5/8 inch screws through the front set of keyboard mounting bosses in the same manner. Do not tighten these screws down yet.
- () Install the remaining 8-32x5/8 inch screws through the mounting bosses at the rear of the case.
- () Carefully tighten down all six screws to secure the case top to the base.

NOTE: Be careful not to damage the PC board during this procedure. The tracks on the board are easily broken if they are scratched with pliers.

- () Referring to the drawing on the next page, put the case top on the unit and align the mounting holes. Install the two 8-32x1 inch screws through the rear set of keyboard mounting bosses. These screws will pass through the base plate bosses, the keyboard mounting holes and into the threaded inserts in the matching bosses of the case top. DO NOT TIGHTEN THESE SCREWS DOWN COMPLETELY but leave enough play to allow the remaining mounting holes to be aligned.



THEORY of OPERATION

The VLCT is basically an octal to binary encoder and a binary to octal decoder. For explanation purposes the circuitry is divided into six basic sections; the power supply, the keyboard encoder, the debounce circuit, the sequence generator, the output register, and the receiver.

Power Supply

The power supply consists of a 1 amp transformer and an MC7805 five volt regulator, along with the necessary rectifying diodes and filtering capacitors. The supply provides 5vdc reg. to drive all of the logic and the output data lights. It also provides 5v unreg. to the input lights, through R35.

Keyboard Encoder

The main function of the keyboard encoder is to convert each keystroke into the 3-digit binary equivalent of the number on the key. It also provides the pulses to the debounce circuit for initiating the "STEP" and "LOAD" pulses to the sequence generator.

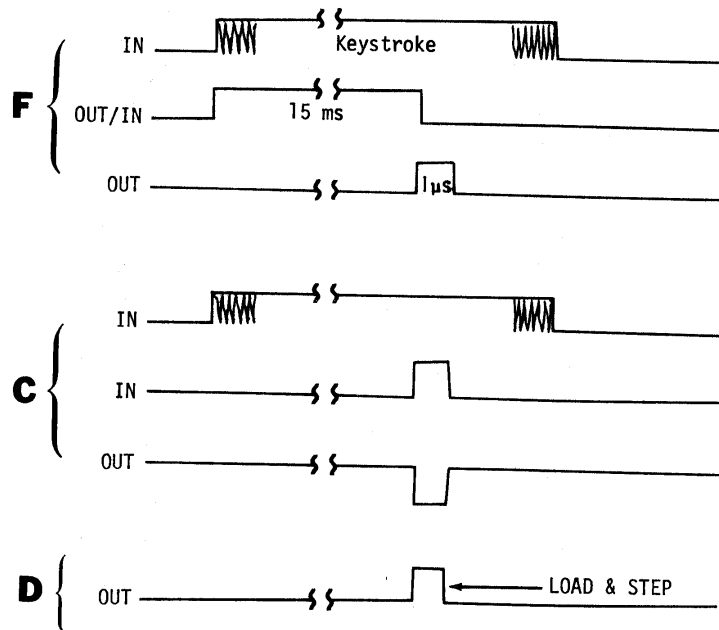
Resistors R1 through R13 are pull-up resistors. The closing of any of the key-switches 1 through 7 provides a path to ground through one or more of these resistors. This places a logic 0 on one or more of the appropriate inputs to the three 4-input NAND gates (A & 1/2 B). The signals are inverted and the binary number of the key which closed is produced on the lines B0, B1 and B2. (B0 being the least significant digit.) These three lines are fed directly to the D inputs of the output register flip-flops.

The three signals are also inverted and fed, together with the "0" key line, into the 4 inputs of another NAND gate (1/2 of B). The closing of any keyswitch 0 through 7 will produce a logic 1 on the output of this NAND gate for the duration of the keystroke. This signal is fed into the debounce circuit.

Debounce Circuit

The debounce circuit consists of a 74123 (ICF) dual retriggerable one-shot and two NAND gates (1 of C and 1 of D). The purpose of this circuit is to eliminate the oscillation produced at the beginning and end of each keystroke, and to provide a "LOAD" and "STEP" pulse to the sequence generator at a time when the data on lines B0 through B2 is valid.

As can be seen from the following timing chart, the one-shots produce a 1 μ sec pulse between the oscillation periods at either end of the keystroke.



This pulse is gated together with the keystroke signal at NAND gate C pins 12 & 13. This allows the 1 μsec signal to pass only when the keystroke signal is "clean" and will block any pulse produced by the one-shots retriggering on the keystroke oscillation as the key is released.

The pulse from the output of C pin 11 is inverted and sent to the sequence generator along two lines for a "LOAD" and "STEP" pulse.

Sequence Generator

The sequence generator consists of a dual J-K flip-flop (I.C. G), several NAND gates and a one-shot (1/2 of H). The purpose of this circuit is to load the data from the keyboard encoder into the correct flip-flops of the output register and to provide a "handshake" function with the computer.

The "load" pulse from the debounce circuit is fed into one of the inputs of each of three 3-input NAND gates (I.C. K). The other two inputs of each of these three gates are tied to the Q and \bar{Q} outputs of the two J-K flip-flops (I.C. G). The "STEP" pulse from the debounce circuit is fed to the clock input of the first flip-flop, and the Q output of that flip-flop is fed to the clock input of the second.

Thus, the first flip-flop will toggle with each keystroke and the second with every other keystroke. As a result, the three 3-input NAND gates will be enabled one at a time placing a logic 0 on their outputs. This will sequentially load the valid data into the output register starting with the two most significant binary digits.

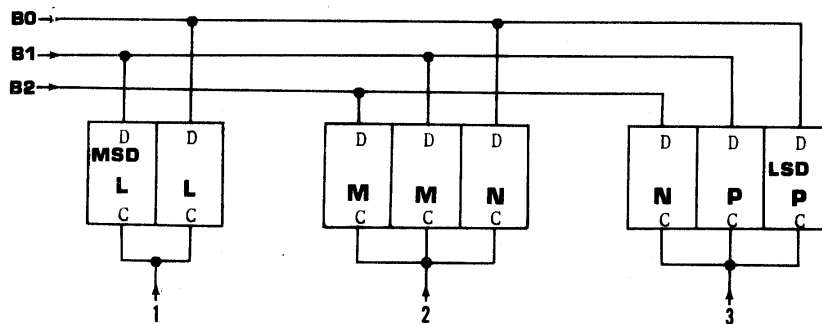
The output pin 3 of I.C. E will also be enabled by the flip-flops after the third keystroke. This low going signal will trigger the one-shot putting a pulse on the READY line to the computer, indicating that all eight bits of data are valid and ready to be transmitted.

The flip-flops in the sequence generator can be set back to the starting position by either the "clear" key or the RESET signal from the computer. The "WAIT" indication will light at any time this clear line is activated, indicating that data can not be transmitted during its operation.

Output Register

The output register consists of four dual D-type flip-flops and eight RL-50 LED's and resistors.

These eight flip-flops are essentially split into three groups by the rest of the circuitry as shown in the diagram below.



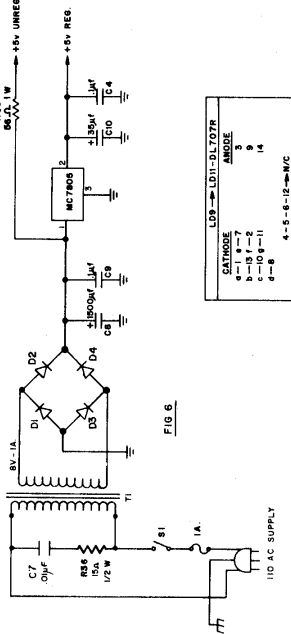
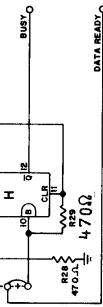
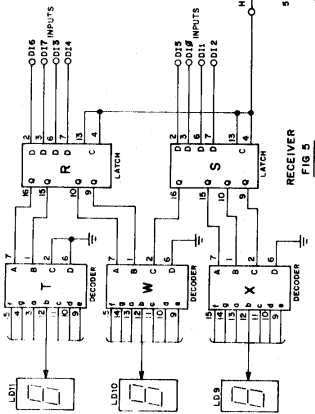
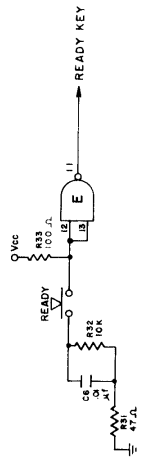
The data present at the D inputs is transferred to the Q outputs on the leading edge of the signal from the sequence generator. The overall result is at the end of three keystrokes, the 3-digit octal code punched in is converted to a binary 8-bit word. The data will remain in this state until a new 3-digit code is punched in.

The Q output lines go directly to the computer parallel interface board. The \bar{Q} outputs are used to provide a path to ground for the 8 RL-50 indicators, allowing them to light when a logic 1 is present at the Q output. The 8 resistors are for current limiting.

Receiver

The receiver consists of two 4-bit latches (R & S), three BCD to 7-segment converters, a one-shot (1/2 of H) and three 707R 7-segment displays.

The eight data lines from the computer feed directly into the 7475 4-bit latches. The load pulse for the latches originates from the computer and is fed through the one-shot to the 7475's. Immediately with the load pulse, the 8 data bits are converted by the 7447's into a 3-digit octal code and are displayed on the 707R's.

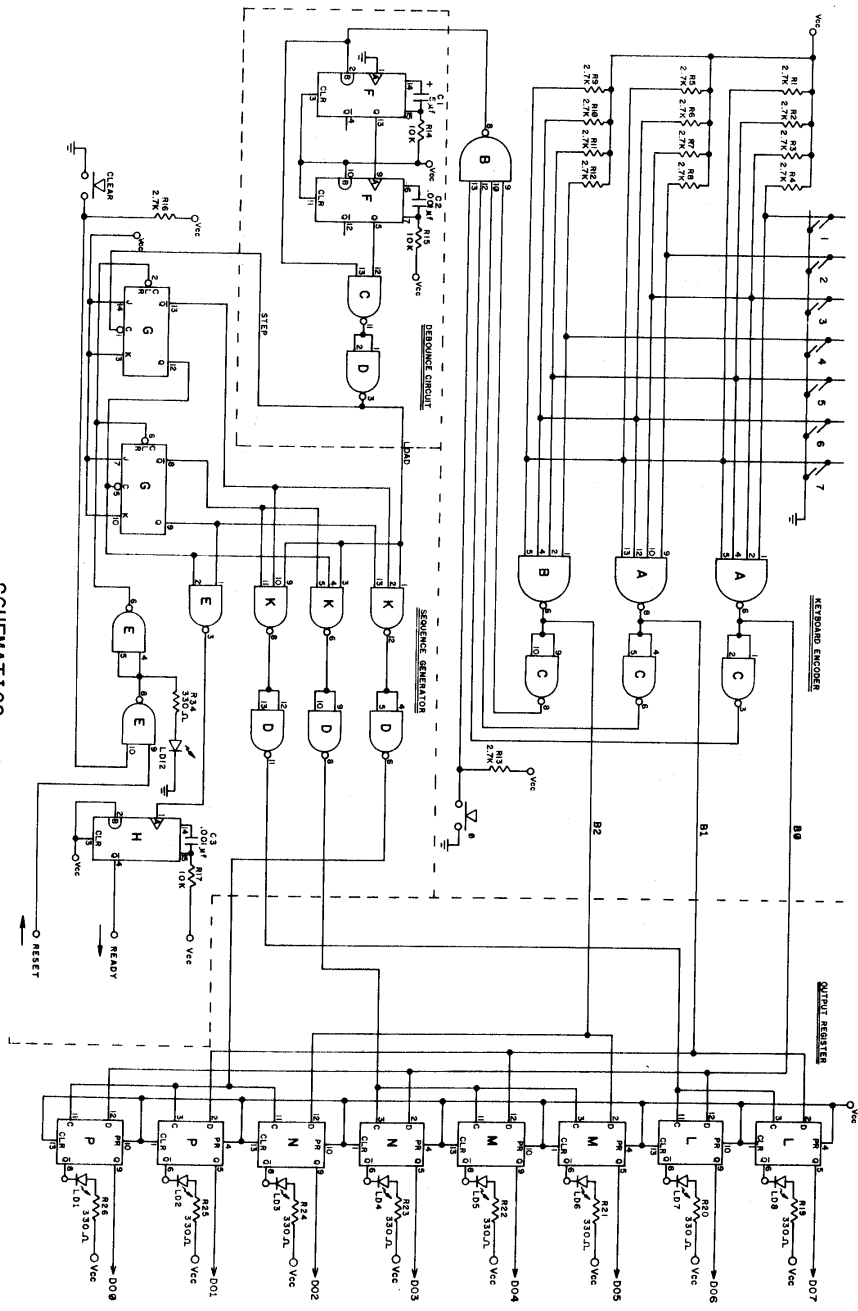


IC	POWER CONNECTION	QVCC	QVDD
A	74250	14	7
B	74250	14	7
L	7474	1, 4, 10, 13, 14	7
M	7474	1, 4, 10, 13, 14	7
N	7474	1, 4, 10, 13, 14	7
P	7474	1, 4, 10, 13, 14	7
X	7410	14	7
Y	7410	14	7
Z	7410	14	7
E	7460	14	7
F	74123	16	8
G	7473	14, 5, 2, 10	11
H	7475	5	12
T	7447	5, 5, 18	8
U	7447	5, 5, 18	8
V	7447	5, 5, 18	8
W	74181	3, 14, 16	8
X	74181	3, 14, 16	8
Y	74181	3, 14, 16	8
Z	74181	3, 14, 16	8

CALIBRATION	LD9 → LD11-DL10TR	AMBI
a-197-2		9
c-108-11		14
g-6		
4-5-4-12-M/C		

SCHEMATICS

SCHEMATICS



88-VLCT SELF TEST

To test the 88-VLCT without the computer or 88-PIO board, make the following jumpers on a DB25S connector (mates with DB25P, the connector on the VLCT cable).

<u>JUMPER</u>		<u>SIGNAL</u>	
Pin 10	to Pin 22	READY out	to DATA READY in
Pin 9	to Pin 25	RESET in	to BUSY out
Pin 8	to Pin 17	D03	to DI3
Pin 7	to Pin 16	D02	to DI2
Pin 6	to Pin 15	D01	to DI1
Pin 5	to Pin 14	D00	to DI0
Pin 4	to Pin 18	D07	to DI7
Pin 3	to Pin 19	D06	to DI6
Pin 2	to Pin 20	D05	to DI5
Pin 1	to Pin 21	D04	to DI4

With the test connector connected to the VLCT cable, after the third keystroke, the "READY" signal goes to the "DATA READY" input, and the information is transferred from the 8 binary LED's to the 3 octal readouts.

88-VLCT TEST PROGRAM

OCTAL ADDRESS	OCTAL CODE	OCTAL ADDRESS	OCTAL CODE
0	333	16	346
1	000	17	001
2	346	20	312
3	002	21	014
4	312	22	000
5	000	23	072
6	000	24	040
7	333	25	000
10	001	26	323
11	062	27	001
12	040	30	303
13	000	31	000
14	333	32	000
15	000		

Also tests PIO Board.

Any octal code entered will be echoed back, upon pressing the READY KEY.

(written with PIO address at 0 and 1)

SERVICE

Should you have a problem with your 88-VLCT, it can be returned to MITS for repair. If the unit is still under warranty, any defective part will be replaced free of charge. The purchaser is responsible for all postage.

If you return your unit to us for repair, pack it in a sturdy cardboard container and surround it on all sides with a thick layer of packing material. You can use shredded newspaper, foamed plastic or excelsior. The packed carton should be neatly sealed with gummed tape and tied with a stout cord. Be sure to tape a letter containing your name and address, a description of the malfunction, and the original invoice (if the unit is still under warranty) to the outside of the box.

Mail the carton by parcel post or UPS--for extra fast service, ship by air parcel post. Be sure to insure the package.

SHIP TO: MITS, Inc.
 6328 Linn Ave. N.E.
 Albuquerque, New Mexico 87108

All warranties are void if any changes have been made to the basic design of the machine or if the internal workings have been tampered with in any way.

