

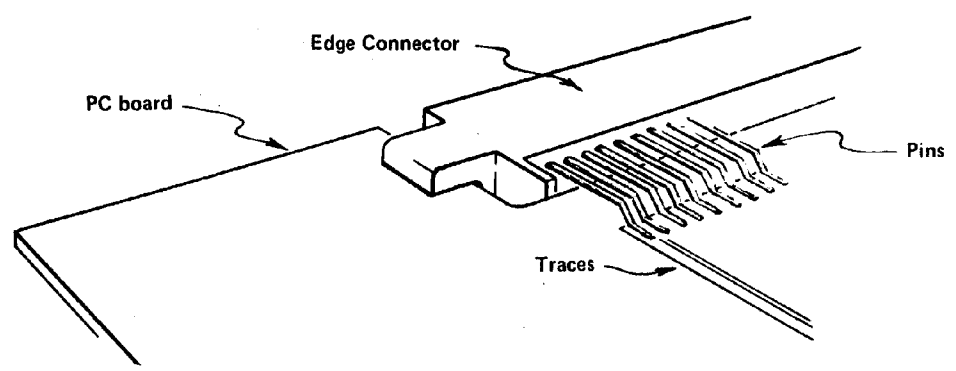
ASSEMBLY INSTRUCTIONS FOR THE S-100 BUSS EXTENDER BOARD/LOGIC PROBE KIT

It should take you less than 2 hours to assemble this kit. We recommend that you start at a time when you will be able to complete it without interruption. Mark the check boxes (☐) as you do each step. This kit could be assembled in many ways, but if you follow these step by step directions your assembly problems should be fewer.

- 1. Make sure you have the tools needed. For this kit you need the following: a soldering iron (20 watt max.), ROSIN CORE solder, and a damp sponge. Other useful aides are needle nose pliers, wire cutters, a small magnifying glass, a screwdriver and lead former.
- 2. Check the PARTS RECEIVED against the PARTS LIST (cover page). Take special care to correctly identify look alike parts, ie., resistors.
- 3. Read our Construction and Soldering Tips (page 7).





USE EYE PROTECTION WHILE SOLDERING OR CUTTING WIRE

- 4. Begin assembly by joining the 100 pin edge connector to the PC board. Align the connector pins with the signal (wider) traces on the board, solder the (4) end pins only. Check the pin alignment on front and back, if aligned with traces, solder the remaining 96 pins. If not aligned, unsolder and try again. This board is solder masked to make kit assembly easier.



Put the PARTS PLACEMENT DIAGRAM (page 5) where you can refer to it easily. Begin parts assembly by bending the leads of the diodes, resistors and bullet capacitors. Use lead former or a pair of needle nose pliers.

- 5. Select and bend:

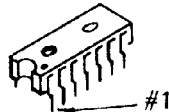
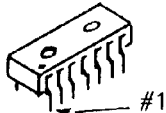
	Diodes .4"		22 μ F CAP .6"
	Resistors .5"		39 μ F CAP .8"



- j. Install the 3 metal links with the 6 (4-40) screws. Tighten gently.

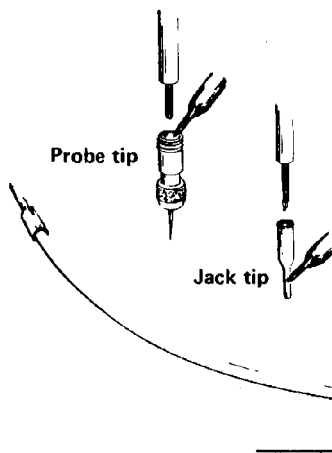
EXAMPLES:
Pin #1 Indicators

- k. CAREFULLY INSERT the 4 ICs. Check and make sure you put them in the right places, and oriented correctly. REMEMBER, pin #1 of the IC must be in the UPPER LEFT CORNER of the socket.



- l. Select (1) pair of edge connector labels. Trim to size. Peel off backing, align and stick to connector. The front pins are 1-50, the back pins 51-100.

7. Assemble test probe:



- a. Begin by stripping about ½ inch of insulation from both ends of wire. Twist strands together and tin lightly with solder.
- b; Unscrew plastic handle from probe tip. Clamp tip (a nail hole in soft wood works). Heat tip until solder flows into it. While solder is liquid insert stripped wire end. Allow to cool. Quench tip on damp sponge before touching. Repeat for probe jack tip.
- c. Try to wiggle! When you have two solid connections, thread the plastic handle over the wire and screw into probe tip. Unscrew and reverse probe needle. Insert jack tip into probe jack on the board.



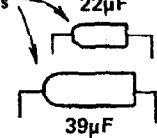
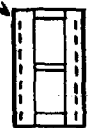


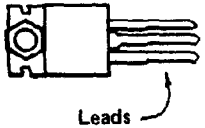


YOUR KIT SHOULD NOW BE READY TO USE. FIRST HOWEVER, INSPECT YOUR WORK. IF, you have put the polarized capacitors in reversed, they will go BANG!, when the power is turned on. So, check the orientation of polarized parts (C4 C5 D1 D2 & D3). Use the Parts Placement Diagram, to check for parts in the wrong places. Look at the ICs, check for bent pins, orientation in socket, and to correct location on the board. Check for unsoldered connections and for solder bridges.

- TO TEST:
- Turn machine power OFF. Insert board with probe attached, and switch DOWN. Turn machine power ON.
 - Display should show 'O' for open, with probe not touching.
 - Put probe on pin #50. 'L' for low should be displayed.
 - Touch the tip to pin #14 of IC4. 'P' for pulse should be displayed for about 1/5 second followed by 'H' for high and the decimal point should light up.
 - Touch the tip to pin #49 (clock). A constant 'P' indicates a stream of pulses.
 - Move the switch to the UP position, while the probe is not touching. Touch pin #14 of IC4, 'P' should be latched on the display. To release, move the switch to the DOWN position.

Lots of luck. If you are unable to make it work send it back for repairs to me.

Begin inserting components, refer to PARTS PLACEMENT DIAGRAM (page 5) and PARTS LIST (cover) to identify and correctly position each part. The weight of the board will hold the parts in place if they are installed and soldered in the following order.

6. Select, insert and solder the following components.

- | | |
|--|--|
|  <p>Band(s)</p> <p>Double check diode polarity.</p> | <input type="checkbox"/> a. Diodes (D1 D2 D3). Diodes are polarized and must be inserted correctly. The end of the diode with the color band or bands, corresponds to the bar of the diode symbol (◄) on the board. |
|  <p>Color Bands</p> | <input type="checkbox"/> b. Resistors (R1 through R16). Check the color codes as you insert. Resistors are not polarized and can be inserted either way. <i>(The pulse sensitivity can be adjusted by changing R15.)</i> |
|  <p>(+) ends</p> <p>22µF</p> <p>39µF</p> | <input type="checkbox"/> c. Bullet shaped capacitors (C4 C5). The 22µF is smaller than the 39µF. Capacitors are polarized, the rounded end is the positive lead and corresponds to the (+) sign on the board. |
|  <p>#1 pin corner</p> | <input type="checkbox"/> d. IC sockets (4 – 14-pin). Sockets have the pin numbers molded into the plastic. Insert the sockets into the board with #1 in the upper left. The #1 pin of the IC will be inserted into this corner, but DON'T INSERT ANY ICs YET. |
|  | <input type="checkbox"/> e. Capacitors (C1 220pF) and (C2 C3 .1uF). These capacitors are not polarized and can go in either way. |
|  | <input type="checkbox"/> f. Probe jack. <i>(Note: hole in board allows the probe to be connected thru the board if desired.)</i> |
|  <p>Leads</p> | <input type="checkbox"/> g. Voltage regulator. Insert the leads gently into the holes on the board. Now gently bend the body over to align the large hole. Tighten in place with a 4-40 screw. |
|  | <input type="checkbox"/> h. Seven segment display, leads fit only one way. |
|  | <input type="checkbox"/> i. Switch is symmetrical and can be inserted either way. |

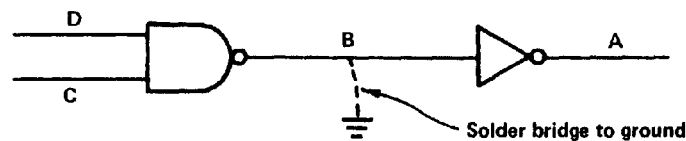
After all soldering on the board has been done, trim off any remaining leads. Be careful of flying wires. Flux can be removed with Freon solvent.

USING THE LOGIC PROBE (DON'T INSTALL OR REMOVE BOARDS WITH POWER ON)

This logic probe is quite useful in checking logic states of TTL devices. It is most useful in checking static conditions. Therefore, a number of error conditions such as solder bridges, broken traces, missing components, defective switches, burned-out ICs, etc., which have static symptoms can be found.

I prefer to trace signals on the component (front) side of a board. I move the probe tip from component terminal to component terminal as I follow the signal path.

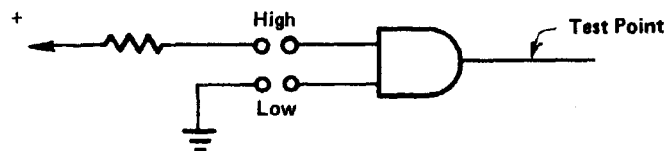
EXAMPLE:



Checking point A shows it is always high. Checking point B shows it is always low. Checking points C and D show that they are sometimes high and sometimes low (pulses). To see if C and D are high at the same time would require a dual-trace scope, but the output could be isolated by bending the output IC pin so that it does not go into the socket. If the isolated output shows pulses, then the trouble is in the input trace or the input of the inverter.

ICs can be checked by substitution or exchange with a working IC. When two like ICs are exchanged and the trouble moves, the IC is the cause. If the trouble stays, something else is wrong. To test unique (one-of-a-kind) ICs it is possible to build up a circuit in the Kluge area of the extender board with controlled inputs and outputs.

EXAMPLE:



By connecting the inputs to high or low, the results of all possible input combinations can be checked. Also, this circuit could be used to look at other signals to determine coincidence.

The fact that the decimal point of the display is on when the probe is on a high signal, also gives a hint as to the duty cycle of the signal. If two signals are high more than half the time, then they must be high at the same time, etc.

Another feature of this logic probe is the pulse catcher. If you are looking for a trouble that occurs rarely, you switch it on (UP). When the first high to low transition occurs, the 'P' will latch, and be continuously displayed until the switch is turned off (DOWN).

Many of the signal conditions in a microcomputer can be controlled (generated, slowed down, stopped, or repeated) by either programming or front panel settings. Basic troubleshooting consists of determining what is wrong and then what causes it. Looking for the trouble requires knowledge of what is right, in order to know what is wrong. In circuits you have designed it is much easier than on a strange board, but the circuit components all work the same way.



CONSTRUCTION AND SOLDERING TIPS

- Choose a well-lit work space with enough room to layout tools, parts and instructions. Two light sources help to eliminate shadows which interfere with seeing your work.
- Tools needed for each individual kit will be listed in the assembly instructions. However, a basic set should include, a low wattage soldering iron (20 watts or less), and a holder which keeps you from accidentally touching the hot tip. Helpful are a pair of wire cutters and needle nosed pliers. A damp sponge to wipe the hot iron's tip, a magnifying glass to examine details, and a lead former to bend leads are all useful aides.
- Soldering has the potential of causing several different kinds of problems in kit building. Heat can damage the PC board, and the components, or cause unwanted electrical connections to form. Using the right soldering iron, the right solder (rosin core) and a little practice to develop an efficient technique, will eliminate most problems.
Parts are inserted on the component side (front) of the board and almost all soldering is done on the back side.

USE EYE PROTECTION WHEN SOLDERING OR CUTTING WIRE

- If you plan to build many kits and have the extra dollars, buy a quality (temperature controlled tip) soldering iron.
 - Use only ROSIN CORE SOLDER when constructing our kits. A solder with a high ratio of tin to lead is important, 63/37 tin/lead, is excellent and 60/40 is good.
 - Solder with a well tinned tip. Tinning is a thin film of solder coating the surface of the iron's tip. Eliminate the oxide which forms on the iron's tip by wiping on a damp sponge often as you work.
 - Heat both the component wire and the solder pad with the tip of the iron until it looks wet (liquid). Next, touch the solder to the junction between the iron, pad and wire. When the solder melts and flows onto the connection quickly remove the iron's tip. Allow to cool without component movement. A good joint will be smooth and bright.
 - Avoid using too much solder. If small drops of solder appear on the opposite side of the board, too much solder or too much heat were probably applied. Solder adjacent pads carefully as the heat may cause the solder to flow between them forming a solder bridge. This makes an unwanted electrical connection. A small solder bridge can be removed by touching it with a clean hot iron tip until it wets and adheres to the tip.
 - Excess wire can be cut off with diagonal cutters, after the joint has cooled. Beware of flying pieces of wire! Freon solvent can be used to remove flux.
 - If sockets are included with the kit, solder the sockets onto the board before inserting the ICs.
-

TB-4

SPECIAL FEATURES – EXTENDER BOARD/LOGIC PROBE

- New interlaced ground and signal traces, improves performance, reduces noise, with the new high clock frequency boards
- New brighter display, makes this very handy logic probe easier to use
- New proposed IEEE buss edge connector label, with all the fine quality documentation you expect with Mullen Kits
- High quality FR-4 board is double sided with plated thru holes and solder-masked for easy kit assembly
- Gold on all matting connector surfaces for better electrical contact
- Formed connector leads for easy scope probe attachment
- Jumper links in power lines makes current measurement and fusing easy
- Large "kluge" area lets you build and test your own circuits

LIMITED WARRANTY INFORMATION

MULLEN COMPUTER PRODUCTS WILL REPAIR OR REPLACE, AT OUR OPTION, ANY PARTS FOUND TO BE DEFECTIVE IN EITHER MATERIALS OR WORKMANSHIP FOR A PERIOD OF 1 YEAR FROM DATE OF INVOICE.

WE ARE NOT RESPONSIBLE FOR DAMAGE CAUSED BY USE OF SOLDER INTENDED FOR PURPOSES OTHER THAN CONSTRUCTION OF ELECTRONIC EQUIPMENT, MISUSE OR ABUSE, UNAUTHORIZED MODIFICATION, USE OF OUR PRODUCTS IN APPLICATIONS OTHER THAN THOSE INTENDED BY MULLEN COMPUTER PRODUCTS.

RETURN TO PURCHASER OF A FULLY FUNCTIONING UNIT MEETING ALL ADVERTISED SPECIFICATIONS IN EFFECT AS OF DATE OF PURCHASE IS CONSIDERED TO BE COMPLETE FULFILLMENT OF ALL WARRANTY OBLIGATIONS ASSUMED BY MULLEN COMPUTER PRODUCTS AND DOES NOT COVER OTHER EQUIPMENT USED IN CONJUNCTION WITH SAID PRODUCTS. WE ARE NOT RESPONSIBLE FOR INCIDENTAL OR FOR CONSEQUENTIAL DAMAGES.

Mullen COMPUTER PRODUCTS

EXTENDER BOARD/LOGIC PROBE FOR S-100 BUSS PARTS LIST

(identify and check-off parts received)

- 1 - Printed circuit board
 - 1 - Edge connector, 50-pin dual
 - 1 - Set edge connector labels*
 - 1 - Probe with wire and jack tip
- Logic circuit parts
- Diodes
- 3 - (D1 D2 D3) IN4148 or equivalent
- Resistors
- 1 - (R1) 100 ohm $\frac{1}{4}$ w brown/black/brown
 - 6 - (R2-R7) either 200 ohm $\frac{1}{4}$ w red/black/brown or 220 ohm $\frac{1}{4}$ w red/red/brown
 - 1 - (R8) 30K ohm $\frac{1}{4}$ w orange/black/orange
 - 1 - (R9) 1M ohm $\frac{1}{4}$ w brown/black/green
 - 1 - (R10) 2.2M ohm $\frac{1}{4}$ w red/red/green
 - 1 - (R11) 5.1K ohm $\frac{1}{4}$ w green/brown/red
 - 1 - (R12) 2.7K ohm $\frac{1}{4}$ w red/violet/red
 - 1 - (R13) 1.5K ohm $\frac{1}{4}$ w brown/green/red
 - 1 - (R14) 470 ohm $\frac{1}{4}$ w yellow/violet/brown
 - 1 - (R15) 470 ohm $\frac{1}{4}$ w yellow/violet/brown
 - 1 - (R16) 20K ohm $\frac{1}{4}$ w red/black/orange
- Capacitors
- 1 - (C1) 220pF
 - 2 - (C2 C3) .1 μ F
 - 1 - (C4) 22 μ F
 - 1 - (C5) 39 μ F
- Chips
- 1 - (IC1) 7400
 - 1 - (IC2) LM319
 - 1 - (IC3) 7405 or 7406
 - 1 - (IC4) 9601
- 4 - 14 pin LP sockets
 - 1 - probe jack
 - 1 - voltage regulator, 7805 or 340T5
 - 1 - seven segment display
 - 1 - switch
 - 3 - jumper
 - 7 - (4-40) screws

* Additional edge labels available. Send self-addressed stamped envelope

MULLEN Computer Products
BOX 6214, HAYWARD, CA 94545

ERRATA - TB-2 JULY 1979

1. PROBLEM: CONFUSION ON DIODE POLARITY.

ANSWER: DOUBLE CHECK THAT YOU HAVE THEM
CORRECTLY ORIENTED BEFORE SOLDERING.

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2. PROBLEM: CAPACITOR SUBSTITUTION. WE ARE
NOW SHIPPING A SMALL SQUARE (RED)
CAPACITOR IN PLACE OF THE 220 PF
DISC, IN THE INSTRUCTIONS.

ANSWER: THE SQUARE CAPACITOR CAN BE SUB-
STITUTED FOR THE 220 PF WITH NO
PROBLEMS.

