PAiA 8750

ELECTRONICS, INC.

PROTEUS I™

ASSEMBLY INSTRUCTIONS

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INTRODUCTION

Thank you for buying the PAiA 8750 PROTEUS I Synthesizer. We realize that you are anxious to get on with the assembly, but before you start, please take the time to read the hints and suggestions that follow.

-- BEFORE YOU BEGIN --

First, as you will notice from the size of this manual and the number of parts involved, THIS IS A BIG KIT. You should not begin assembly with the thought in mind that you will be done in an evening, or even a weekend. TAKE YOUR TIME, time invested in careful assembly now will pay great dividends in the time saved trouble-shooting for careless errors when you're done.

Familiarize yourself with this manual. It's not necessary to read the whole thing in detail, but at least go through and look at the illustrations. Get a feel for the parts and how they fit together.

While assembling, keep yourself alert and if you find yourself getting tired or bored TAKE A BREAK. We know, you've been looking forward to this for some time and want to get it done as soon as possible, but do us all a favor - take your time.

GETTING FAMILIAR WITH PROTEUS

There are 5 circuit boards which together make up the PROTEUS I Synthesizer. Their designations and general functions are as follows:

BOARD #	NAME	COMMENTS
8750A	PROTEUS Card	The assembly of this Synthesizer Card is not covered in this manual. See the PROTEUS SYNTHESIZER CARD ASSEMBLY MANUAL for these instructions. DO NOT ASSEMBLE THIS CARD UNTIL INSTRUCTED TO DO SO.
8750B	Backplane Board	Power supply, AGO Keyboard DAC, Systems interconnections, Computer Interface.
8750C	Controller Board	Panel Control Digitizer, Memory and support circuitry, Parameter DAC.
8750D	Display Board	Preset Display, programming controls.
8750E	Encoder Board	AGO Keyboard Digital Encoder, fits on keyboard.

8750 PACKING LISTS

Prior to beginning assembly of your PROTEUS I, check the supplied parts with the following parts lists. NOTE that the parts are divided into (5) bags, including the PROTEUS card bag (the parts list for this card is part of its assembly manual). While initially checking the parts, make sure that those from the various bags do not get mixed up. Maintaining these divisions will avoid much confusion during assembly. BE DILIGENT.

These parts are what will become your finished unit, they are the highest commerical quality (or better) available. Do they look right? Do they feel right? Like most merchants or manufacturers, we want you to be completely satisfied with your transaction with PAiA. If you have any doubts about the quality of the parts or these instructions, now is the time to resolve them. Later may be too late.

If any parts are missing or suspect, contact PAiA immediately for replacement or adjustment. Along with your request we MUST have the packer number from the parts bag and the order number that was assigned to your order for this kit.

8750 Hardware bag

1	5/16 Allen wrench
1	#8 solder lug
1	wire nut
1	beaded wire tie
1	4" dowel rod
4	rubber feet
1	fuse post w/hardware
1	strain relief
1	1/2a. fuse
1	26v. 1a. power transformer
1	grounding line cord
1	molex connector body
3	pins for molex connector
8	5/16 "J" clips
8	5/16 X 3/8" allen screws
8	5/16 black flat washers
7	4-40 X 1/2" machine screws
4	4-40 X 1/4" machine screws
2	#4 X 3/8" spacer
5	#4 X 1/4" spacer
7	#4 washer (flat)
11	#4 lock washers
11	4-40 nuts
5	#8 hex nuts
5	#8 internal star lock washers
5	#8 X 32 "J" clips
6	#8 X 3/8" binder head screw
3	#8 X 1/4" binder head screw
4	#8 split lockwashers
20	knobs

8750E Encoder parts bag

1	22K 5% resistor (red-red-orange)
1	2.7K 5% resistor (red-violet-red)
1	.01 mfd. disk capacitor
1	.001 mfd. disk capacitor
1	4024 7 stage counter IC
1	4001 Quad NOR IC
2	4051 8 channel mulitplexer IC
36"	22 gauge bare wire
5-24"	22 gauge insulated wire strands
1	18" 14 pin DIP cable
2	16 pin DIP sockets
3	14 pin DIP sockets

8750C Controller parts bag

24	100 ohm resistor	(brown-black-brown)
6	4700 ohm 5% resistor	(yellow-violet-brown)
5	680 ohm resistor	(blue-grey-brown)
10	1K 5% resistor	(brown-black-red)
2	1500 ohm 5% resistor	(brown-green-red)
6	2200 ohm 5% resistor	(red-red-red)
1	4700 ohm 5% resistor	(yellow-violet-red)
7	10K 5% resistor	(brown-black-orange)
2	15K 5% resistor	(brown-green-orange)
15	33K 5% resistor	(orange-orange-orange)
5	39K 5% resistor	(orange-white-orange)
8	47K 5% resistor	(yellow-violet-orange)
25	68K 5% resistor	(blue-grey-orange)
2	100K 5% resistor	(brown-black-yellow)
2	240K 5% resistor	(red-yellow-yellow)
1	270K 5% resistor	(red-violet-yellow)
3	470K 5% resistor	(yellow-violet-yellow)
1	910K 5% resistor	(white-brown-yellow)
1	1 meg 5% resistor	(brown-black-green)
5	2.2 meg 5% resistor	(red-red-green)

1	100 pf ceramic disk capacitor
1	.001 mfd ceramic disk capacitor
4	.05 mfd ceramic disk capacitor
7	.01 mfd ceramic disk capacitor
3	33 mfd 16v. electrolytic capacitor
1	4066 Quad bi-lateral switch IC
1	748 type op-amp IC
1	9368 display drive IC
1	4070 Quad exclusive-or IC
1	3302 Quad comparator IC
1	5101 CMOS 256 X 4 memory IC
1	5008 Digital to Analog conv. IC
1	FND-357 7 segment display
2	4024 Quad latch IC
2	4148 type glass signal diode
2	4001 Quad NOR IC
2	4011 Quad NAND IC
4	4051 8 chan. multiplexer IC
2	2N5139 transistor
17	2N5129 transistor

13	5K pc mount potentiometer
7	SPDT long bat slide switch
7	2P4T pc mount rotary switch
16	TIL 209B Light Emitting diode
36"	20 guage sleeving
108"	22 gauge bare wire
2"	foam tape
4-50"	22 gauge insulated wire
1	8 pin DIP IC socket
1	22 pin DIP IC socket
6	16 pin DIP IC socket
9	14 pin DIP IC socket
2	min push-button switch
2	15 pin Molex edge connector
10	Molex IC terminal
2	#4 X 1/4 machine screws
2	#4 hex nuts
2	#4 lock-washers
1	2 AA size battery holder
2	AA alkaline batteries
1	8750D p.c. board

8750 Backplane parts bag

1	5 ohm 5 watt power resistor	
3	330 ohm 5% resistor	(orange-orange-brown)
1	470 ohm 5% resistor	(yellow-violet-brown)
1	680 ohm 5% resistor	(blue-grey-brown)
8	1K 5% resistor	(brown-black-red)
1	1800 ohm 5% resistor	(brown-grey-red)
2	4700 ohm 5% resistor	(yellow-violet-red)
1	5600 ohm 5% resistor	(green-blue-red)
1	10K 5% resistor	(brown-black-orange)
2	22K 5% resistor	(red-red-orange)
2	470K 5% resistor	(yellow-violet-yellow)
2	100K 5% resistor	(brown-black-yellow)
2	1 meg 5% resistor	(brown-black-green)

Backplane cont.

1	.005 mfd ceramic disk capacitor	2	7805 Voltage regulator
2	.01 mfd ceramic disk capacitor	2	7905 Voltage regulator
4	470pf. ceramic disk capacitor	1	3 circuit male Molex power conn.
7	.05 mfd ceramic disk capacitor	6	15 pin male Molex edge connector
1	2.2 mfd 16v. electrolytic cap	1	DPDT slide switch
2	1000 mfd. 25v. electrolytic	2	#4 X 1/4 machine screws
4	10 mfd. 16v. electrolytic	2	#4 lockwashers
4	33 mfd. 16v. electrolytic	2	#4 hex nuts
1	5K panel mount potentiometer	2	1/4" open circuit phone jacks
1	potentiometer mounting nut	7	min closed circuit phone jack
1	push on knob	13	min open ciruit phone jack
2	1K pc mount trimmer pot	2	clip on heat sinks
2	10K pc mount trimmer pot	3	14 pin DIP IC socket
4	1N4003 type power diodes	3	16 pin DIP IC socket
1	4148 type glass signal diode	84"	22 gauge bare wire
1	2N5129 transistor	42"	20 gauge hollow sleeving
1	5008 Digital to Analog conv. IC	4-30"	22 gauge insulated wire
1	4136 Quad op-amp IC		gauge hollow sleeving
1	4001 Quad NOR IC		gauge insulated wire
2	4042 Quad latch IC		

YOUR KIT SHOULD ALSO CONTAIN:

1 each 36 note split bus keyboard
1 each metal sub-panel
1 each reinforcing bracket
1 each PROTEUS I case top
1 each PROTEUS I bottom tray
1 pair wooden end panels
1 each 8750A PROTEUS synthesizer voice card kit
1 each plastic bezel
1 each 8750B circuit board
1 each 8750C circuit board
1 each 8750E circuit board

8750 ASSEMBLY INSTRUCTIONS

SOLDERING

Successful operation of your kit, as well as it's longevity, is probably more dependent on how the components are soldered in place than any other one thing that the assembly involves. There are three key rules to go by, these are as follows:

TYPE OF SOLDER: Use ONLY ROSIN CORE SOLDER. Acid core solder or paste flux should never be used to assemble electronic circuitry, and the use of either on this kit will VOID THE WARRANTY. Good 60/40 rosin core solder is expensive, but it may be considered a long term investment, and well worth it.

SOLDERING TOOL: Use a soldering iron with a power rating of about 25 watts to 35 watts, and a small pointed tip. Soldering guns are completely unacceptable for soldering solid state components, as the large magnetic fields they generate can easily damage some components.

Be sure to keep your soldering iron tip clean. Before soldering a connection, wipe the tip on a damp sponge. This will aid in heat transfer and prolong tip life.

SOLDERING TECHNIQUE: We recommend looking at the solder connections on commercially avaiable amps and effects units and try to imitate them as closely as possible. A proper circuit board solder joint has just enough solder to cover the soldering pad and about 1/16" (2mm) of the component lead passing through it.

To solder, hold the tip of the iron against both the wire to be soldered and the circuit board trace (or jack lug, switch lug, or whatever). Hold it there for a second or two to let things heat up, then feed a small amount of solder onto the connection. Do not simply feed the solder onto the tip of the iron and expect it to run down onto the connection. Continue holding the iron against the connection until the solder melts fully and flows freely over the connection. Then remove the iron and let the joint cool. Do not move any of the wires while the solder is cooling; if this happens, re-heat the connection, feeding in a tiny bit more solder.

There are two types of improper connections to watch out for; using too little solder (or too little heat) will result in a connection which will appear to be soldered when actually there is a layer of flux or oxidation insulating the component lead. To cure this, re-heat the connection and flow a small additional amount of solder on the joint. Using too much solder can lead to excess solder flowing between adjacent terminals or traces of a circuit board, causing a short circuit. Unintentional solder bridges of this type can be cleaned off onto the tip of a CLEAN, hot soldering iron while holding the board upside down. Another problem with using too much solder is that it can flow over to an adjacent hole, blocking it with solder. If this happens, again hold the board upside down and flow solder away from the blocked hole and onto the tip of a clean hot iron. Use a pin to poke through any remaining solder left in the hole.

Finally, avoid using too much heat or leaving the iron on a connection for too long. Excessive heat can damage many types of electronic parts, and in extreme cases can cause circuit traces to lift from circuit board.

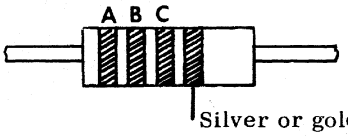
8750 CASE ASSEMBLY

KEYBOARD ENCODER ASSEMBLY

() Locate the 8750E circuit board and prepare it for assembly by thoroughly cleaning the conductor side of the board with steel wool or a "scotchbrite" pad.

A BRIGHT SHINY BOARD IS ESSENTIAL FOR SUCCESSFUL SOLDERING.

Solder each of the fixed resistors in place following the parts placement designators printed on the circuit board. Note that the fixed resistors are non-polarized and may be mounted with either of their leads in either of the two holes provided. Insert both leads in the mounting holes and push the resistor FULLY against the board. On the conductor side of the board, bend the leads outward to about a 45 degree angle to help hold the component in place while soldering. AFTER SOLDERING, clip off each lead flush with the top of the solder joint.(see fig. 1)



Silver or gold - disregard this band.

DESIGNATION	VALUE	COLOR CODE A-B-C
() R1	22K	red-red-orange
() R2	2700 ohm	red-violet-red

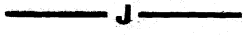
Install the ceramic disc capacitors. Without exception the value will be marked on the body of the part or the component will be bagged separately with the value indicated. Solder in place and clip excess leads.

DESIGNATION	VALUE	ALTERNATE MARKINGS
() C1	.001	(102)
() C2	.01	(103)

ceramic disc capacitor

Using the bare wire provided, form and install the jumpers indicated on the circuit board graphics by the solid lines broken by the letter "J".

() Install 33 vertical jumpers
() Install 6 horizontal jumpers



Double check to be sure all jumpers have been installed.

Next we will install the sockets for the Integrated Circuits. Note that both 14 and 16 pin sockets are used.

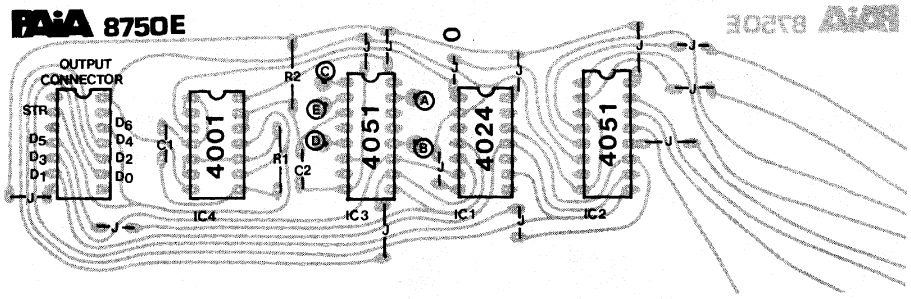
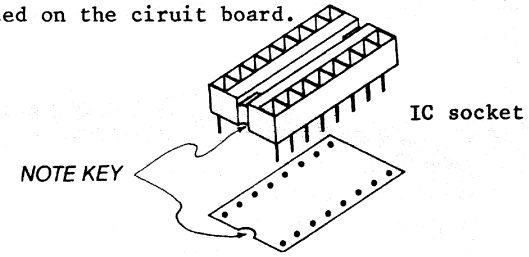


Figure 1: Keyboard Encoder Parts Placement

Also note that the orientation of many sockets is keyed by a notch in one end which will correspond to similar notches in the IC's when they are installed. If the sockets supplied with your kit are keyed in this manner, take care to see that they are installed so that the notches correspond to the parts placement diagram (fig. 1) and the legends printed on the ciruit board.

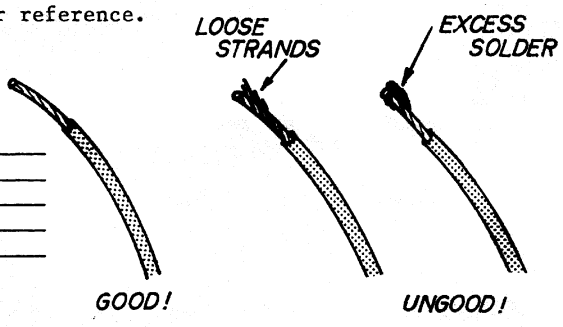
IC LOCATION	SOCKET TYPE
() IC1	14 pin
() IC2	16 pin
() IC3	16 pin
() IC4	14 pin
() OUTPUT CONN.	14 pin



() Locate the 5 strands of insulated wire provided and prepare one end of each strand by stripping 3/16" (5 mm) of insulation from one end of each wire. Twist the exposed strands tightly together and "tin" them by melting a small amount of solder into the strands. Make sure that the tip of your soldering iron is very clean while tinning. The tinned end of the wire should be smooth and cylindrical without loose strands or excess solder (see below).

The wires prepared above will now be passed through the p.c. holes labeled "A" thru "E" and soldered to the circuit board pads. In later steps these wires will connect to the buss bars of the keyboard switch contacts. At each step record the color of the wire used for later reference.

POINT	WIRE COLOR
() A	_____
() B	_____
() C	_____
() D	_____
() E	_____



() Route all 5 of the wires installed above through the closest large hole in the edge of the encoder circuit board as shown in figure 2 below.

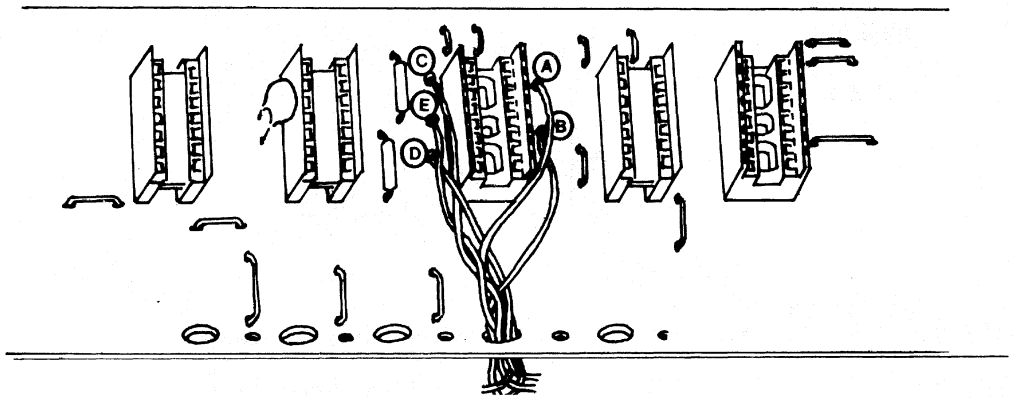


Figure 2: Wire Routing

Locate the 37 note AGO keyboard and orient it on your work surface so that it is upside down (key contacts, mounting frame, etc. exposed) with the keys pointing away from you. In this position, note the "L" brackets attached to the rear of the keyboard frame and the pointed solder stakes on the p.c. board which support the key switch contact wires.

() Carefully mount the previously assembled encoder board to the keyboard by first passing the rectangular cut-outs in the encoder circuit board over the "L" bracket mounting legs of the keyboard. Align the holes in the solder pads along the edge of the encoder board with the solder stakes protuding from the keyboard. Push the encoder board down onto these stakes so that approximately 1/8" (3 mm) protrudes beyond the surface of the board. DO NOT ATTEMPT TO PUSH THE ENCODER BOARD DOWN ALL THE WAY. (see fig. 3)

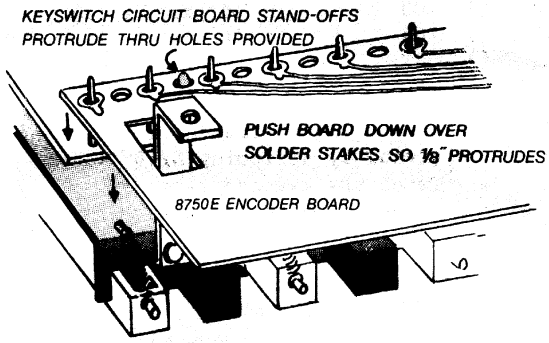


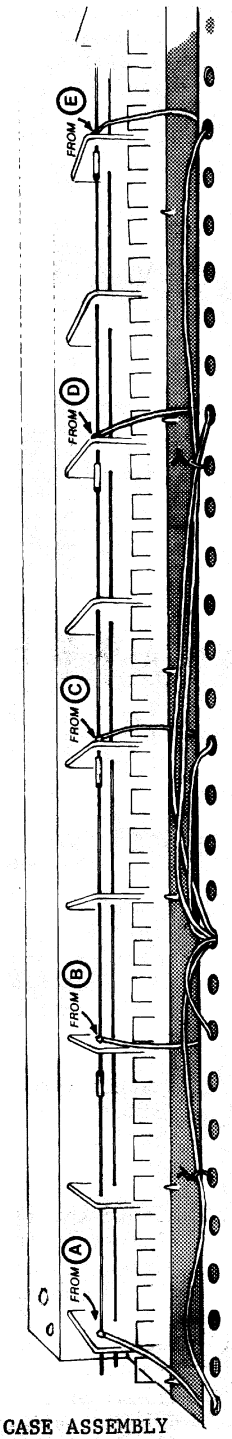
Figure 3: Encoder Circuit Board Installation Detail

NOTE: If you have inadvertently routed the previously installed wire bundle through a hole which is required for clearance of the keyswitch circuit board stand-offs, re-route the wires through the closest empty hole.

() Solder each of the 38 connections where the solder stakes protrude through the encoder board.

Observe that the rear-most buss rod is cut into 5 separate sections which are electrically isolated from one another with short lengths of insulating sleeving. These 5 buss bar sections are the destination of the insulated wires coming from the encoder circuit board. As shown in figure 4, these wires will be routed along the edge of the encoder circuit board and held in place by passing them through conveniently located holes.

EXTREME CARE MUST BE TAKEN WHEN THESE WIRES ARE SOLDERED TO THE BUSS ROD SECTION. Solder must not be allowed to spread along the bar and interfere with the action of the switches. With this in mind, connect the wires to the buss rods as close to the right side of the nylon support pieces as possible.



bottom side of keyboard assembly

Figure 4: Wire Routing

() As outlined above, route the wire originating at ciruit board point "A" so that it will reach to the left-most buss rod section. Cut the wire to an appropriate length and strip 1/4" (6 mm) of insulation from the end. Tin the expose strands. Form a small "hook" in this wire before connecting and soldering it to the buss rod.

() As above, route and connect the wire coming from pc point "B" to the next buss rod section to the right.

() As above, route and connect the wire from point "C" to the next buss rod section.

() Route and connect the wire from point "D" to the next buss rod section.

() Route and connect the wire from point "E" to the right-most buss rod section.

TEMPORARILY PUT THE KEYBOARD ASIDE AND PROCEDE TO LOWER CASE ASSEMBLY

Study the illustration below to familiarize yourself with the general areas in which the transformer and keyboard will mount in the tray shaped case bottom. For purposes of standard orientation the edge of this part with the bent down lip we will call the FRONT.

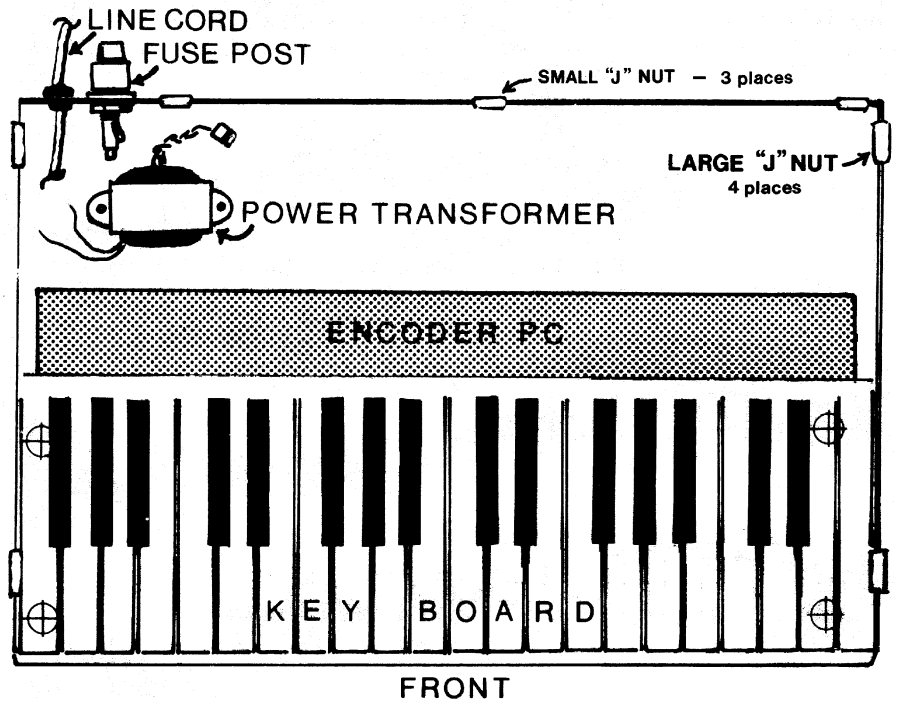
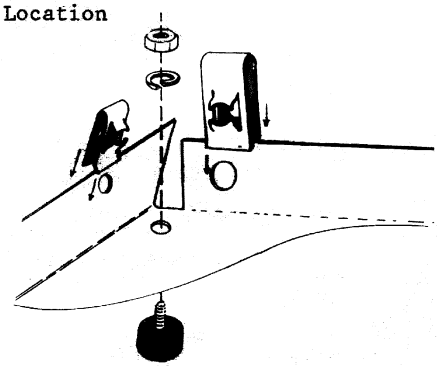


Figure 5: Major Component Location



() Locate 4 of the large 5/16" "J" nuts and install them over the large holes in the folded-up end flaps of the case bottom. Note that the "dome" of the "J" nut goes on the inside of the case.

() Locate 3 of the smaller 8-32 "J" nuts and install them over the three holes in the folded up back lip of the case. Again, the "dome" goes to the inside of the case.

() Locate the rubber feet supplied and install them in the 4 holes in the tray closest to the corners. Push the threaded stud of the foot through from the bottom of the case and fasten in place using the #8 split lock-washer and the #8 nut supplied. Tighten securely.

() Locate the grounding type line cord and install using the strain relief supplied in the hole provided in the rear of the case. Be sure that 6" (15cm) of cord extends into the tray. Squeeze the strain relief closed with a large pair of pliers during installation (it has to be tight). See figure 6.

() Strip 3/8 inch (9.5 mm) of insulatior from the ends of each of the three wires in the power cable. If more than 3/8 inch (9.5 mm) of the conductors are already exposed, clip them back to this length.

() While supporting the supplied No.8 ground lug in a small vise (clothespin or pliers held closed with a rubber band), connect and solder to it the GREEN wire of the power cable. This wire is from the round ground pin on the wall plug. FOR SAFETY, MAKE SURE YOU HAVE THE RIGHT WIRE. If in doubt, check continuity with an ohm meter.

() Locate the fuse post and mount it by passing it through the remaining hole in the rear tray lip. Note that the solder lug on the side of the post should be mounted so as to be accessible. Fasten in place with the hardware provided.

() Connect and solder the BLACK wire from the line cord to the solder lug on the end of the fuse post. Use a crimp connection.

() Locate the power transformer and prepare it for installation by scraping the laquer coating from the top and bottom surfaces of the mounting tabs.

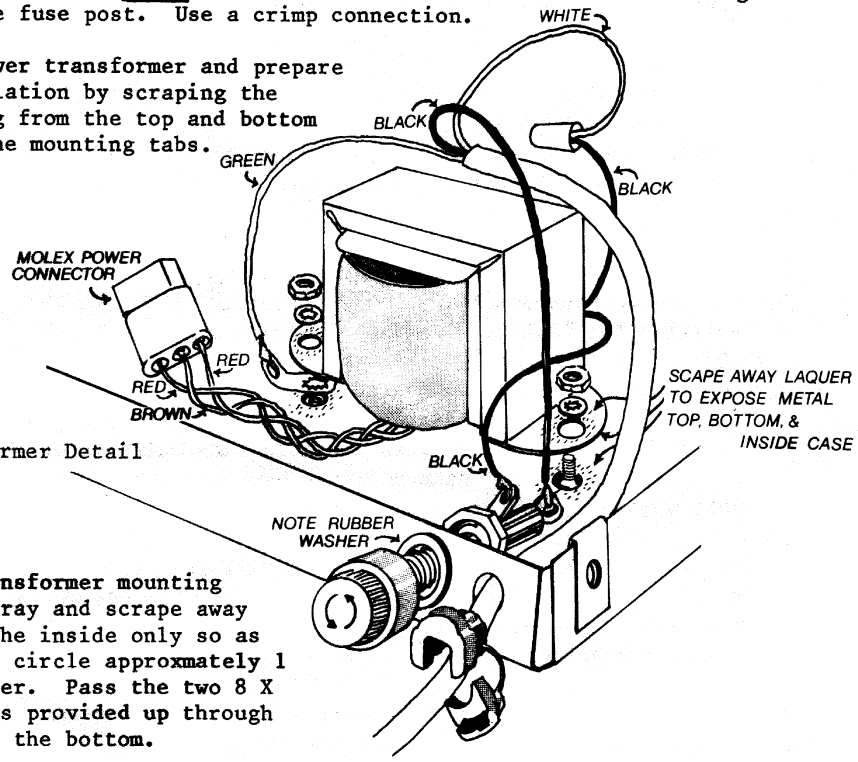


Figure 6: Transformer Detail

() Locate the transformer mounting holes in the tray and scrape away any paint on the inside only so as to form a bare circle approxmately 1 inch in diameter. Pass the two 8 X 3/8 inch screws provided up through the holes from the bottom.

() Slip the solder lug previously soldered to the GREEN wire of the power cable over the right hand screw and then slide the power transformer over the screws. Make sure that the two black leads emerge from the side of the transformer away from the rear edge. Fasten the transformer in place with 2 #8 lockwashers and nuts. Tighten securely.

() Either strip insulation or clip the wire so that 3/8 inch of conductor is exposed on the two black leads of the transformer. Tin the exposed conductors.

() Connect and solder one of the black leads to the lug on the side of the fuse post. Use a crimp connection.

() Use the wire nut supplied to twist together the WHITE wire from the power cable and the remaining black transformer lead.

() Expose 1/4 inch (6 mm) of conductor on each of the three remaining wires from the transformer. Make sure the conductors are tinned.

We will now install the power connector on the secondary leads of the transformer. This connector consists of a white nylon body and three stamped metal pins.

() Locate the male Molex pin. This is the one which looks like a rounded bullet. (The two which look like open cylinders are the female Molex pins.) Lay the tinned end of one of the two RED wires coming from the power transformer into the central section of the male Molex pin, and solder into place. Using a pair of needle nose pliers, fold the strain relief "ears" of the Molex pin around the insulation of the wire. (see figure 7)

Molex power connector

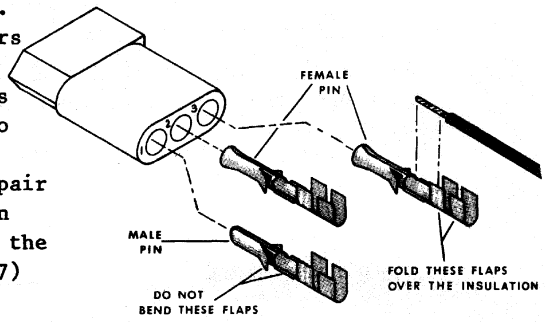


Figure 7: Power Connector Assembly Detail

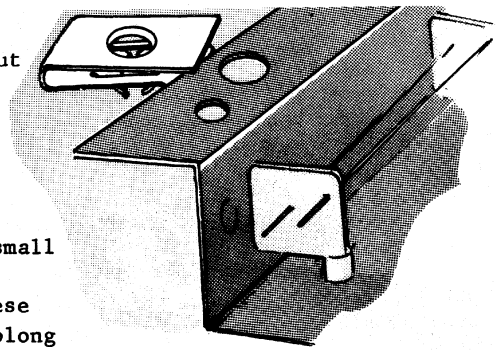
() Locate the molded plastic Molex pin holder. Note that one end is rounded and one end is squared off with a triangular polarization feature. On the rounded end of the holder, you will find that the three holes have been numbered.

Number 1 is the hole which is closest to the triangle polarizer on the other end. Hole number 1 is the hole into which we will insert the Molex pin prepared above. MAKE SURE you have properly identified the location of hole number 1, as the Molex pins are IMPOSSIBLE to remove once they are installed. Grasp the wire with a pair of needlenose pliers just behind the Molex pin. Insert the pin into hole number 1 from the rounded end of the plastic holder. Push the pin into the hole as far as it will go. The far "bullet" shaped end of the plug should be approximately flush with the other end of the holder.

() In a manner similar to the above, connect the BROWN wire from the transformer to a female Molex pin and install in hole #2 in the holder.

() Connect the remaining RED wire to the last female pin and install in hole #3.

We can now complete the case bottom sub-assembly by installing the previously assembled keyboard and encoder in the bottom tray. Note that the "L" brackets which serve as the rear mounting feet may become slightly deformed during shipping and could require some fitting during installation. A pair of pliers may be used to bend the brackets slightly to fit the holes in the case bottom. Only small adjustments should be necessary.



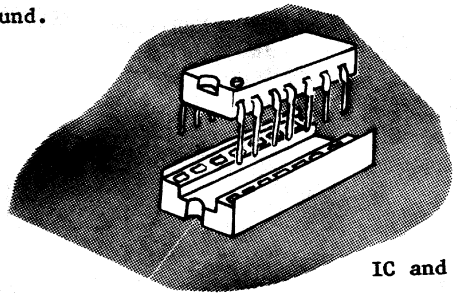
() On the keyboard assembly, slide two small "J" nuts over the large holes in the lower lip of the keyboard frame. These holes correspond to the front most oblong pair of mounting holes in the tray.

() Fasten the keyboard assembly in place using four of the #8 X 3/8" machine screws provided. The front two screws pass through the "J" clips installed above and the rear two through the "L" brackets attached to the rear of the keyboard frame. Tighten securely.

Complete this assembly section by installing the Integrated Circuits in their sockets. Be sure to observe polarizing notches as mentioned earlier and note that some IC's may be keyed with a shallow indentation adjacent to pin 1.

WARNING: The IC's used here are CMOS (Complementary Metalic Oxide Semiconductor) circuits and are susceptible to damage from static electricity. When installing these parts (and other CMOS elements in future section) observe the following precautions to avoid damage. Do not wear synthetic materials such as nylon or rayon. Immediately before installing these IC's touch a cold water pipe or other source of good earth ground.

IC LOCATION	TYPE
() IC1	4024 counter
() IC2	4051 1/8 mux
() IC3	4051 1/8 mux
() IC4	4001 quad NOR



IC and socket

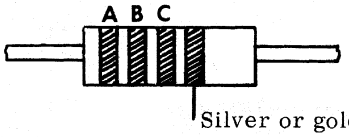
THIS COMPLETES ASSEMBLY OF THE PROTEUS CASE BOTTOM. Take a break before proceeding to the assembly of the backplane board.

8750 BACKPLANE BOARD ASSEMBLY

() Locate the 8750B circuit board and prepare it for assembly by thoroughly cleaning the conductor side of the board with steel wool or a "scotchbrite" pad. Notice that there are designations on the conductor side of this board which will be visible through the rear of the case when PROTEUS I is completely assembled. Take care not to obliterate this printing.

A BRIGHT SHINY BOARD IS ESSENTIAL TO SUCCESSFUL SOLDERING.

As with the previous board, solder each of the resistors in place following the parts placement designators printed on the circuit board and parts placement drawing figure 8. Remember that the fixed resistors are non-polarized and may be mounted with either of their two leads in either of the holes provided. Insert both leads in the mounting holes and push the resistor FULLY against the board. On the conductor side of the board, bend the leads outwards to about a 45 degree angle to help hold the component in place while soldering. AFTER SOLDERING, clip off each lead flush with the top of the solder joint.



Silver or gold - disregard this band.

DESIGNATION	VALUE	COLOR CODE A-B-C
() R1	1 meg	brown-black-green
() R2	470K	yellow-violet-yellow
() R3	470K	yellow-violet-yellow
() R4	100K	brown-black-yellow
() R5	330 ohms	orange-orange-brown
() R6	330 ohms	orange-orange-brown
() R10	1K	brown-black-red
() R11	5600 ohms	green-blue-red
() R12	1K	brown-black-red
() R13	1K	brown-black-red
() R14	1K	brown-black-red
() R15	1K	brown-black-red
() R16	1K	brown-black-red
() R17	1K	brown-black-red
() R18	1K	brown-black-red
() R19	330 ohms	orange-orange-brown
() R21	22K	red-red-orange
() R22	1800 ohms	brown-grey-red
() R23	100K	brown-black-yellow
() R24	1 meg	brown-black-green
() R25	4700 ohms	yellow-violet-red
() R26	4700 ohms	yellow-violet-red
() R28	22K	red-red-orange
() R32	470 ohms	yellow-violet-brown

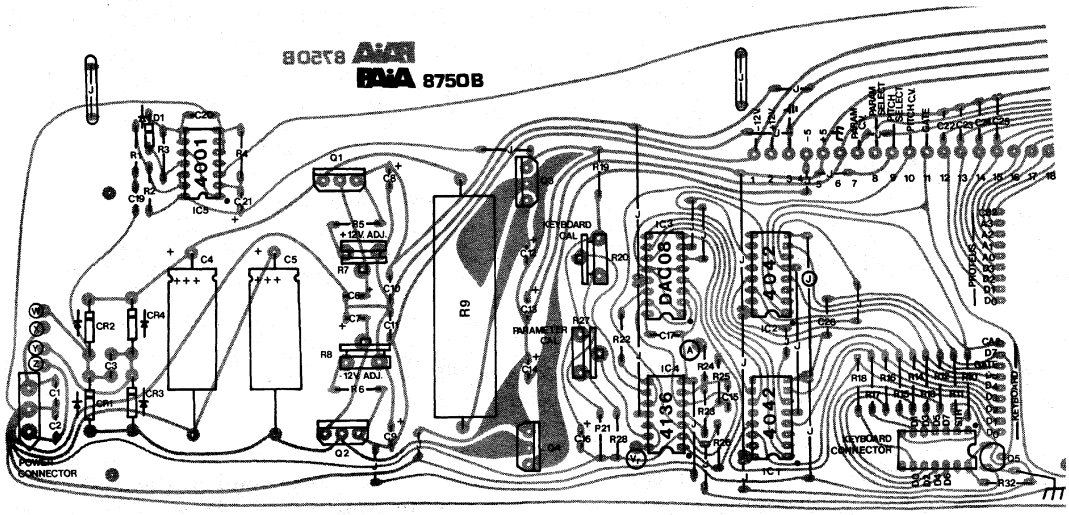
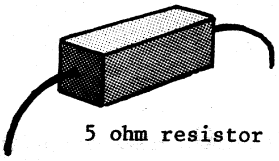


Figure 8: 8750B Parts Placement

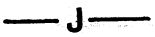
() Locate and install the larger 5 ohm power resistor (R9). When mounting this component the body of the resistor should remain about 1/4 inch (7mm) away from the circuit board to allow for proper cooling.



5 ohm resistor

There are three kinds of solid wire jumpers indicated in the parts legends on the circuit board.

These jumpers are to be formed from either resistor clippings or the solid bare wire provided. Cut the jumper somewhat longer than needed and use pliers to pull the tail on the foil side of the circuit board until the jumper is straight and flush with the board.

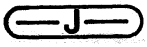


() Install these jumpers at this time.

These jumpers are as above but with an appropriate length of the hollow plastic sleeving slipped on prior to installation.

() Install these jumpers at this time.

These are sleeved jumpers as above, but are reserved for use a hold downs for stranded wire cabling. As this cabling is not yet installed, DO NOT INSTALL THESE JUMPERS AT THIS TIME.

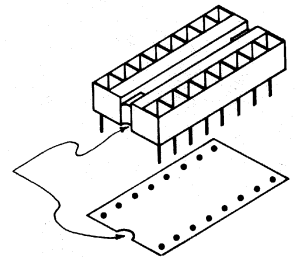


As outlined above, install the bare and insulated jumpers (but NOT the cable hold downs). The summary below will help you check to make sure that you have installed all jumpers.

() vertical bare 18
() horizontal bare 5
() vertical sleeved 2

Install the 14 and 16 pin DIP sockets as directed below. Observe polarizing keys.

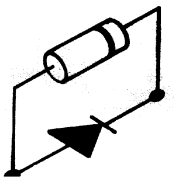
	TYPE	LOCATION
()	16 pin	IC1
()	16 pin	IC2
()	16 pin	IC3
()	14 pin	IC4
()	14 pin	IC5
()	14 pin	Keyboard connector



Install the rectifier diodes. Note that these parts are polarized by a colored band on one end. This end corresponds to a similar band on the circuit board designators. All semi-conductors (diodes, ICs, voltage regulators, transistors, etc.) are heat sensitive and may be damaged if allowed to get too hot while soldering. To be on the safe side, heat sink each lead during the soldering operation by grasping it with a pair of needle nose pliers at a point between the circuit board and the body of the component.

DESIGNATION	TYPE NO.
() CR1	1N4001
() CR2	1N4002
() CR3	- or -
() CR4	1N4003

rectifier and signal diodes



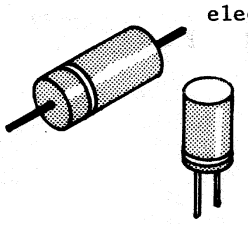
In a similar manner, install the glass signal diode D1. Observe polarity and be careful not to overheat.

DESIGNATION	TYPE NO.
() D1	1N4148 or 1N914

Install the electrolytic capacitors. Note that these components are polarized, and the component lead which has been designated positive (+) on the body of the part MUST be installed in the circuit board hole which is labeled (+). In the event that the capacitors supplied have their negative lead (-) marked, it is to go through the unmarked hole in the circuit board. Note that the specified operating voltage is a minimum acceptable rating. Capacitors supplied with specific kits may have a higher voltage rating than that specified, however they will not affect the performance of the kit.

DESIGNATION	TYPE NO.
() C4	1000 mfd./25v.
() C5	1000 mfd./25v.
() C6	10 mfd./15v.
() C7	10 mfd./15v.
() C8	10 mfd./15v.

electrolytic capacitor



()	C9	10 mfd./15v.
()	C12	33 mfd./16v.
()	C13	33 mfd./16v.
()	C14	33 mfd./16v.
()	C16	33 mfd./16v.
()	C21	2.2 mfd./16v.

Next install the ceramic disc capacitors. These are non-polarized, either lead may go in either circuit board hole.

DESIGNATION		TYPE	ALTERNATE MARKINGS
()	C1	.05 mfd.	
()	C2	.05 mfd.	
()	C3	.05 mfd.	
()	C10	.05 mfd.	
()	C11	.05 mfd.	
()	C15	.05 mfd.	
()	C17	.01 mfd.	(103)
()	C19	.01 mfd.	(103)
()	C20	.05 mfd.	
()	C22	470 pf.	(470K)
()	C23	470 pf.	(470K)
()	C24	470 pf.	(470K)
()	C25	470 pf.	(470K)
()	C26	.005 mfd.	(502)

ceramic disc capacitor

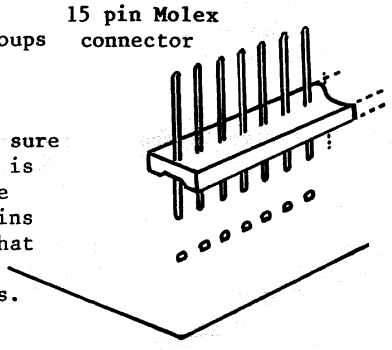
Install the trimmer resistors as illustrated below.

DESIGNATION		VALUE
()	R7	1K
()	R8	1K
()	R20	10K
()	R27	10K

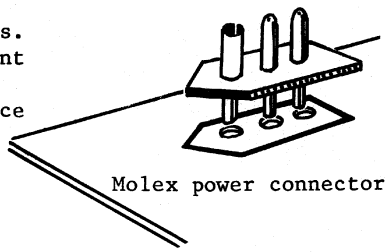
trimmer resistor

() Install the Molex card edge connector fingers. Note that the connectors are grouped into 3 groups of 30 pins each, but that each 30 pin group is composed of two 15 pin connectors end to end. Insert the short ends of the connector fingers through the component side of the board. Make sure that the nylon wafer holding the pins in place is flush with the circuit board before tacking the connector in place by soldering only the end pins of the connector. Double check to make sure that the connector is flush, and if so finish installation by soldering the remaining 13 pins. These connectors are not polarized.

15 pin Molex connector

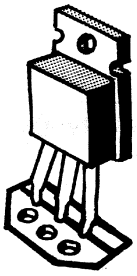


() Install the 3 prong MOLEX POWER CONNECTOR in the location indicated by the parts placement graphics. NOTE that this connector is polarized and the point of the connector wafer corresponds to a similar point on the graphics. Tack the connector in place by soldering only the middle lug. Check to see that the connector is flush with the board before soldering the outer two lugs.



Molex power connector

We will now install the voltage regulators. Note that the regulator cases are square plastic cases (which we will call the "front") mounted on a larger metal tab (the "back"). When properly installed, the back (metal tab) should align with the twin parallel lines of the circuit board graphics, while the body will be facing in the direction of the "angled" edges of the designator on the circuit board. Insert the regulator fully into the mounting holes until the broader mounting leads stop the regulator about 1/4 inch (6mm) above the board. Heat sink the leads while soldering in place.

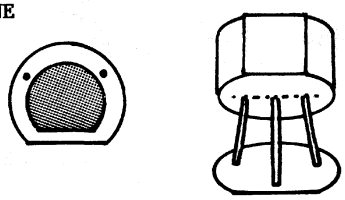


voltage regulator

DESIGNATION	TYPE NO.
() Q1	7805
() Q2	7905
() Q3	7805
() Q4	7905

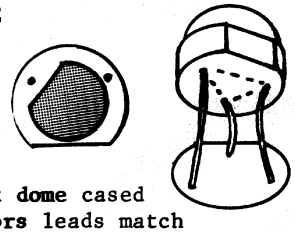
() Install transistor Q5 (2N5129). This transistor may be in one of two different case styles. If the transistor supplied with your kit has in-line leads, bend the center lead slightly toward the flat face of the case so that the leads will match the triangular hole pattern on the circuit board.

IN-LINE



bend center lead to match holes.

DOME CASE



note that dome cased transistors leads match holes but polarizing flat does not correspond to graphics.

It is time to mount the controls and jacks on the pc board. Note that all of these parts mount from the component side of the board (see fig. 9).

() Using two 4-40 X 1/4 inch machine screws, two #4 lock washers and two #4 nuts mount the slide switch in the location shown in the circuit board graphics. Pass the screws through from the conductor side of the board. Orientation is not critical. Tighten securely.

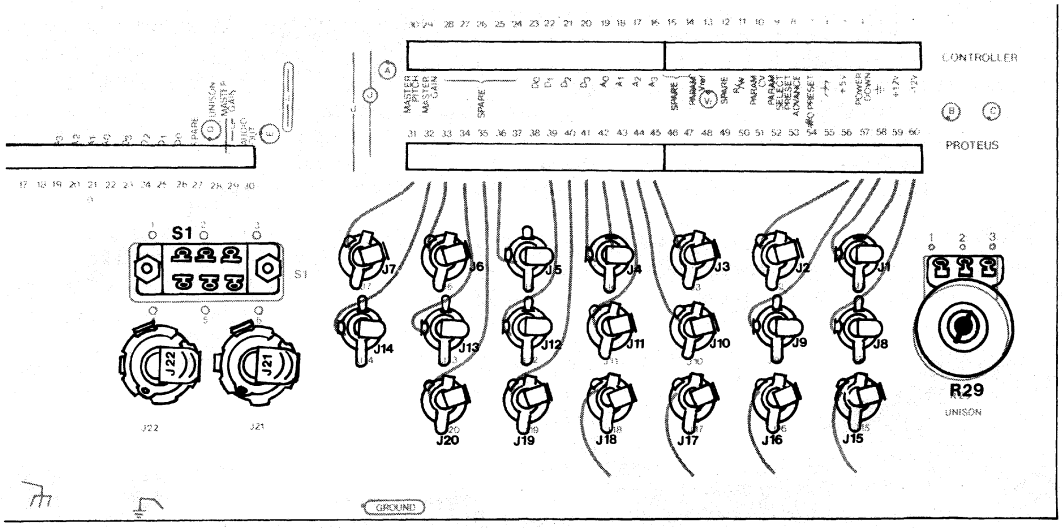
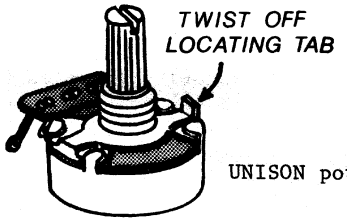


Figure 9: Location of Controls and Jacks

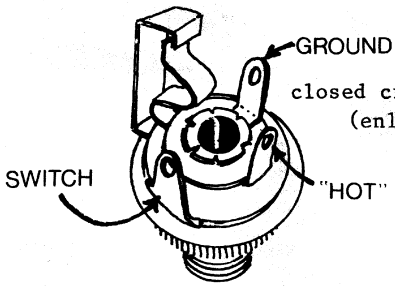
() **Locate the UNISON potentiometer (R29, 5K ohms) and prepare it for mounting by twisting off the locating tab. Mount by passing its shaft and bushing through the 3/8 inch hole provided. Fasten in place with the 3/8 inch nut provided. Tighten securely.**



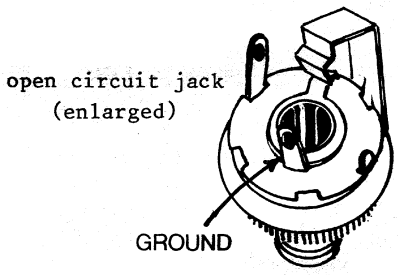
UNISON potentiometer

() Mount the two 1/4 inch phone jacks at the locations marked for J21 and J22. Fasten in place with the large nut and flat washer provided. Orient as shown in figure 9.

Both "open circuit" and "closed circuit" miniature phone jacks are provided with this kit. In all cases these jacks will be slightly modified by bending some (but not all) of their solder lugs down to be parallel with the board. When instructed to do so, use pliers to bend the lugs as close to the body of the part as possible. These modifications will greatly simplify subsequent wiring of the jacks.

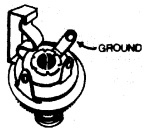


closed circuit jack
(enlarged)



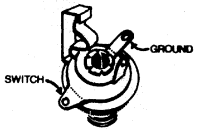
open circuit jack
(enlarged)

Locate two of the closed circuit miniature jacks supplied and prepare them for installation by bending down the ground lugs only. Using the nut and flat washer provided, mount the jacks in the locations listed below. Orient as shown in figure 9. DO NOT OVERTIGHTEN.



() J1
() J4

The remaining five closed circuit jacks should be prepared for installation by bending down both their ground and "switch" lugs. Following the procedure above, mount these jacks in the indicated locations.



() J5
() J8
() J9
() J12
() J13

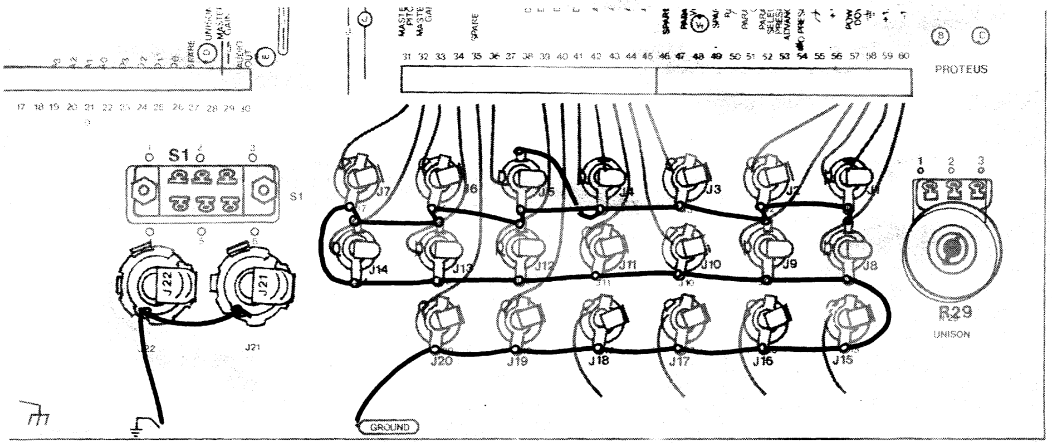
All thirteen of the open circuit jacks should be prepared for installation by bending down the ground lug only. Mount these jacks in the locations listed below. Orient as illustrated in figure 9.

() J2
() J3
() J6
() J7
() J10
() J11
() J14
() J15
() J16
() J17
() J18
() J19
() J20

() Cut a 1 1/4 inch (3.2 cm) length of bare wire and use it to connect the "switch" lug of J5 to the ground lug of J4. Solder both connections (see fig. 10)

() Prepare the remaining bent-down lugs of jacks J1 - J20 for the next step by tinning each with a small spot of solder.

Figure 10: Ground Wire Installation



() Using the remaining bare wire as required, wire together all of the lugs on jacks J1 - J20 which were bent down in the steps above (see figure 10). Starting at J8, solder the end of the solid wire to the "switch" lug. Next route the wire up to J1's ground lug and tack solder in place (do not try to pass the wire through the hole in the lug). Continue to the left and tack solder the wire to the ground lug of J2 and "switch" lug of J9. Proceed around the jacks as shown in the referenced illustration (figure 10) until all of the bent-down lugs have been chained together. When you have made the final connection at J20, cut the wire so that a 1-1/2 inch (3.8 cm) pigtail remains.

() Pass the above pigtail through the pc hole marked GROUND and solder in place. Trim flush with the circuit board.

() Pass one end of the remaining bare wire through the ground lug of the 1/4 inch phone jack J22 (DO NOT SOLDER), and then through the ground lug of J21. SOLDER THE CONNECTION AT J21 ONLY.

() Cut the above wire so that a 1-1/2 inch (3.8 cm)pigtail remains extending beyond the lug of J22. Pass this wire end through the circuit board hole marked with the analog ground symbol (⏚). Solder and trim flush with the conductor side of the board.

In the following steps the stranded insulated wire provided will be used to interconnect isolated points on the circuit board. At each step cut the wire to the length called for and prepare it for installation by stripping 3/16 inch (5 mm) of insulation from both ends. Twist and "tin" the exposed wire strands.

LENGTH	FROM	TO
() 9 inch (22.9cm)	A	A'
() 13-1/2" (34.3cm)	Vr	Vr'

The following wire lengths should be prepared as above. These wires will connect at only one end to the circuit board. The free ends will connect to the solder lugs of controls in later steps.

LENGTH	FROM
() 16-1/2 inch (42 cm)	W
() 16-1/2 inch (42 cm)	X
() 16-1/2 inch (42 cm)	Y
() 16-1/2 inch (42 cm)	Z
() 9 inch (23 cm)	D
() 2-1/2 inch (6.5 cm)	B
() 2-1/2 inch (6.5 cm)	C
() 3 inch (7.5 cm)	E

In the following steps, the wires installed above will be connected to the controls. Solder each connection as it is made.

	FROM	TO
()	W	lug 1 S1
()	X	lug 2 S1
()	Y	lug 4 S1
()	Z	lug 5 S1
()	B	lug 1 R29
()	C	lug 3 R29
()	D	lug 2 R29

() Locate the wire originating at circuit board point "E" and connect its free end to the non-grounded lug of phone jack J21. DO NOT SOLDER.

() You may now group the insulated wires together and route along the circuit board as shown in figure 11. After routing, the three sleeved solid wire hold downs illustrated may be installed, soldered and clipped flush with the board.

() Locate the remaining 10K resistor R30 (brown-black-orange). Cut the leads of this resistor to a length of 1/2 inch (1.3 cm) as measured from the body of the part. Slip one end of this resistor through the hole in the non-grounded lug of J22 and the other through the comparable lug on J21. Solder the two wires now connected to the lug of J21, but DO NOT SOLDER THE CONNECTION AT J22.

() Locate the remaining 680 ohm resistor R31 (blue-grey-brown) and proceding as above, connect it between the grounded and ungrounded lugs of J22. Both of these connections may now be soldered.

We will now use the remaining bare wire to connect circuit board pads associated with the PROTEUS card edge fingers in the group 31 - 60 to the patch bay jacks J1 - J20. In all cases these connections will be made following the heavy parts designator lines connecting the jacks to the edge connector.

The wires to the top row of jacks (J1-J7) need not be insulated so long as care is taken that they do not short against one another. Solder one end of the wire to the lug of the jack, cut to an appropriate length and push the free end through the corresponding circuit board hole. Solder and trim flush with the pc pad. Note that J1 and J4 each has two wires to the edge connector.

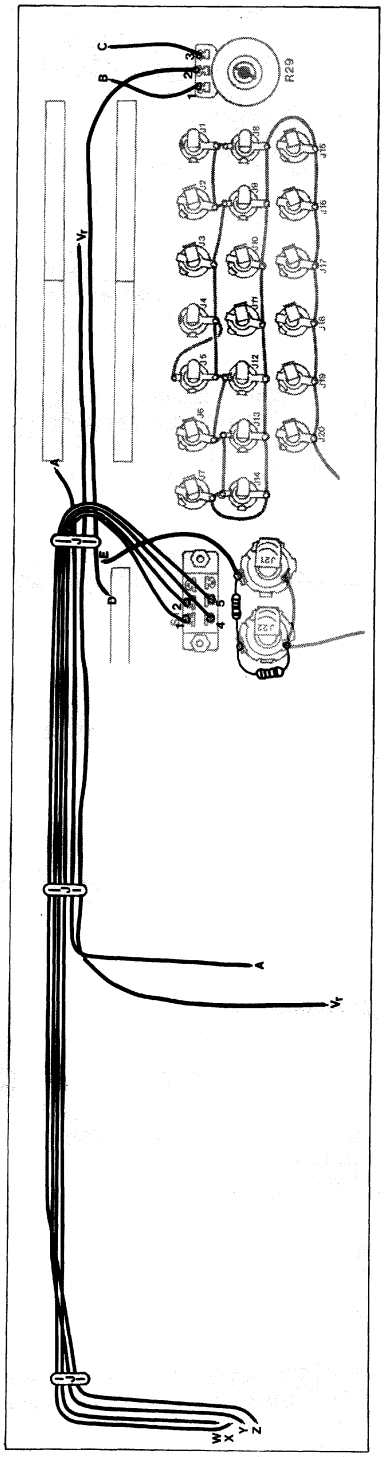


Figure 11: Wire Routing

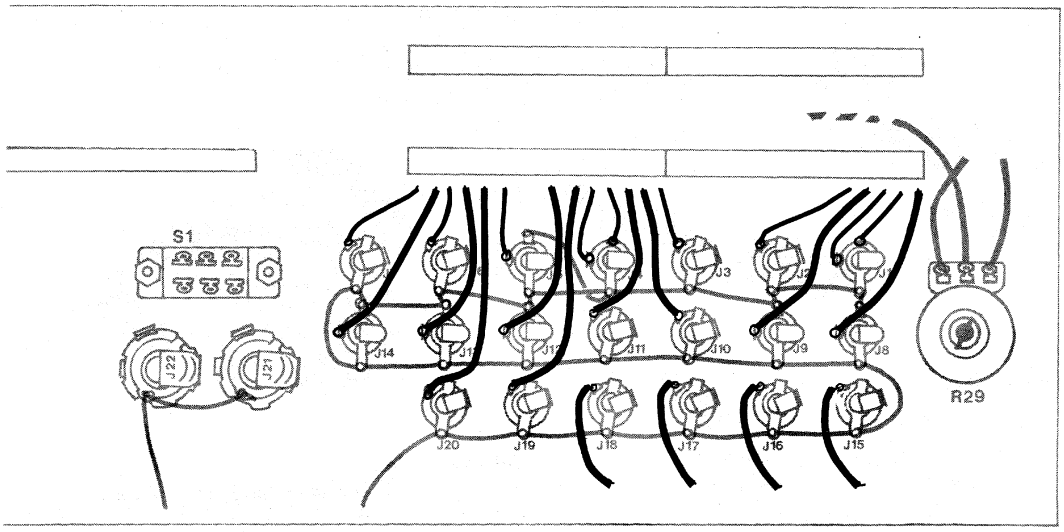
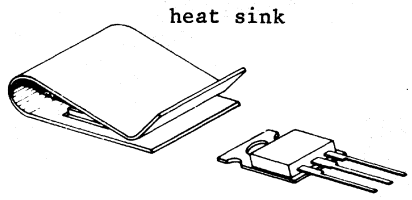


Figure 12: Wire Connections

Wires to J8 - J20 must be sleeved. Measure and cut an appropriate length of sleeving and slide it over the wire before soldering the end of the wire to the solder lug of the jack. Cut the wire so that 3/16 inch (5 mm) protrudes beyond the end of the sleeving and push the exposed wire through the circuit board hole. Solder and trim flush.

() Following the procedure outlined above, make the connections between the jacks J1 - J20 in the patch bay and the circuit board points indicated by the parts placement graphics. When all wiring is in place, the jacks may be tightened completely.

() Install the heat sinks on the voltage regulators Q3 and Q4. The flat surface of the heat sink should contact the back of the regulator, and the curved section of the heat sink should press against the plastic body. Note that the heat sink is made with internal flanges to guide the sink over the regulator, and there will be a "snap" which locks the sink in place when it is fully installed.



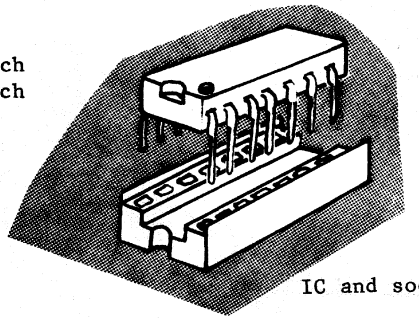
() Install the knob on the shaft of the UNISON pot by pushing it firmly into place.

Complete this assembly section by installing the Integrated Circuits in their sockets. Be sure to observe polarization as mentioned earlier.

WARNING: CMOS CIRUITS

The Integrated Circuits marked with an asterisk (*) are CMOS IC's and should be handled using the precautions outlined earlier.

DESIGNATION	TYPE NO.
() IC1	4042 (*) Quad Latch
() IC2	4042 (*) Quad Latch
() IC3	1408 DAC
() IC4	4136 Quad Op Amp
() IC5	4001 (*) Quad NOR



IC and socket

THIS COMPLETES THE ASSEMBLY OF THE BACKPLANE. Take a short break before proceeding to the initial testing of the keyboard encoder and backplane.

NOTES

KEYBOARD ENCODER/BACKPLANE TEST

Because of the size and complexity of PROTEUS, it is very desirable to deal with it as much a possible in "bite-sized" chunks. We will now stop assembly for a time and perform some tests on what we've done so far. Any problems which you may discover at this point will be much more easily handled than if the same problems are encountered when the unit is finally assembled. Toward the end, this will become a very busy collection of circuitry indeed.

NOTE that each of these test steps has been numbered. If you should run into problems which require correspondence with PAiA refer to these numbers in describing the problem.

() (1) Begin by installing the 1/2 amp fuse supplied in the fuse post at the rear of the previously assembled bottom tray. Push the cap of the post in slightly and turn in a counter-clockwise (CCW) direction to remove. Insert the fuse into the cap and re-install.

() (2) Refering to figure 13, orient the bottom tray and back-plane board on your work surface with the tray to the left with the keyboard keys facing away from you. The back-plane goes on the right and is oriented so that the conductor side of the board is down (best put a towel or similar insulating layer beneath the board to make sure that wire-clippings or solder blobs don't accidentally short conductors on the board). The graphics and parts placement legends on the component side of the board should be right-reading. Mate the Molex power connector on the leads coming from the transformer with the corresponding connector on the backplane board. (See figure 13) DO NOT INSTALL THE KEYBOARD CONNECTING CABLE AT THIS TIME (just in case there is some major problem there is no need to risk the encoder circuit board yet).

****

CAUTION - LETHAL VOLTAGE PRESENT

In a moment we will be applying power for the first time. Power line voltages will be present at the fuse post and connections to the primary side of the transformer. The tests will not require you to reach into this area - stay clear of it. Only safe lower voltages will be present on the back-plane where we will be working.

****

() (3) Plug the power cord into a convenient wall outlet and slide the power switch on the backplane card to "on". Let the equipment sit in this configuration for a few minutes to allow the electrolytic capacitors in the power supply to form and watch carefully for signs of immediate distress (smoke, sparks, excessive heat, etc.). At this point, no part on the back-plane should get so hot that it is uncomfortable to the touch.

If there are no problems so far, congratulations; we've passed the first and most critical test of any new piece of equipment, the "smoke" test.

We will now measure and in some cases adjust the more critical voltages present on the back-plane. If any of the following tests do not produce the results described, stop and re-examine your work to determine why. These voltages may be read either with a volt-ohm or multimeter, or with a DC coupled oscilloscope. Use of either instrument will produce comparable results.

() ④ With your measuring equipment, examine the voltage that appears between the "+5v." and digital ground pins of the PROTEUS edge connector (pins 5 and 6 respectively). You should read between 4.5 and 5.5 volts. There is no adjustment for this voltage.

() ⑤ In a similar manner, read the voltage between the "-5v." and digital ground pins of this same connector (pins 4 and 6). Note that if you are using a meter, the leads will probably have to be reversed to read this negative voltage. You should read between -4.5 and -5.5 volts.

() ⑥ Rotate the adjusting disk of the "+12v. adj." trimmer (R7) fully CW as seen from your viewing position and read the voltage between the "+12v." and analog ground pins of the PROTEUS connector (pins 2 and 3). Adjust R7 in a CCW direction until you read +12 volts between these pins.

() ⑦ Starting with the "-12v. adj." trimmer (R8) fully CCW, measure the voltage between -12v. and analog ground (pins 1 and 3) and adjust R8 in a CW direction for a reading of 12v. Again, meter leads may need to be reversed for this test.

() ⑧ Check the "+12v." and "-12v." pins on the CONTROLLER connector to see that the voltage there is the same as was present at the corresponding PROTEUS connector pins.

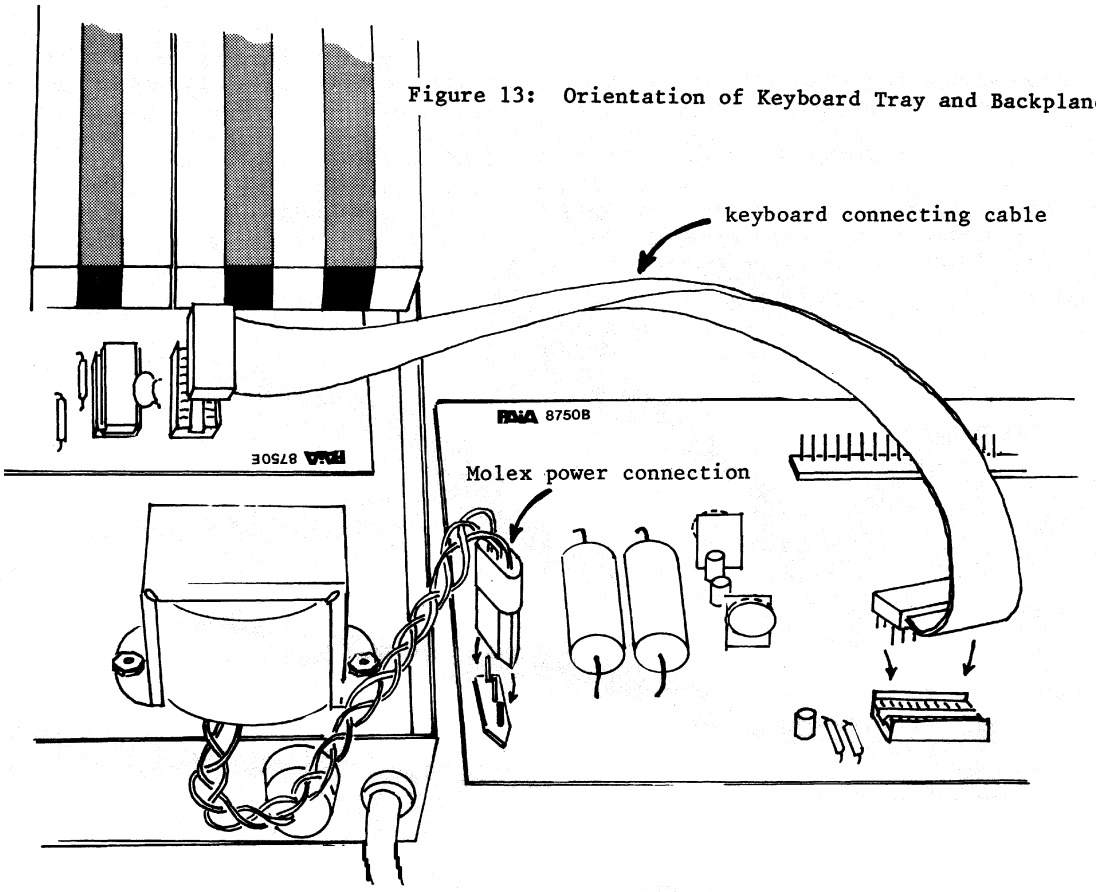
() ⑨ Measure the voltage between the "+5v." and digital ground pins of the CONTROLLER connector and confirm that the correct voltage is also present here.

() ⑩ While still reading the +5v. supply at the CONTROLLER connector, slide the power switch to "off" and observe that it takes on the order of a second for the voltage to decay completely to 0v. Slide the power switch back to "on" and observe that the voltage re-appears at this point almost instantly.

() ⑪ Measure the voltage between the POWER DOWN pin of the CONTROLLER connector (pin 4) and confirm that it is now +5v. with respect to digital ground. Again slide the power switch to "off" and observe that this voltage falls to 0v. essentially instantaneously. slide the switch to "on" and observe that there is a slight delay (the major part of a second) before the +5v. re-appears at this pin.

() ⑫ Unplug the power supply from the wall outlet and using the DIP header terminated flat cable supplied, make the connection between the KEYBOARD CONNECTOR socket on the back-plane and the OUTPUT CONNECTOR socket on the keyboard encoder. When properly installed, the cable coming from these headers will be on the side of the socket closest to the edge of their respective circuit boards (see fig. 13). With this connector in place, once again apply power and confirm that the slide switch is "on".

Figure 13: Orientation of Keyboard Tray and Backplane



() Going back to the PROTEUS edge connector pins once more, read the voltage between the GATE (pin 11) and digital ground (pin 6). Between these pins
⑬ you should read +5v. while any key is pressed and 0v. when no keys are pressed.

() Read the voltage between the PITCH C.V. (pin 10) and analog ground (pin 3) and confirm that the voltage at this pin increases as progressively up-scale
⑭ keys are pressed (up-scale keys will be to the left if the equipment is still oriented as originally described).

() Press the highest G# on the keyboard (second black key from the left in this orientation) and adjust the KEYBOARD CAL. trimmer (R20) for a reading of
⑮ +4v. at pin 10.

Skip this step

~~()~~ Finally, read the voltage between the UNISON (pin 28 of the PROTEUS
⑯ connector) and analog ground and observe that the voltage at this point is adjustable between 0 and +5v. as the UNISON pot is rotated.

Successful completion of the above test sequence is a strong indication that both the encoder circuitry and most of the essential back-plane circitry are operating properly.

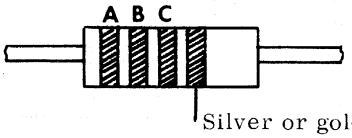
TAKE A BREAK (we've all earned it) before proceeding to the assembly of the CONTROLLER card.

8750C ASSEMBLY

() Locate the 8750C circuit board and clean its conductor side thoroughly in preparation for assembly.

A BRIGHT SHINY BOARD IS ESSENTIAL TO SUCCESSFUL SOLDERING

As with previous boards, assembly begins with the installation of fixed resistors. Refer to the parts placement graphics printed on the board and figure 14. There are lots (there have to be), take your time.



Silver or gold - disregard this band.

DESIGNATION	VALUE	COLOR CODE
() R2	10K	brown-black-orange
() R5	270K	red-violet-yellow
() R6	1K	brown-black-red
() R7	1K	brown-black-red
() R8	1K	bown-black-red
() R9	1K	brown-black-red
() R10	1K	brown-black-red
() R11	1K	brown-black-red
() R12	1K	brown-black-red
() R13	1K	brown-black-red
() R14	2.2 meg	red-red-green
() R15	1K	brown-black-red
() R16	680 ohms	blue-grey-brown
() R17	680 ohms	blue-grey-brown
() R18	680 ohms	blue-grey-brown
() R19	680 ohms	blue-grey-brown
() R20	10K	brown-black-orange
() R21	10K	brown-black-orange
() R22	10K	brown-black-orange
() R23	10K	brown-black-orange
() R24	47K	yellow-violet-orange
() R25	47K	yellow-violet-orange
() R26	47K	yellow-violet-orange
() R27	47K	yellow-violet-orange
() R28	1K	brown-black-red
() R29	4700 ohms	yellow-violet-red
() R30	15K	brown-green-orange
() R31	15K	brown-green-orange
() R32	39K	orange-white-orange
() R33	47K	yellow-violet-orange
() R34	100K	brown-black-yellow
() R35	2.2 meg	red-red-green
() R36	100K	brown-black-yellow
() R37	39K	orange-white-orange
() R38	47K	yellow-violet-orange

()	R39	2.2 meg	red-red-green
()	R40	470K	yellow-violet-yellow
()	R41	240K	red-yellow-yellow
()	R42	470K	yellow-violet-yellow
()	R43	39K	orange-white-orange
()	R44	47K	yellow-violet-orange
()	R45	2.2 meg	red-red-green
()	R46	910K	white-brown-yellow
()	R47	470K	yellow-violet-yellow
()	R48	240K	red-yellow-yellow
()	R49	1 meg	brown-black-green
()	R50	39K	orange-white-orange
()	R51	47K	yellow-violet-orange
()	R52	2.2 meg	red-red-green
()	R53	2200 ohms	red-red-red
()	R54	2200 ohms	red-red-red
()	R55	2200 ohms	red-red-red
()	R56	2200 ohms	red-red-red
()	R57	470 ohms	yellow-violet-brown
()	R58	470 ohms	yellow-violet-brown
()	R59	470 ohms	yellow-violet-brown
()	R60	470 ohms	yellow-violet-brown
()	R61	100 ohms	brown-black-brown
()	R62	100 ohms	brown-black-brown
()	R63	68K	blue-grey-orange
()	R64	68K	blue-grey-orange
()	R65	33K	orange-orange-orange
()	R66	68K	blue-grey-orange
()	R67	33K	orange-orange-orange
()	R68	68K	blue-grey-orange
()	R69	33K	orange-orange-orange
()	R70	68K	blue-grey-orange
()	R71	68K	blue-grey-orange
()	R72	33K	orange-orange-orange
()	R73	68K	blue-grey-orange
()	R74	33K	orange-orange-orange
()	R75	68K	blue-grey-orange
()	R76	33K	orange-orange-orange
()	R77	68K	blue-grey-orange
()	R78	100 ohms	brown-black-brown
()	R79	100 ohms	brown-black-brown
()	R80	68K	blue-grey-orange
()	R81	68K	blue-grey-orange
()	R82	33K	orange-orange-orange
()	R83	68K	blue-grey-orange
()	R84	33K	orange-orange-orange
()	R85	68K	blue-grey-orange
()	R86	33K	orange-orange-orange
()	R87	68K	blue-grey-orange

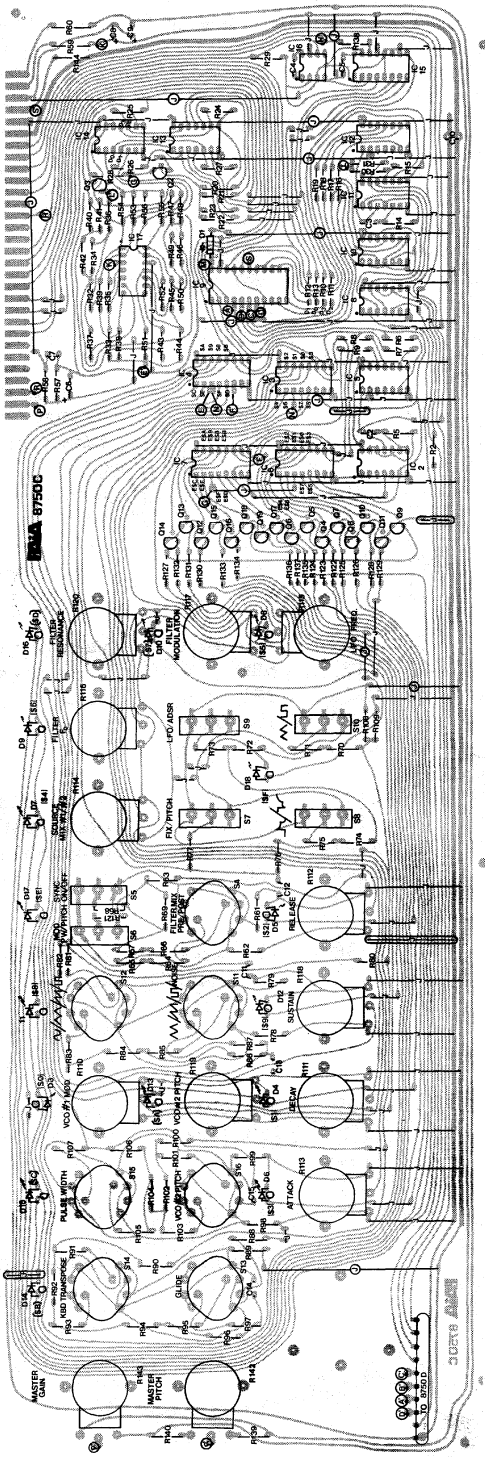


Figure 14: Location of Resistors

()	R88	100 ohms	brown-black-brown
()	R89	100 ohms	brown-black-brown
()	R90	68K	blue-grey-orange
()	R91	68K	blue-grey-orange
()	R92	33K	orange-orange-orange
()	R93	68K	blue-grey-orange
()	R94	33K	orange-orange-orange
()	R95	68K	blue-grey-orange
()	R96	33K	orange-orange-orange
()	R97	68K	blue-grey-orange
()	R98	100 ohms	brown-black-brown
()	R99	100 ohms	brown-black-brown
()	R100	68K	blue-grey-orange
()	R101	68K	blue-grey-orange
()	R102	33K	orange-orange-orange
()	R103	68K	blue-grey-orange
()	R104	33K	orange-orange-orange
()	R105	68K	blue-grey-orange
()	R106	33K	orange-orange-orange
()	R107	68K	blue-grey-orange
()	R108	470 ohms	yellow-violet-brown
()	R109	470 ohms	yellow-violet-brown
()	R121	68K	blue-grey-orange
()	R122	100 ohms	brown-black-brown
()	R123	100 ohms	brown-black-brown
()	R124	100 ohms	brown-black-brown
()	R125	100 ohms	brown-black-brown
()	R126	100 ohms	brown-black-brown
()	R127	100 ohms	brown-black-brown
()	R128	100 ohms	brown-black-brown
()	R129	100 ohms	brown-black-brown
()	R130	100 ohms	brown-black-brown
()	R131	100 ohms	brown-black-brown
()	R132	100 ohms	brown-black-brown
()	R133	100 ohms	brown-black-brown
()	R134	100 ohms	brown-black-brown
()	R135	100 ohms	brown-black-brown
()	R136	100 ohms	brown-black-brown
()	R137	100 ohms	brown-black-brown
()	R138	2200 ohms	red-red-red
()	R139	1500 ohms	brown-green-red
()	R140	1500 ohms	brown-green-red
()	R144	2200 ohms	red-red-red

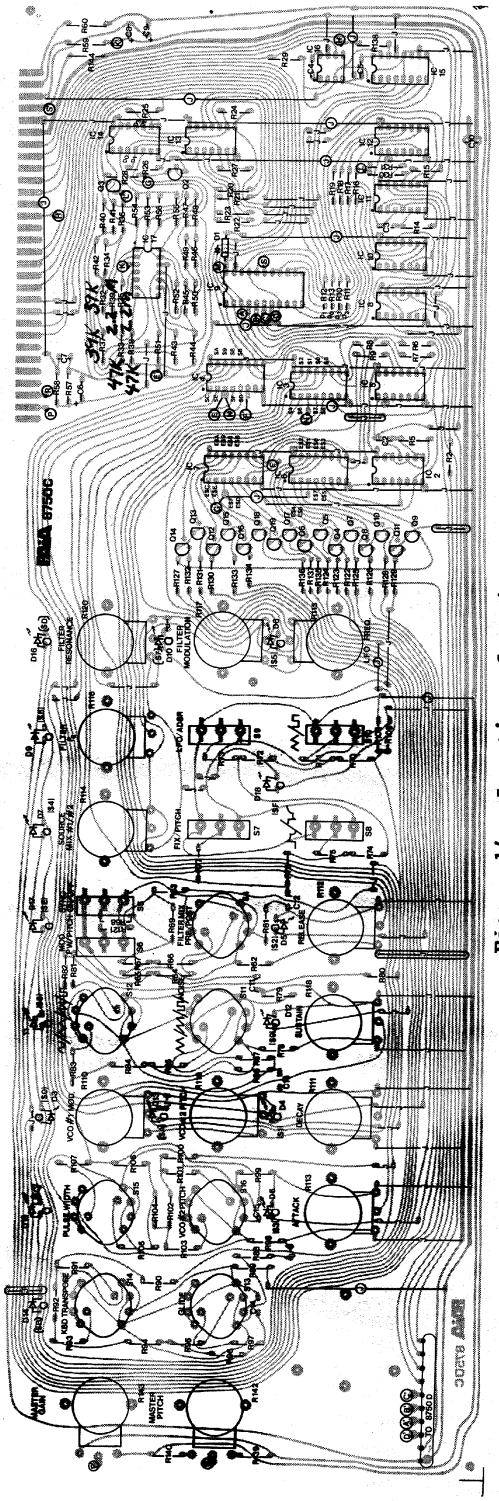


Figure 14: Location of Resistors

Using the bare wire and hollow sleeving provided and following the previously established conventions, install both the bare and sleeved jumpers. As before, DO NOT INSTALL THE WIRE HOLD-DOWN JUMPERS AT THIS TIME. The summary below will help to make sure that you have installed all jumpers.

() 57 vertical bare
() 12 horizontal bare } —J—
() 8 vertical sleeved
() 3 horizontal sleeved } —(J)—

Install the IC sockets. If the sockets supplied with your kit have polarizing notches take care that they are installed to correspond with the similar marks on the parts placement designators.

() 8 pin socket at IC16

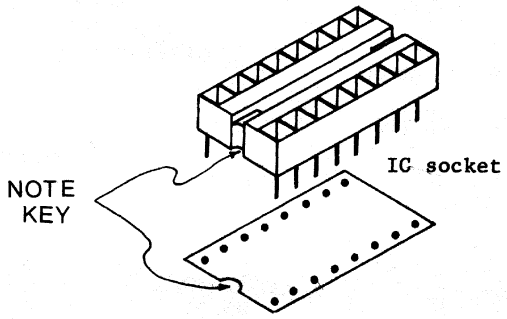
14 pin sockets:

() IC2 () IC5
() IC8 () IC10
() IC11 () IC12
() IC13 () IC14
() IC17

16 pin sockets:

() IC3 () IC4
() IC6 () IC7
() IC15

() 22 pin socket at IC9



Install the ceramic disc capacitors.

DESIGNATION	VALUE	ALTERNATE MARKINGS
() C2	.001	(102)
() C3	.05	
() C4	100 pf.	(100K)
() C5	.01	(103)
() C7	.05	
() C10	.05	
() C11	.01	(103)
() C12	.01	(103)
() C13	.01	(103)
() C14	.01	(103)
() C15	.01	(103)


ceramic disc capacitor

Install the electrolytic capacitors. Observe polarity.

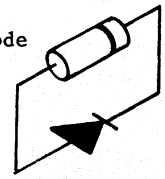
electrolytic capacitor

DESIGNATION	VALUE
() C6	33 mfd.,16v.
() C8	33 mfd.,16v.
() C9	33 mfd.,16v.

Install the signal diode. Observe previous precautions about overheating and polarization.

DESIGNATION	TYPE NO.
() D1	1N4148 (1N914)

signal diode



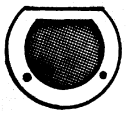
Install the transistors. Observe previous precautions about overheating and orientation.

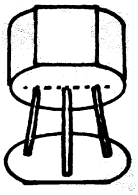
DESIGNATION	TYPE NO.
() Q2	2N5129
() Q3	2N5139
() Q4	2N5129
() Q5	2N5129
() Q6	2N5129
() Q7	2N5129
() Q8	2N5129
() Q9	2N5129
() Q10	2N5129
() Q11	2N5129
() Q12	2N5129
() Q13	2N5129
() Q14	2N5129
() Q15	2N5129
() Q16	2N5129
() Q17	2N5129
() Q18	2N5129
() Q19	2N5129

DOME CASE

note that dome cased transistors leads match holes but polarizing flat does not correspond to graphics.

IN-LINE





bend center lead to match holes.

Locate the 7 rotary switches (S4, S11 - S16). Before pressing the solder lugs on the back of the switch through their holes in the circuit board, inspect them to see that they have not been bent during shipping. The switch will match the holes better if the lugs are bent slightly inward. Before soldering the 10 lugs on the conductor side of the circuit board, MAKE SURE the switch is pressed as flush with the board as possible and is not "cocked". Alignment with front panel holes will be difficult if this precaution is not observed. (See figure 15.)

() Install seven rotary switches S4, S11-S16.

Install the 13 pc mount 5K potentiometers (R110 - R120, R142, R143). The solder lugs may need to be formed slightly to match the holes. Press the pot flush with the circuit board before soldering in place. The mounting tabs on the sides of the pots need not be bent after installation.

() Install thirteen 5K pc mount pots R110-R120, R142, R143.

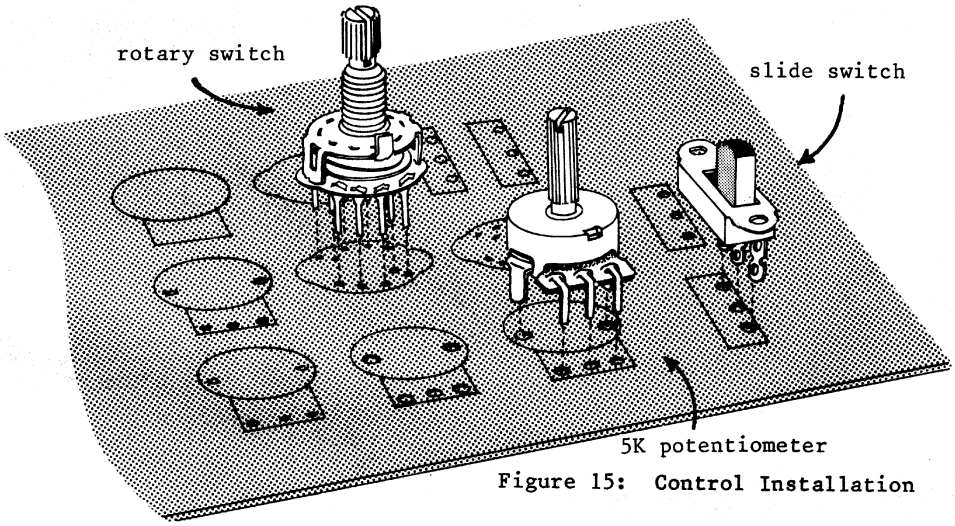
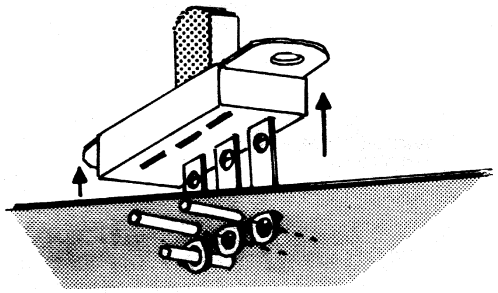


Figure 15: Control Installation

Locate the 6 single pole double throw slide switches S5 - S10. Note that the solder lugs on the back of these switches are off-center with respect to the body of the part. Note also that the rectangles which locate the switches on the pc board placement art are similarly off-center with respect to the holes through which the switch lugs will pass.

Taking care that the switch is aligned with the graphics, pass its three solder lugs through the holes from the component side of the board. The holes are slightly undersized to help support the switch in operation, so work the lugs slowly and gently into them.

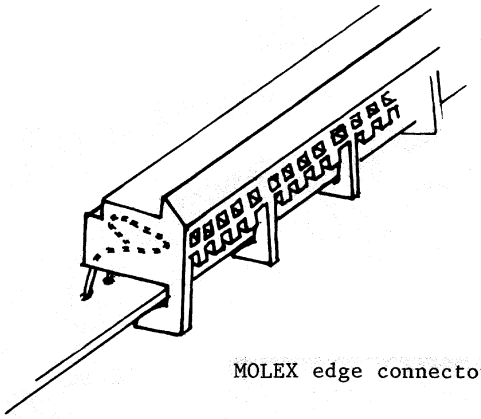
When properly mounted, the bottom of the switch will stand off from the board by approximately 1/4 inch. To set this height, slide resistor clippings through the large holes in the end of the switch lugs that are protruding from the conductor side of the board and then lift the switch away from the board so that the clippings are held against the copper traces.



Solder the clippings to both the pc conductor and the switch lugs to hold the switch in place and make electrical connection. Be very careful that unintentional solder bridges are not formed between adjacent conductors and clip the resistor leads as short as possible when done.

() Install six slide switches S5 - S10.

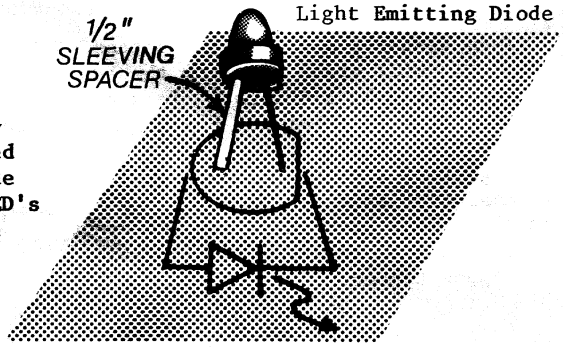
() Install the two 15 pin MOLEX edge connector sockets on the board (note location, figure 16) by slipping the mounting fingers over the edge of the card and the solder lugs through the holes provided. Solder all connections.



MOLEX edge connector socket

We will now install the 16 Light Emitting Diodes D3 - D18. Note that during installation two details need to be watched carefully.

First, the LEDs must be mounted with their leads left long enough that they will be visible through holes provided for them in the front panel. This height is easily gauged by cutting a 1/2 inch (be exact) length of clear sleeving and slipping it over one of the leads before installation.



Also be careful of the LED's polarity during installation. Polarity is keyed either with a slightly shorter cathode lead or with a small "flat" in the LED's circular base adjacent to the cathode lead.

() Install sixteen Light Emitting diodes D3 - D18.

In the following steps, the insulated wire provided will be used to interconnect isolated points on the circuit board. At each step, cut the wire to the length indicated and strip and tin both ends so that 3/16 inch (5 mm) of the inner conductor is exposed.

LENGTH	FROM	TO
() 17" (43 cm)	A	A'
() 17" (43 cm)	B	B'
() 17" (43 cm)	C	C'
() 17" (43 cm)	D	D'
() 17" (43 cm)	R	R'
() 15 1/4" (39 cm)	P	P'
() 6 1/4" (16 cm)	H	H'
() 5 1/2" (14 cm)	G	G'
() 5 1/2" (14 cm)	S	S'
() 3 3/4" (9.5 cm)	K	K'
() 3 1/2" (9 cm)	L	L'
() 1 1/2" (3.5 cm)	E	E'
() 1 1/2" (3.5 cm)	F	F'
() 1 1/2" (3.5 cm)	N	N'

() Dress and route the insulated wires just installed as shown in figure 16 and install the 4 remaining sleeved jumpers to hold them in place.

Temporarily set the 8750C board aside and proceed to the assembly of the Display and programming control board 8750D.

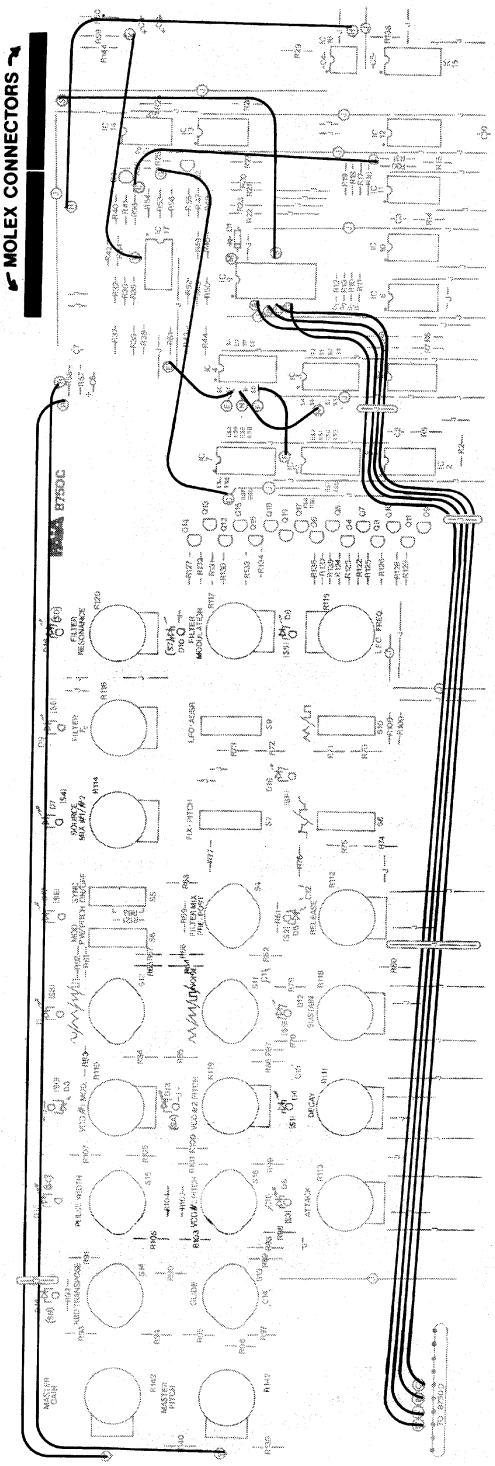
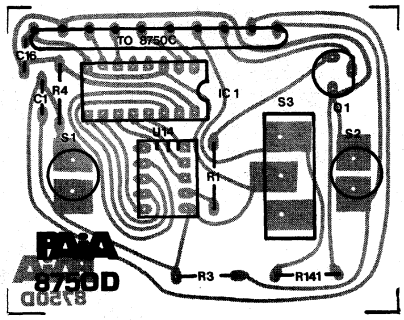
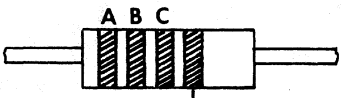


Figure 16: Wire Routing and Location of Molex Edge Connectors

DISPLAY BOARD ASSEMBLY - 8750D

() Locate the small display circuit board (8750D) and clean it thoroughly in preparation for assembly.





Silver or gold - disregard

Install the fixed resistors.

DESIGNATION	VALUE	COLOR CODE A-B-C
() R1	680	blue-grey-brown
() R3	10K	brown-black-orange
() R4	39K	orange-white-orange
() R141	10K	brown-black-orange

Install the ceramic disc capacitor

DESIGNATION	VALUE	ALTERNATE MARKINGS
() C1	.01	(103)
() C16	.05	

ceramic disc capacitor

While observing precautions for semi-conductor installation, install the transistor.

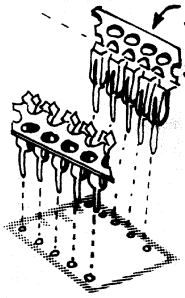
DESIGNATION	TYPE NO.
() Q1	2N5139

IN-LINE

DOME CASE

() Install the 16 pin IC socket at IC1. Observe polarizing notch.

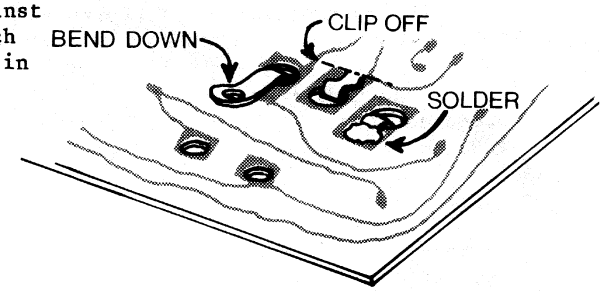
Like the IC's, the seven-segment display is also socketed, but because of the height required for the display to be visible through the front panel, Molex pins are used to mount this part. These pins are held together at the top by a metal strip referred to as a "carrier". During installation, the carrier should be on the outside of the two strips that will constitute the socket. If the pins are supplied in a continuous strip, they should be cut into two strips of 5 pins each.



() Install and solder the two rows of Molex pins at the location marked as U14. Snap off the carrier strip after the pins are soldered in place.

Unlike those on the main controller board, slide switch S3 is installed so that it sits directly on the surface of the component side of the display board. Mount the switch by pushing its solder lug through the holes provided (Note that the lugs are slightly off-center as indicated by the circuit board graphics).

When the switch is firmly seated against the board, bend the lugs over to cinch it in place (The lugs should be bent in opposite directions). Clip off the excess part of the lug which extends beyond the edge of the solder pads. Finish installation by soldering the switch lugs to the pads.



() Install slide switch S3.

We will now use the aluminum sub-panel as a fixture to aid in the installation of push-button switches S1 and S2. Locate this metal part and while it is oriented as in figure 17, fasten the switches in place with the hardware provided as illustrated.

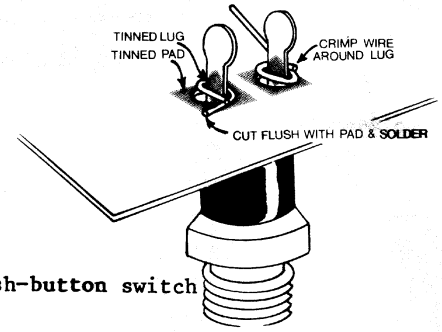
Make sure that the lugs of the push-buttons are ready to accept solder by lightly tinning them. Also tin the large square circuit board pads through which the lugs will pass.

Slip the circuit board over the lugs.

Form a small hook in the end of a short piece of bare wire and slip it around the lug. Squeeze the hook tight before wrapping the wire around so that it lays on the circuit board pad.

Clip the lead off even with the edge of the pad and solder the wire loop to both switch lug and pc pad. Repeat the sequence for all 4 lugs.

() Install push button switches S1 and S2 as detailed above.



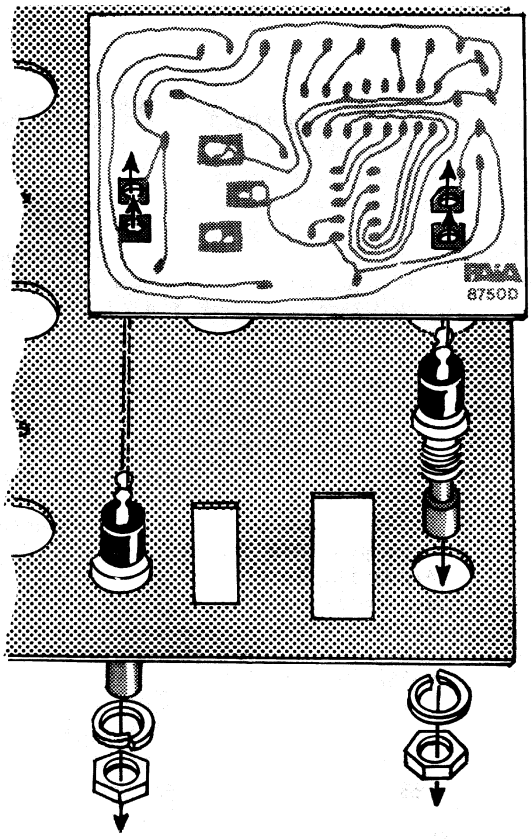


Figure 17: Orientation of Sub-panel with 8750D

Remove the display board from the sub-panel.

() Cut ten 4 1/2 inch (11.5 cm) lengths of the remaining stranded insulated wire and prepare each by stripping and tinning both ends so that 3/16 inch (5 mm) of the inner conductor is exposed.

() Solder one end of each of the wires prepared above to the circuit board pads in the lower left hand corner of the controller board as shown in figure 18.

() Connect and solder the other ends of the wires to the corresponding pads on the display board. Note carefully the orientation of the boards illustrated in figure 18.

() Install IC1 (9368 display driver) in its socket. Observe polarizing notch.

() Install the FND 357 display in the molex pins at U14. Notice that orientation of the part is keyed by the shallow grooves along one edge of the display.

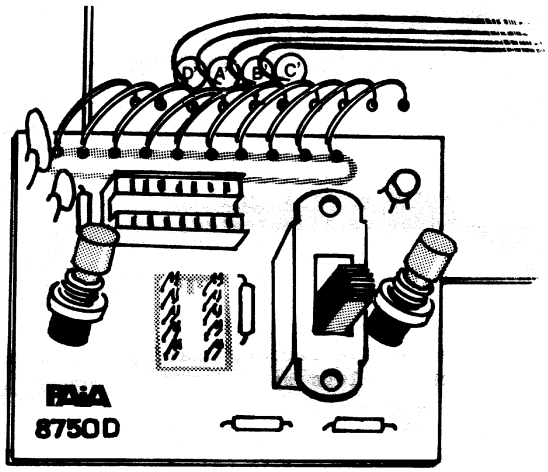
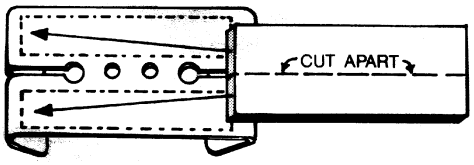


Figure 18: Wire Installation, 8750C to 8750D

The clip that holds the two AA size memory back-up batteries is installed from the conductor side of the CONTROLLER board. Locate the battery clip.

() Locate the short length of thin foam tape provided and cut it in half along its length to produce two narrow strips. Adhere these strips to the bottom of the clip taking care not to cover the mounting holes.



battery clip

() Using the two 4-40 X 1/4 machine screws, two 4-40 nuts and pair of lockwashers provided, mount the battery clip as shown in figure 19. Tighten the hardware securely, but do not over-tighten.

() Locate the remaining 1N4148 (1N914) type glass signal diode and install it between the two solder lugs on the right end of the battery clip. Note the orientation of the diode as keyed by the colored band. While observing precautions for heat sensitive components, solder both connections.

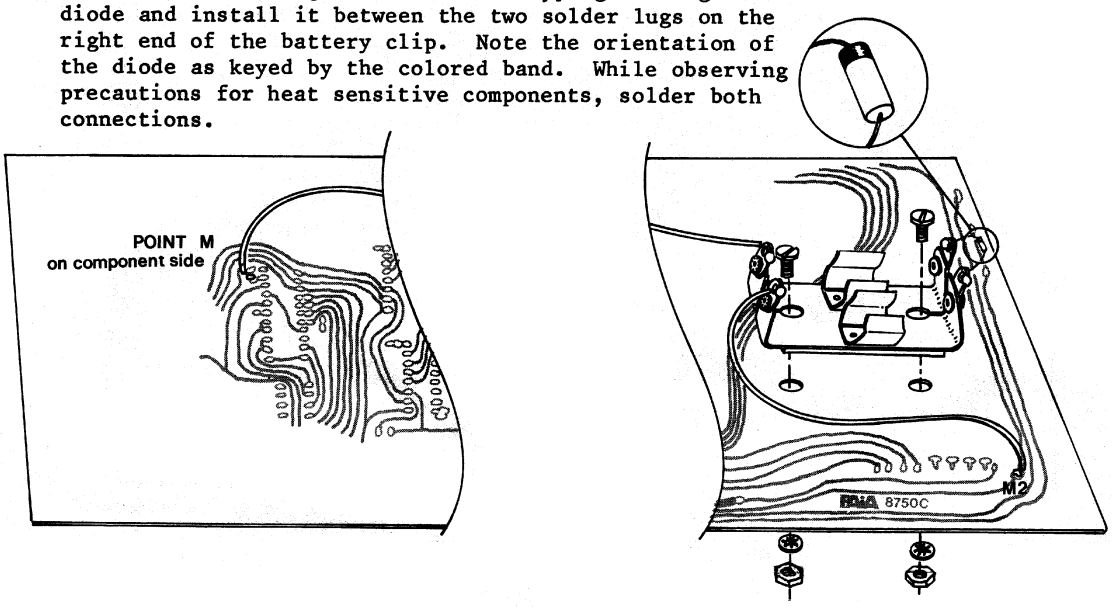


Figure 19: Battery Clip, Diode Installation, and Wiring Locations

() Strip and tin both ends of a 14 inch (35.5 cm) length of insulated wire. Connect and solder one end of this wire to the upper left hand lug of the battery clip.

() Connect and solder the other end of the wire installed above to the pad at pin 22 of IC9. This pad is marked "M" on the components side of the board. Do not pass the wire through the hole, simply tack solder it to the conductor directly. Be very careful the wire does not short to adjacent conductors during installation. DO NOT push this wire against the board.

() In a manner similar to that described above use a 3 1/2 inch (8.9 cm) length of insulated wire to connect the lower left lug of the battery clip to pad "M2" illustrated in figure 19.

The sub-panel is a means by which all of the control shafts of the switches and pots as well as the EDIT LED's may be pre-aligned with their corresponding front panel holes. Taking care that the various parts are oriented as in figure 20, begin by passing the shafts of push-buttons S1 and S2 on the display board through their holes in the sub-panel. The switch mounting nuts may be used to temporarily hold the assembly in place.

Now carefully work the sub-panel down over the switch bats and shafts of the controls. Take particular care that all of the LEDs protrude through their holes.

When satisfied with alignment of the sub-panel it may be held in place by threading the nuts provided onto the shafts of rotary switches S4, S12, S13 and S14. These nuts will be removed before final case installation, so do not over-tighten.

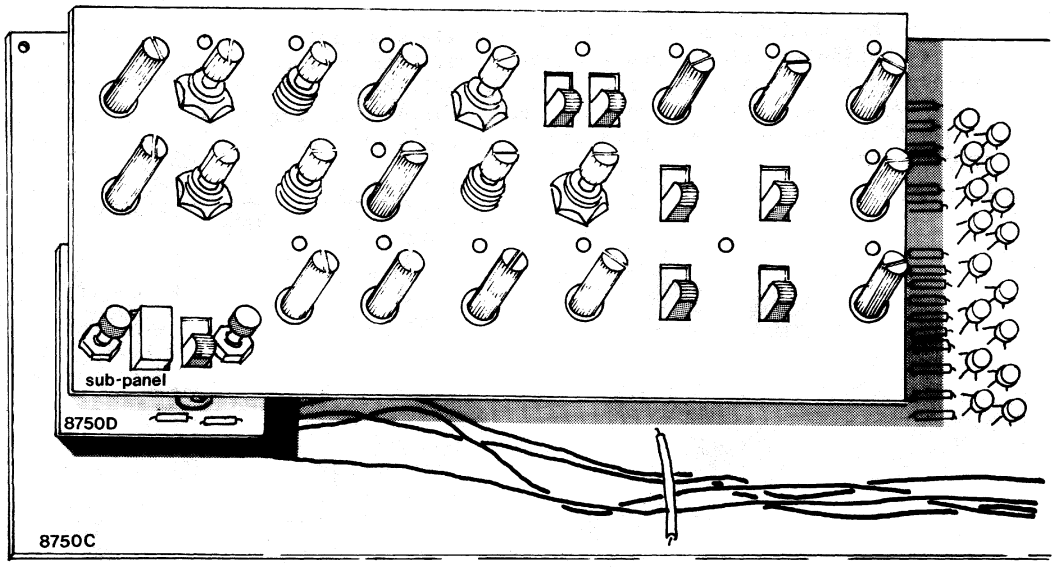


Figure 20: Orientation of 8750C, 8750D, and Sub-panel

() As outlined above, install the sub-panel.

Finish this assembly section by installing the Integrated Circuits in their sockets.

CAUTION CMOS INTEGRATED CIRCUITS, OBSERVE PREVIOUS PRECAUTION

()	IC2	4011 Quad NAND
()	IC3	4051 8 chan. MUX
()	IC4	4051 8 chan. MUX
()	IC5	4024 7 stage counter
()	IC6	4051 8 chan. MUX
()	IC7	4051 8 chan. MUX
()	IC8	4001 Quad NOR
()	IC9	5101 CMOS RAM
()	IC10	4066 Quad bilateral switch
()	IC11	4011 Quad NAND
()	IC12	4024 7 stage counter
()	IC13	4070 Quad Ex-OR
()	IC14	4001 Quad NOR
()	IC15	1408 8 bit DAC
()	IC16	748 Op-Amp
()	IC17	3302 (339) Quad Comparator

This completes preliminary assembly of the 8750C Controller board. Take a short break before proceeding to the initial testing of this board.

CONTROLLER TEST

Once again in the interest of finding any problems early, we will now perform some quick, rough checks on the Controller circuit board and at the same time get some initial exposure to the operation of the EDIT LED's. Before beginning these tests, take a moment to examine your work critically. Particularly keep an eye out for cold solder joints and solder bridges. It takes only a hair-line of solder to keep the whole board from working. Review the "BEFORE YOU START" section of this manual for tips on how to deal with any questionable areas.

Before beginning this procedure, make sure that the line cord is unplugged. You will also find the mating of the 8750B and 8750C boards much easier if the transformer leads are not plugged into the 8750C board.

Referring to figure 21, prepare the controller board for test by mating its edge connector with the corresponding 30 pin connector marked "CONTROLLER" on the 8750B Backplane Board. This connector will be tight the first time, so work it down slowly. Make sure no wires are caught in the connectors.

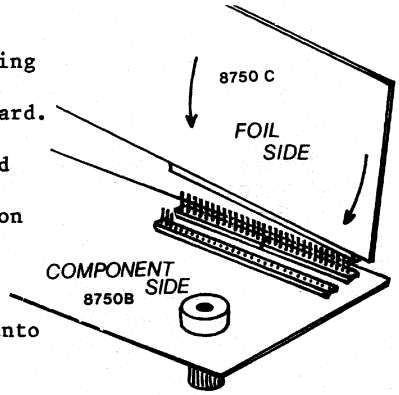


Figure 21: Controller Board as it plugs into pin connectors of Backplane

Check to make sure that the power switch on the 8750B board is "off" and that the line cord is unplugged before mating the Molex power connector between this board and the transformer in the case bottom. The keyboard connector cable need not be installed for these tests. Orient the 8750B/C subassembly on your work surface as shown in figure 22. It is alright for the left end of the controller board to rest on ceramic disk capacitor C20 on the Backplane board.

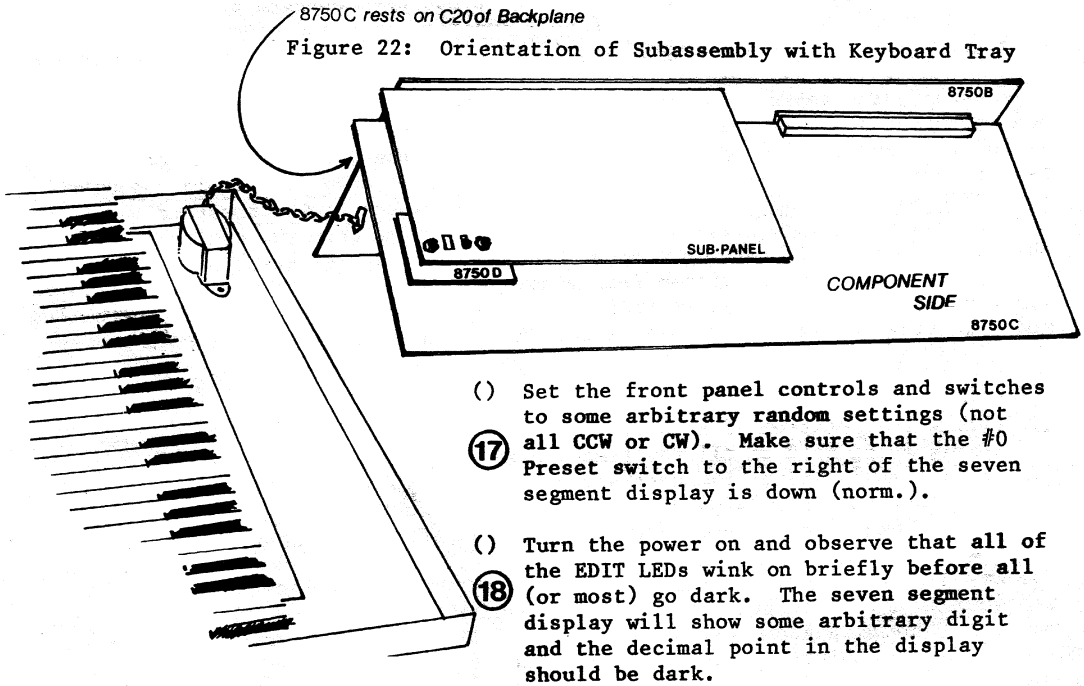


Figure 22: Orientation of Subassembly with Keyboard Tray

() Set the front panel controls and switches to some arbitrary random settings (not all CCW or CW). Make sure that the #0 Preset switch to the right of the seven segment display is down (norm.).

(17)

() Turn the power on and observe that all of the EDIT LEDs wink on briefly before all (or most) go dark. The seven segment display will show some arbitrary digit and the decimal point in the display should be dark.

(18)

() Press and hold down the advance key (left-hand push button) and observe that the seven segment display counts through the sequence of hexadecimal digits
(19) $0 - $F. Slightly more than 2 seconds should be required to scan through all 16 digits. While the diplay is counting, some EDIT LEDs may flash on and off. This is normal and simply indicates that the random data that happened to appear in the memory when the power was turned on matches the settings of the controls corresponding to the lit LEDs.

() Press the ADVANCE button with quick single-strokes and observe that each
(20) activation advances the display by one digit.

() With the display showing some digit other than 0, slide the #0 Preset switch
(21) (to the right of the display) up. The display should change to show the digit 0.

() Press the PROGRAM switch (right push-button) and observe that the PROGRAM
(22) INDICATOR (decimal point in the preset display) glows. Also notice that all EDIT LEDs will glow dimly indicating that the data in memory (which is now coming from the front panel) agrees with the front panel (obviously!).

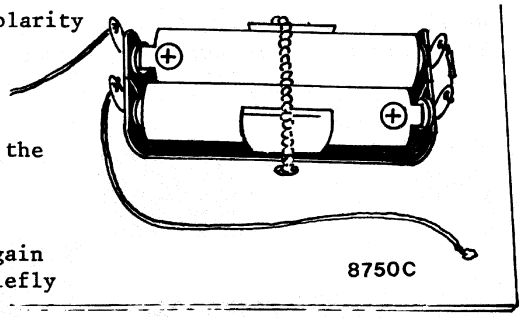
() Press the ADVANCE button (on the left) and observe that the PROGRAM
(23) INDICATOR goes dark (ADVANCE cancels the PROGRAM mode). Since #0 Preset is selected by its slide switch, the preset number should not advance. Also observe that all or most of the EDIT LEDs will glow somewhat brighter, indicating that the front panel control settings still correspond to what was just programmed.

NOTE: The front panel digitizing process used when preset data is coming from memory is slightly different and somewhat less precise than that used during programming. In some cases this will show up as an EDIT LED being dark at this point, even though the control positions have not been changed since the preset was programmed. This is an error in EDIT function only and does not affect the data in memory. Controls with extinguished LEDs may need to be "tweaked" to the right or left slightly to get the EDIT LED to come on. Similarly, you may at some later point notice that there is some interaction between the EDIT LED of one parameter and the control knob of some other seemingly unrelated parameter. Again, this error is in the digitizing process of the EDIT mode and does not have a corresponding error in memory. When all EDIT LEDs are lit in the normal (non-PROGRAM) mode, the controls are all set such that they correspond to memory and you can punch into PROGRAM assured that the voice from the controls will be the same as that which was in memory. In PROGRAM mode the state of the front panel controls is being written into memory at the PRESET shown in the display. You can now edit the preset as desired before ADVANCEing to exit the programming mode, leaving the altered preset at the PRESET number shown during programming.

() Change the position of each of the controls to be sure that no LEDs are simply being held on all the time. Make sure that changing the controls
(24) significantly causes the corresponding LED to go out (changing the setting of any switch is a "significant" change). Do not be concerned if there is some interaction of seeming unreleated EDIT LEDs as explained above.

You may want to observe that without the batteries, the memory "forgets" the settings of the front panel controls whenever the power is turned off. When the power is turned back on most or all of the EDIT LEDs will be dark showing that the memory no longer corresponds to the control settings.

Figure 23: Battery Installation, note polarity



() Turn off the power and install the batteries in the clip on the back of the 8750C board. Observe polarity as indicated in figure 23. (25)

() Turn the power back on and observe again that all of the EDIT LEDs wink on briefly before some or all go out. (26)

() Save the current state of the controls as a preset by pushing the right-hand PROGRAM button and then exit this mode by pushing the ADVANCE button. Adjust the controls so that all EDIT LEDs are lit. (27)

() Turn off the power for 10 seconds or so and then turn it back on again. All of the EDIT LEDs should be lit, indicating that memory and control settings agree. (28)

() Secure the batteries by wrapping the supplied wire tie around batteries and through holes on either side of battery clip. (29)

As with previous preliminary tests, successful completion of this procedure and getting the described results is a strong indication that this circuit board is performing properly.

Take a break before proceeding to the assembly of the PROTEUS synthesizer card as outlined in the separate 8750A assembly manual. The PROTEUS card is tight and has some expensive components on it. Check your work carefully. We have sequenced the assembly of the cards from the simplest to the hardest, so by this point you're a seasoned assembler, but even the best make mistakes. Be critical of solder joints and double check values and polarity of parts as they are installed. Any errors that you find and fix as you go along can't possibly blow something else up later.

() Assemble the PROTEUS card following the instructions in the 8750A PROTEUS CARD ASSEMBLY MANUAL. Return to this point in this manual when you are done with this assembly.

We will now turn the 8750 A, B and C boards into an electrically integrated and mechanically stable unit (see figure 24).

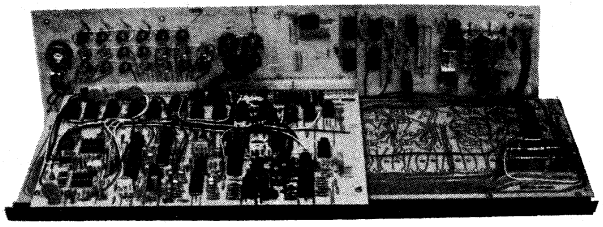


Figure 24: 8750 A, B, and C assembled

() Locate the aluminum front panel reinforcing bracket and attach it to the front edge of the 8750C circuit board as shown in figure 25. Note that only two of the four holes in the reinforcing bracket are used in this step (from the foil side they are, the one far left and the one right of center). Attach the bracket with 2 ea. 4-40 X 1/4 machine screws, 2 ea. 4-40 nuts and 2 ea. internal star lockwashers.

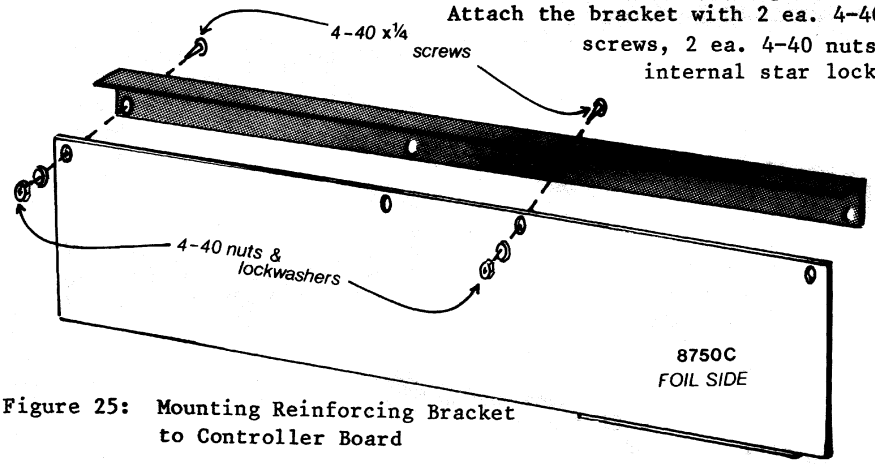
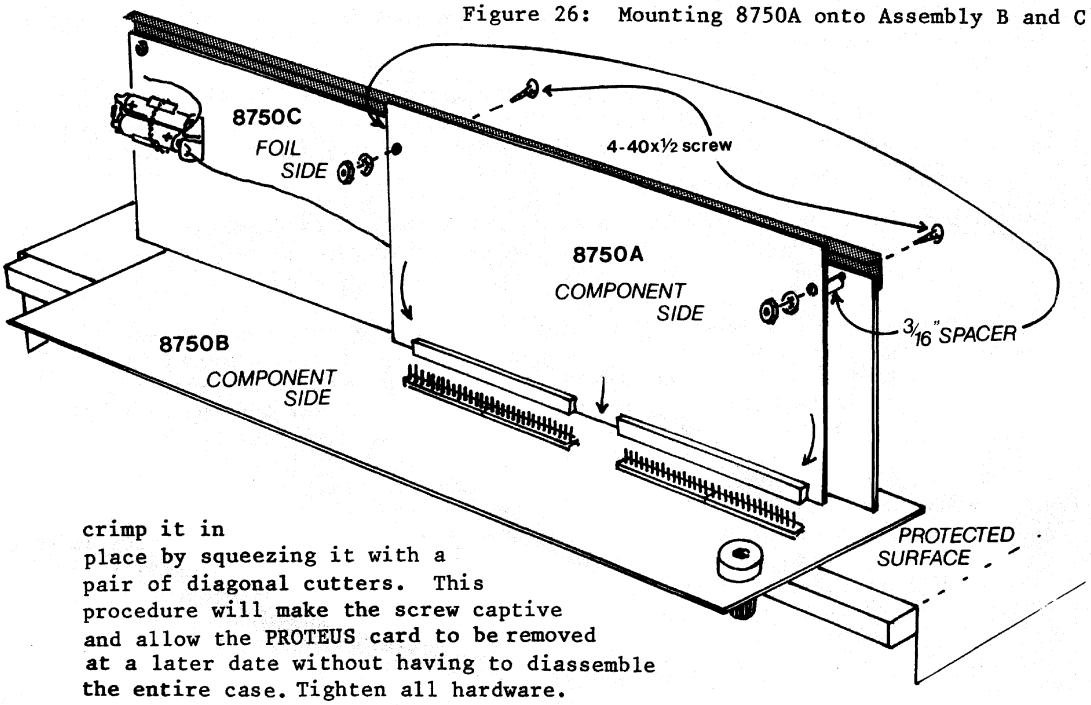


Figure 25: Mounting Reinforcing Bracket to Controller Board

() Mate the 2 groups of 30 edge connector pins on the 8750A board with the corresponding PROTEUS pins on the 8750B backplane board. When properly installed, the conductor side of the 8750A card will be facing the conductor side of the 8750C board. As before, these edge connectors are tight the first time. You may have to slowly go from one edge of the board to the other making sure that the pins are lining up and then "wobble" the board down by applying force alternately to the corners. It will also help to work on the edge of a protected work surface so that the unison control is beyond the edge. See figure 26.

() Fasten the 8750A and 8750C boards together using 2 ea. 4-40 X 1/2 machine screws and associated #4 hardware as shown in figure 26. Note particularly that the board are held apart by 2 ea. #4 X 3/16" spacers (do not confuse these spacers with the longer 1/4" spacer which will eventually be used to mount the entire assembly in the case). Be sure that the screws are installed from the Controller board side and after the spacer is installed

Figure 26: Mounting 8750A onto Assembly B and C



crimp it in place by squeezing it with a pair of diagonal cutters. This procedure will make the screw captive and allow the PROTEUS card to be removed at a later date without having to diassemble the entire case. Tighten all hardware.

() Center the adjusting disks on all the PROTEUS card trimmer potentiometers.

PROTEUS TEST

We are now ready to run some preliminary tests on the entire PROTEUS I assembly before final installation in the sheet metal of the case.

Make sure that the power switch on the 8750B board is off and the line cord is unplugged before interconnecting the power and keyboard cabling. As in previous tests, the Controller circuit board is oriented as it will be when installed in the case.

Remember that the card has not yet been calibrated, so during these tests don't expect the oscillators to be in tune (for instance) and don't be overly concerned with any miscellaneous clicks and pops.

() (30) Patch the hi or low level output jack on the backplane board (as appropriate, low level when using hi-fi or guitar amplifiers) to the input of an amplifier (turn the gain down all the way) and set the PROTEUS front panel controls as shown in the schematic front panel shown in figure 27 (note that all of the controls are set to one or the other of the extremes of their rotation).

() (31) Turn the PROTEUS I power switch on the 8750B board on. Press the PROGRAM button in the PRESET control block and while holding any key on the AGO keyboard down begin to turn up the gain on the amplifier. You should hear a relatively mellow sine-wave-like waveform (since sine symmetry has not yet been adjusted, there may be a slight higher harmonic edge to the sound).

() (32) While still holding down an AGO key, check the other waveforms of OSC 1 by turning the W.F. knob clockwise. Leave the knob in its extreme CW position (⊓⊔ waveform).

() (33) Check for the presence of the OSC 2 output by rotating the Filter Source Mix knob fully CW. You should hear the harsh square wave sound mix and fade to a mellow triangle waveform at a much lower frequency (on the order of several octaves.

() (34) As with OSC1, rotate the OSC2 W.F. select knob in a CW direction checking to see that all waveforms are present. After verifying that all waveforms are present, return the knob to its extreme CCW setting.

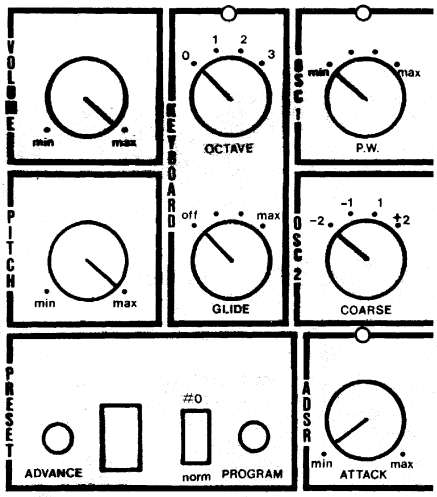
() (35) Rotate OSC2 COARSE switch CW and back to make sure that the control transposes the oscillator. Rotate the OSC2 Fine control slowly CW and observe that this also transposes the pitch of the selected oscillator, but in smaller increments. At this point, neither of these controls has been calibrated so they will not yet work in octave or semi-tone increments.

() (36) Set the FILTER Source Mix control to the middle of its rotation and while listening to the mix of both oscillators, rotate the KEYBOARD Transpose switch though its settings and observe that the pitch of both sources is transposed. Also check the operation of the KEYBOARD Glide control by playing two notes at opposite ends of the AGO keyboard and observing that as the control is set to progessively CW positions the length of time needed to go from one pitch to the other increases. Leave both controls in their extreme CCW positions.

() (37) Set the FILTER Source Mix pot fully CCW (#1) and advance the OCS1 Modulation Control to observe a very fast vibrato (pitch modulation). Retard the LFO Freq. control until you reach a point where the frequency is about 1 cycle per second before sliding the OSC1 Mod switch to the P.W. setting to observe the phasing type sound produced by pulse width modulation. Observe that as the OSC1 Mod knob is advanced the effect increases and that at extreme modulation the pulse is actually turned off for a part of each LFO cycle. Rotate the OSC1 P.W. switch CW and observe the effect of the modulation on different intial pulse width settings.

() (38) Go back to OSC1 Pitch Mod and observe the difference in modulation as the LFO (⊓ / ∧) switch is changed from the sweeping (∧) to the trilling (⊓). Leave the switch at (∧).

() (39) Test the action of the filter by rotating FILTER Source Mix to 2 and OSC2 W.F. to N(oise) (fully CW). Press an AGO key and verify that noise has been selected before changing the FILTER Pre/Post switch to Post (fully CW). Again press the AGO Key and observe that you now hear the near "whistling" sound showing that the filter is working. Run you finger up and down the keyboad and observe that the corner frequency of the filter tracks the keyboard.



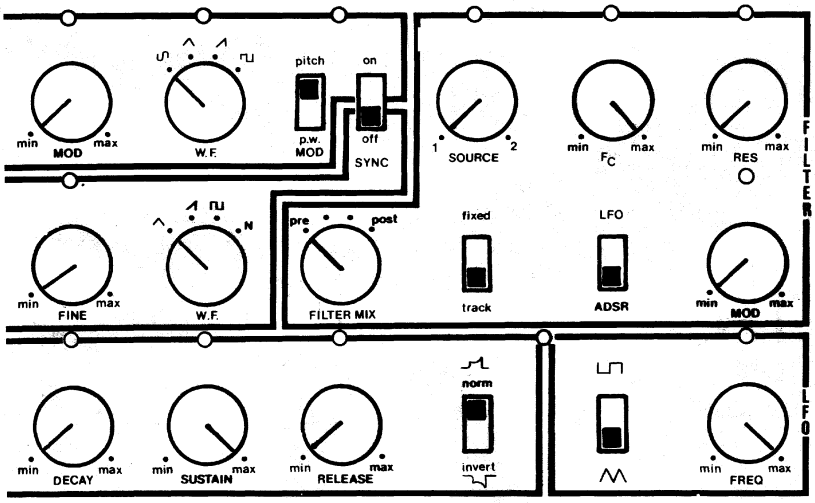
() (40) While holding a key down, rotate the FILTER Fc knob back and forth and observe the wide range of the control (at these panel control settings) from high pitch to below audio. Leave the control roughly centered.

() (41) Observe the LFO modulation of the filter corner frequency by sliding the FILTER LFO/ADSR switch to LFO and advancing the FILTER Mod control. With Fc sweeping at some pleasant rate and range, back off on the FILTER Res. control (CCW) and observe the sound change from a whistle to a more surf-like sound. Leave the FILTER Mod and FILTER Res fully CW (at max.) and FILTER Fc fully CCW (at min).

() (42) Finally, change the FILTER LFO/ADSR back to ADSR and observe the result as you play with the ADSR's controls. In this configuration, you will be able to hear ADSR effects both on dynamics (volume) and on the corner frequency of the filter. Slide the ADSR norm/invert switch to invert and observe the change in the sweep of the filter corner frequency.

Once again, successful completion of these tests is a strong indication that the entire PROTEUS I assembly is functioning properly. You may now proceed to installation of the upper case sheet metal.

Figure 27: Calibration Start Patch



We will now install the previously tested electronic subassembly into the upper case sheet metal.

() Slide 4 of the large 5/16" "J" nuts supplied over the 4 large holes punched in the folded down end panels of the case top. Note that the dome side of the "J" clip will be on the inside of the case.

() Remove all nuts from the switch and push-button shafts so that the sub-panel will be flush with the front panel when installed. Do not remove the sub-panel as it is needed to locate LEDs, etc.

() Lift the electronic sub-assembly into the case top. After checking to make sure that all LEDs align with the holes provided for them in the front panel, secure the assembly by installing 7 flat washers and 7 switch mounting nuts on the shafts of the rotary switches. Also install the split lock washers and nuts on the shafts of the two push-button switches. Tighten this hardware securely, but do not overtighten.

() Using 5 each 4-40 X 1/2" machine screws, #4 flat washer, #4 X 1/4" spacer, #4 internal star lock washer and #4 nut, fasten the backplane board to the rear of the case top as shown in figure 28. Note that the three holes along the upper edge of the case top's patch bay cut-out are not used. Also note that the three large holes along the bottom edge of the back of the top will be used in later steps. Tighten this hardware.

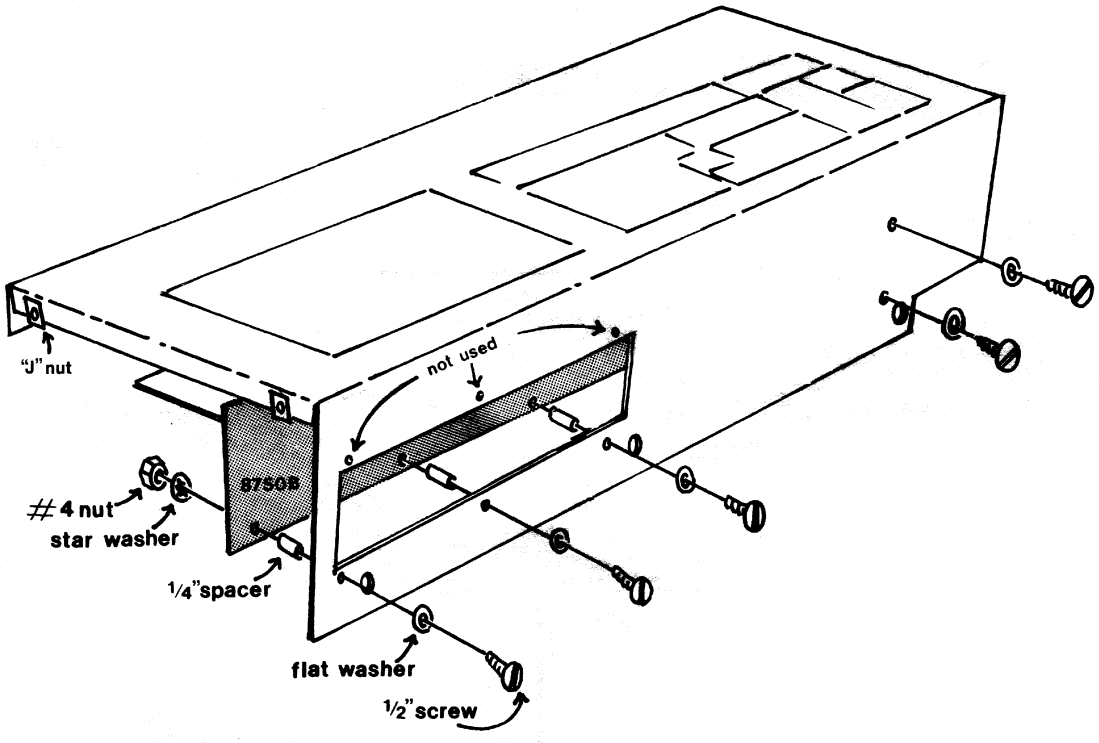
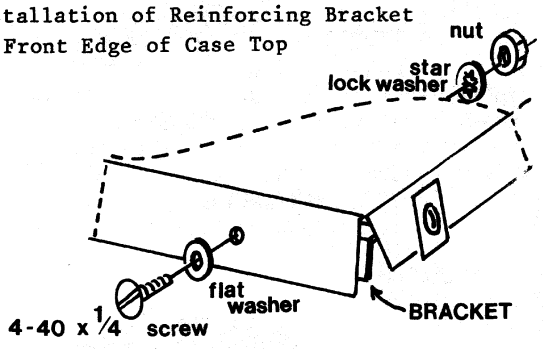


Figure 28: Installation of Backplane and Subassembly into Case Top

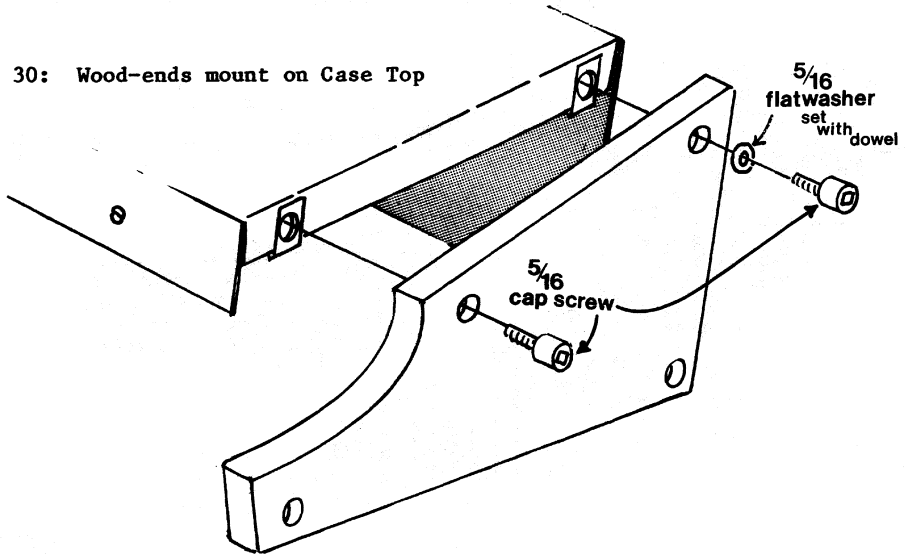
() Use 2 each 4-40 X 1/4 machine screws, #4 flatwashers, #4 star lockwashers and #4 nuts, secure the reinforcing bracket to the PROTEUS I case top as shown in figure 29.

Figure 29: Installation of Reinforcing Bracket to Front Edge of Case Top



() Locate and examine the wooden end panels. Notice that there is a left and right end and that the difference is in which side of the 4 large mounting holes are countersunk. Locate the 8 large (5/16") black flat-washers and using a hammer and the short length of dowel rod supplied press one of the flat-washers into each of the counter-sunk holes.

Figure 30: Wood-ends mount on Case Top



() Use 4 of the 5/16" allen head cap screws to fasten the left and right wood-ends to the case top as shown in figure 30. Use the allen wrench provided to tighten securely.

This complete assembly of the PROTEUS I synthesizer. Proceed to the "calibration" section of the PROTEUS I USING MANUAL for instructions on calibration and closing the case.

KEYBOARD ENCODER

A scanning type encoder is used to convert AGO keyboard key activations to a digital format that is consistent with the requirements of the keyboard Sample and Hold and Pitch Control Voltage DAC.

AGO KEYBOARD ENCODER

As is shown in figure 31, the encoder design is fairly simple and straight-forward. Action begins with the astable multivibrator clock circuit consisting of two of the NOR gates from IC4 and the timing network R1 and C1. As long as the logic level at pin 9 of IC4 is a digital 0, the astable free-runs at a frequency of approximately 20kHz. The output of the clock (IC4 pin 4) is buffered by one of the remaining NOR gate packages in IC4 before being applied to the input of the 4024 type 7 stage counter (IC1 pin 1).

Six of the seven outputs of the counter are applied to the address inputs of the pair of 4051 type 1 of 8 multiplexers IC2 and IC3 which perform the sequential interrogation of each of the AGO keys.

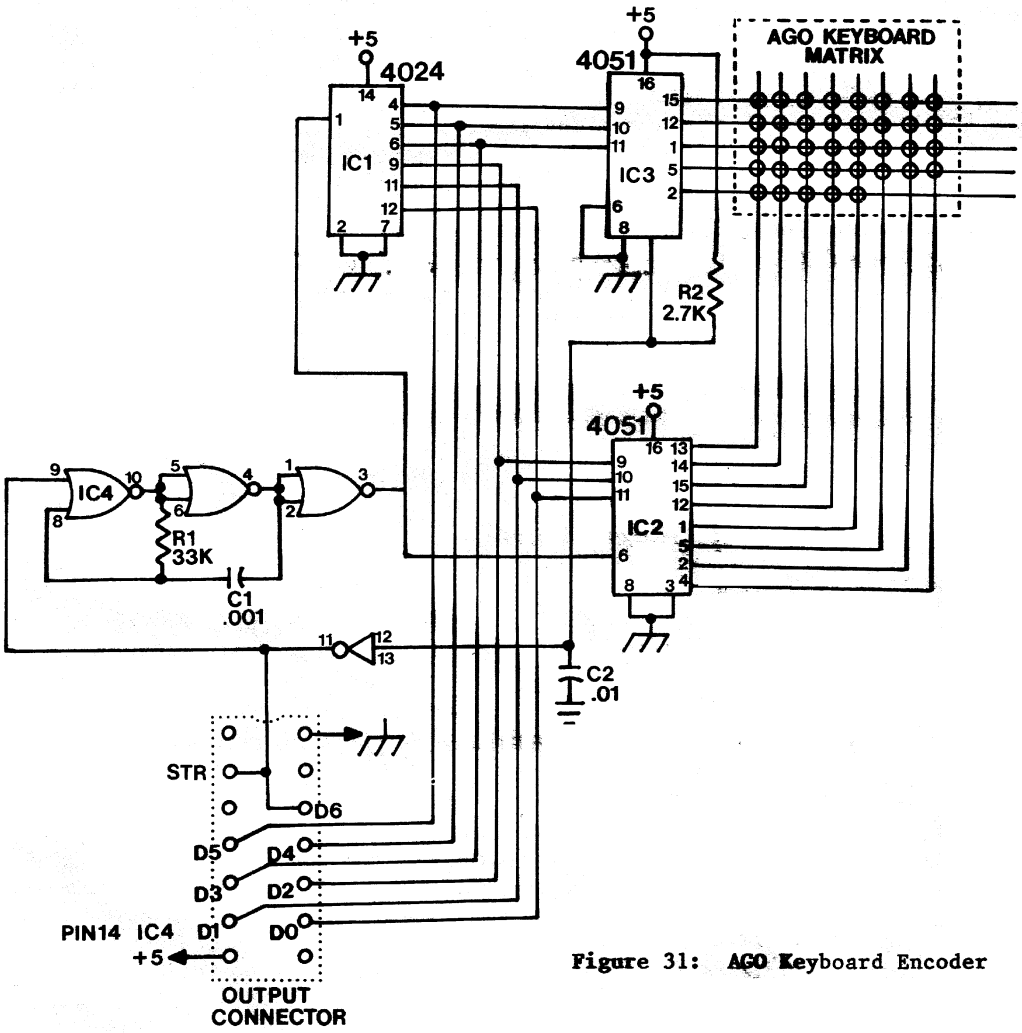


Figure 31: AGO Keyboard Encoder

As long as the keyswitch being examined at any given instant is open, the full supply voltage appears at the junction of R2 and C2 and this high logic level is inverted by the remaining inverter-connected NOR gate in IC4 and applied to the pin 9 input of IC4 where it allows the clock to free-run.

If, on the other hand, the keyswitch being examined is closed, there is a completed electical path from pin 3 of IC2 to pin 3 of IC3. This electrical connection pulls the junction of R2 and C2 to ground and, when inverted as explained above, stops the clock which in turn causes the counter to stop with its 6 output bits showing the number of the key that is down. The same "key down" signal that stops the clock also appears at the STR and D6 outputs of the DIP OUTPUT CONNECTOR which ties the encoder to the backplane circuitry.

When the key that caused the encoder to stop is released, the ground path to the junction of R2 and C2 is removed, which lets the STR and D6 signals at the DIP connector go low in turn starting the clock.

BACKPLANE

In addition to providing interconnection wiring between the Controller/Memory and PROTEUS synthesizer card, the backplane circuit board contains circuitry for several other functions. See figure 32.

KEYBOARD/DAC INTERFACE

Digital information from the keyboard encoder appears at the backplane's KEYBOARD CONNECTOR and subsequently at the inputs of the latches IC1 and IC2 which function as a digital sample/hold. The latches are configured such that a high level at the STR line (indicating that a key is pressed) causes the data on the inputs to pass through to the outputs. When the key is released, both the gate bit (D6) and the STR line go low simultaneously but because of the slight delay provided by R10 and C26 the gate bit changes state slightly before the strobe line, allowing the latches to go to their holding state with the low order 6 bits representing the key which was down and the gate bit low indicating that the ley represented by the low order six bits is no longer pressed.

Key data from the latches is applied to the digital inputs of the Digital to Analog converter IC3. Of the 8 bits provided for by the DAC, only 6 are required by the keyboard. The least significant and most significant bits of the converter are not used.

The reference voltage to the converter is derived from the voltage divider comprising R20 and R21 and buffered by the voltage follower built up from one stage of the quad op-amp IC4. The current output of the converter is converted to a voltage by a second stage of IC4 and its associated feedback resistor R26. A third stage of IC4 along with R23 and R24 is used to buffer the master pitch kontrol voltage from the Controller circuitry before summing it into the V/I converter by means of R25. The final output of the keyboard DAC appears on the Pitch Control Voltage (PICV) edge connector finger.

The final amp from IC4 is configured as a voltage follower which buffers the reference voltage for the parameter DAC on the Controller card.

PROTEUS BACKPLANE

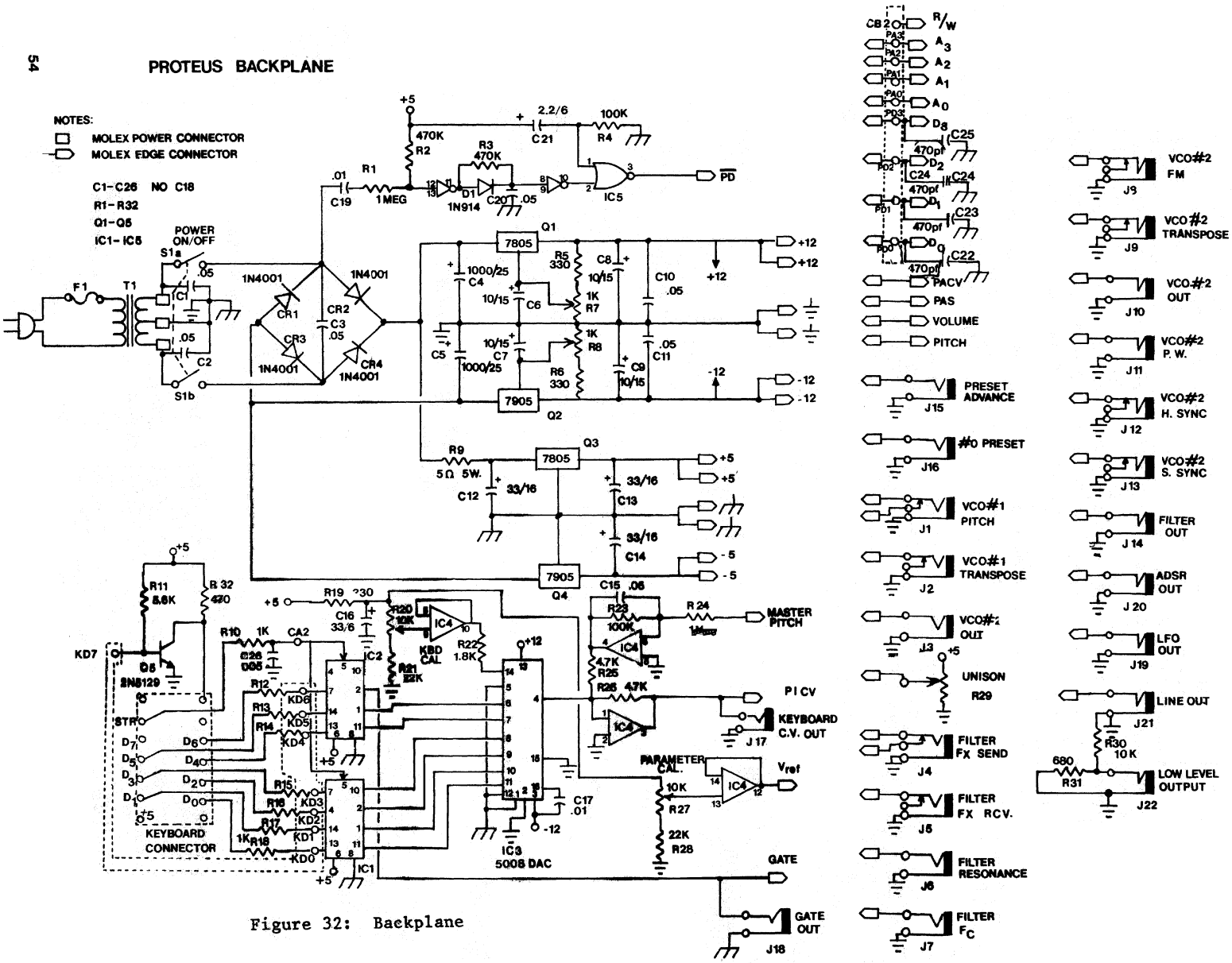


Figure 32: Backplane

POWER SUPPLY

The nominal 24 v.a.c. from the secondary of power transformer T1 is full wave rectified by the bridge composed of CR1-CR4 and filtered by capacitors C4 and C5. The approximately +(-) 18v. which appears across these capacitors is applied to positive voltage regulators Q1 and Q3 (R9 helps dissipate some of the heat caused by the heavy current flow through Q3) and negative regulators Q2 and Q4. The reference voltages for regulators Q1 and Q2 are adjusted with trimmer potentiometers R7 and R8 respectively allowing the +(-) 12v. supplies to be set exactly.

POWER DOWN

When power is interrupted the circuitry consisting of IC5 and its associated components is responsible for providing a Power Down signal to the controller circuit board so that the memory can be put in its "hold" state before decaying supply voltages can cause undefined logic states to exist.

Positive half-cycles of the output of the transformer are coupled by C19 and R1 to an inverter built from one of the gates in IC5 where they are converted to a rectangular pulse train which is rectified by D1 and used to charge C20. This high voltage level is inverted and applied to one leg of the NOR gate (pin 2). The other input to this gate (pin 1) is held low by R4 which results in a high logic level on the PD line. If there is an interruption of power, C20 quickly discharges causing the PD line to go low.

When power has been off for a time and is restored, it takes C21 a second or so to charge through R4. Pin 1 being held high by C21 as it charges causes the PD line to remain low until the power supplies are stable.

CONTROLLER CARD

It is the function of the Controller/Memory card to digitize the settings of the front panel controls and organize this data into a form compatible with the system memory. This card is also responsible for reconstructing and multiplexing parameter control voltages derived from this data and for the timing and control signals necessary to keep the Synthesizer card's analog sample and hold circuits refreshed and updated.

For the purposes of analysis, we can think of the Controller board as comprising four distinct sections: Digitizer, Controls, Memory and Edit LED's.

DIGITIZER

The digitizer is a 4 bit flash type Analog to Digital converter built around the quad comparator IC17. As is shown in figure 33, in this design the reference voltage provided to each succeeding less significant stage is determined by the state of the more signigicant bits. For example, the comparison threshold for bit D0 is a result of the weighted summation of bits D1, D2 and D3 that occurs in R46, R47 and R48 respectively.

The digitizer can be turned on and off by turning Q3 on and off. When this transistor is off, the pull up resistors R53 - R56 are disconnected from the digital supply rail so that the outputs all go to digital 0 and the reference voltage to each stage is representative of this zero state. Turning the digitizer on and off allows it to start from a known constant state each time a parameter is to be quantized which prevents parameters adjacent to one another in the multiplexing scheme from interacting.

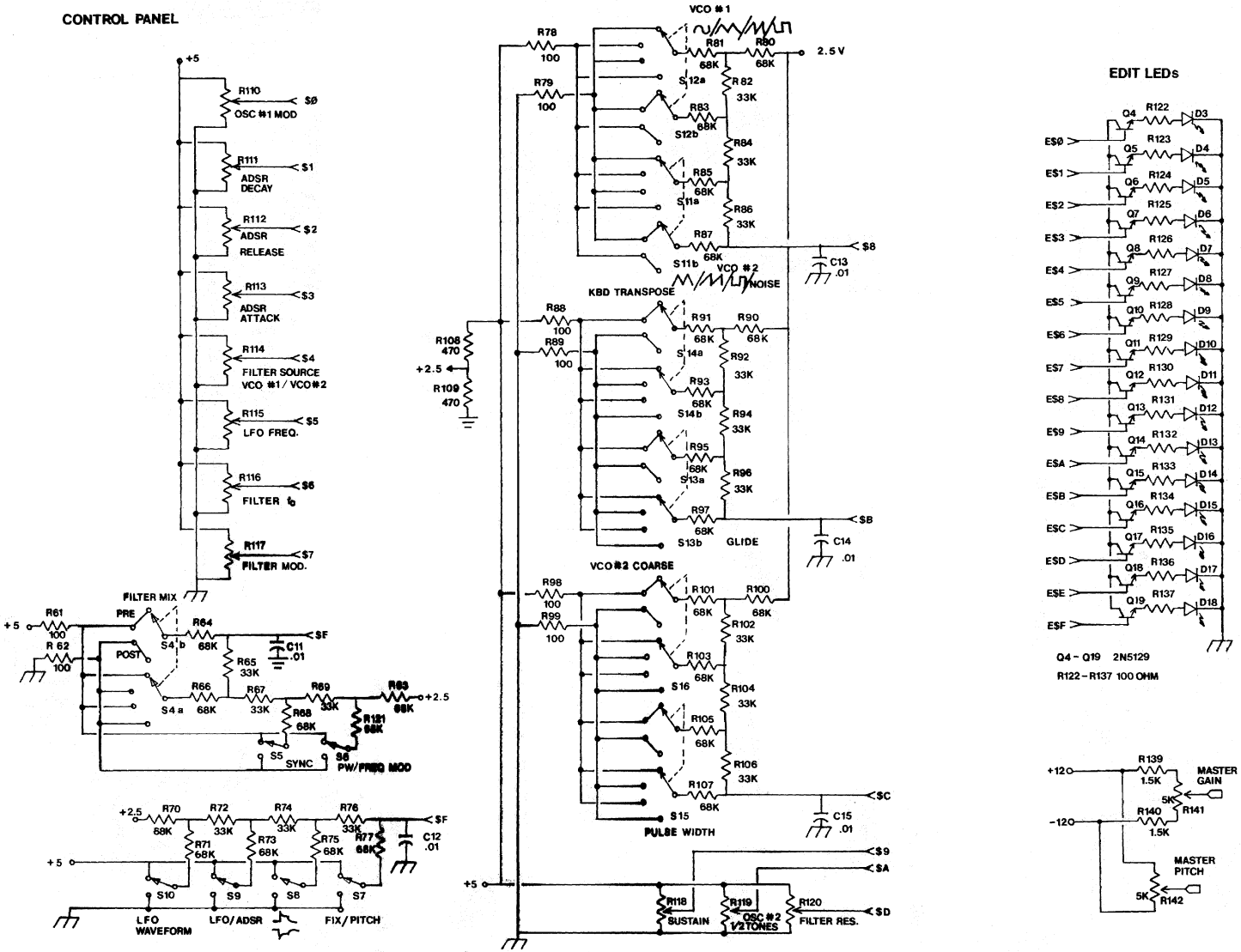


Figure 33: Control Panel

CONTROLS

It is important to note that all of the PROTEUS I front panel Controls begin by generating a voltage which is ultimately multiplexed into the Digitizer for quantization (see figure 34). In the case of continuously variable controls (e.g. ADSR Attack, R111) this is fairly obvious.

Less obvious is the fact that even the Controls with discrete operating postions (rotary and slide switches) are connected to simple R-2R ladder type digital to analog converters so that they also generate a voltage which in its turn is multiplexed to the Digitizer. This is most readily seen in the circuitry surrounding the four switches S7 - S10 which represent the 4 bits of parameter word $F.

All together, 16 controlling voltages are generated by the programmable front panel controls, as summarized by the Parameter Map, see below. On the CONTROL PANEL SCHEMATIC figure 34 these voltages appear at the connections marked $0 - $F.

Address	PARAMETER(S)			
	D_3	D_2	D_1	D_0
Ø	VCO #1 MOD ATTENUATOR			
1	ADSR DECAY			
2	ADSR RELEASE			
3	ADSR ATTACK			
4	VCO #1		#2 MIX	
5	LFO FREQUENCY			
6	VCF CORNER FREQ			
7	VCF MOD ATTENUATOR			
8	#2 WAVEFORM		#1 WAVEFORM	
9	ADSR SUSTAIN			
A	VCO #2 FINE OFFSET			
B	GLIDE		KBD TRANSPOSE	
C	VCO #1 PULSE WIDTH		VCO #2 COARSE PITCH	
D	VCF RESONANCE			
E	FILTER PRE/POST		SYNC	#1 MOD* PITCH/P.W.
F	FILTER TRACK/FIXED	ADSR NORM/INV	FILTER MOD ADSR/LFO*	LFO WAVEFORM ∧ / ⊓

*When #1 MODULATION of PITCH, HARD SYNC selected
*Alternate LFO/ADSR selected as VCO modulator

MEMORY

The voltages from the front panel controls are multiplexed by the pair of 4051 type 1/8 MUX IC's (IC3, IC4) under control of the parameter counter IC5 and its associated free running clock comprising two stages of IC2 and C2 and R5. See figure 35. The 4 bit output of the parameter counter can be thought of as a "Parameter Address" which is used two ways.

First, it is applied to the MUX pair described above where it causes one of the 16 control voltages from the panel controls to be connected to the input of the digitizer. Simultaneously, these 4 bits appear at 4 of the 8 address lines of the RAM (IC9) and at the Parameter Address pins (A0 - A3) of the card edge connector.

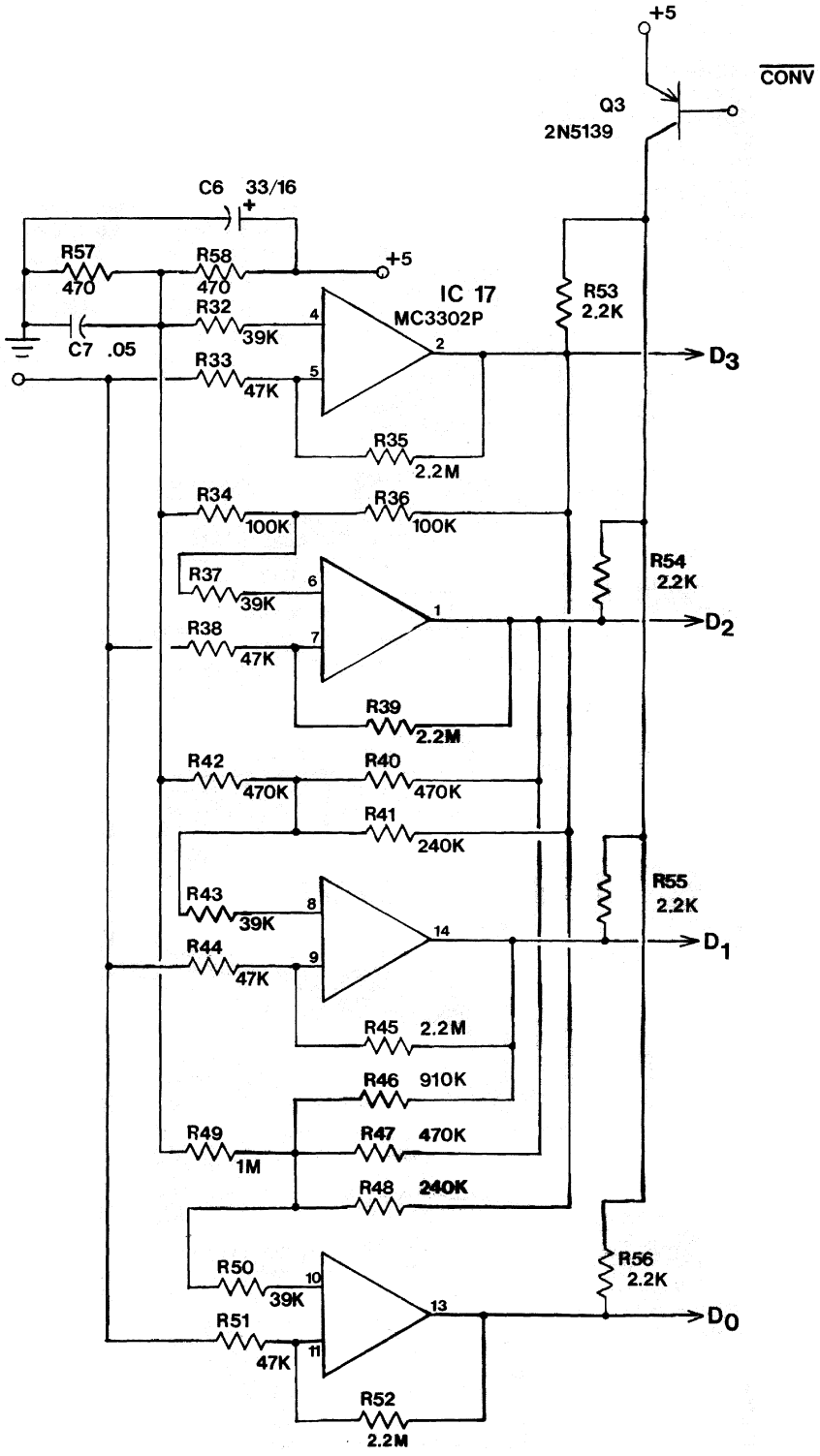


Figure 34: Digitizer

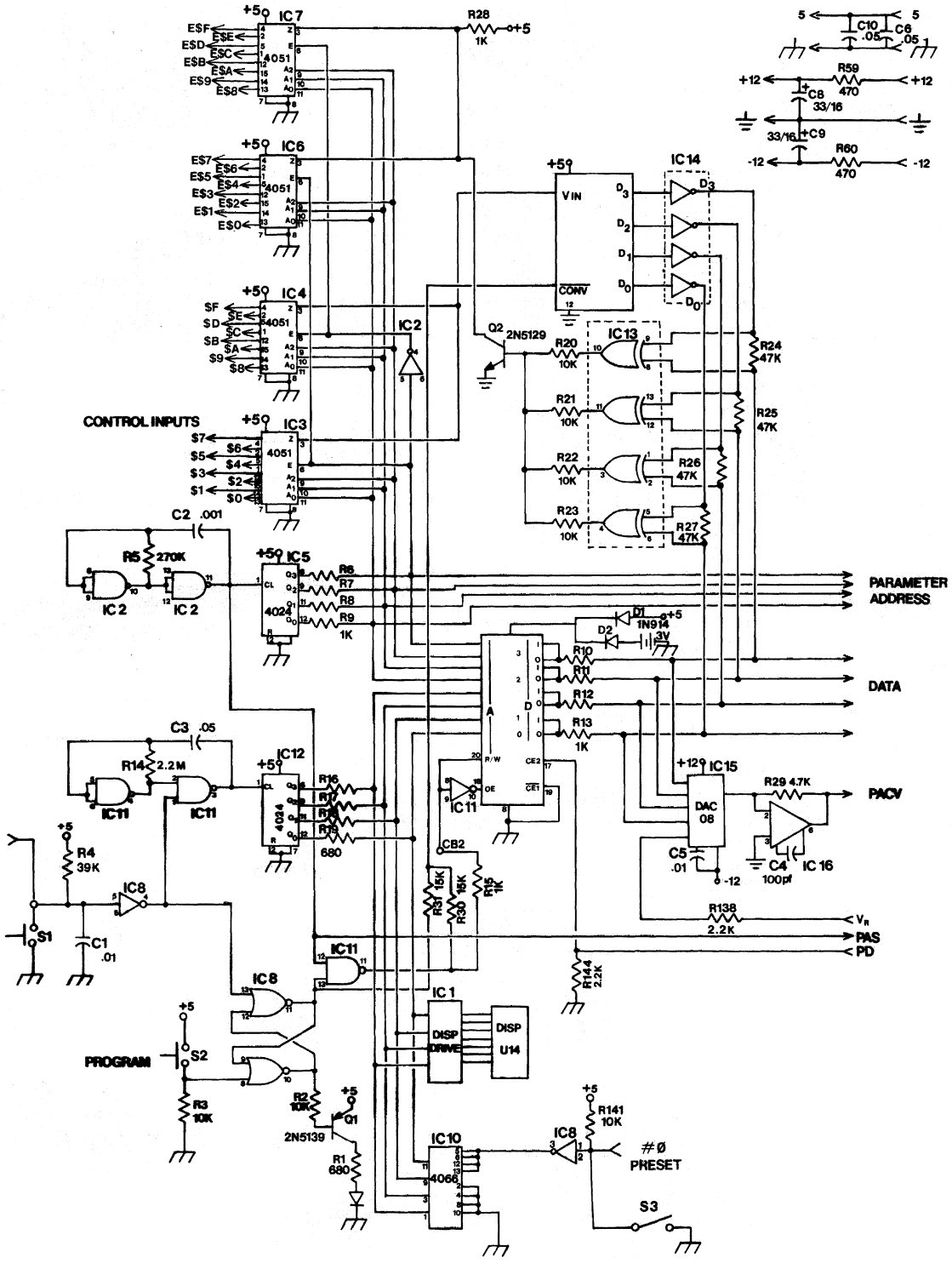


Figure 35: Controlboard: Memory/Multiplexing Circuitry

The remaining 4 bits of RAM address are derived from the "Preset Address" counter IC12 which is itself controlled by the astable comprising two stages of IC11. In response to a contact closure of the PRESET ADVANCE push button S1 this astable generates a single pulse which advances the Preset Address by one count. If S1 is held closed, the astable free runs to advance through the presets.

After being isolated by R16 - R19, the Preset Address is applied to the RAM and to the display driver IC1 which decodes the bits and provides at its output pins signals suitable for controlling the 7 segment display (U14) in such a way that it indicates one of the sixteen hexadecimal digits $0 - $F. This display shows the preset currently in force.

Closing the #0 PRESET switch S3 causes all 4 sections of the 4066 type bi-lateral switch IC10 to turn on, which cause all 4 preset address lines go be grounded, producing a Preset Address of $0.

The output of the digitizer is buffered by the 4 NOR gates in IC14 and isolated by R24 and R27 before appearing at the Controller card's edge connector as data lines D0 - D3 and at the DATA lines to the RAM and the PARAMETER DAC IC14 input lines.

As mentioned previously, the reference voltage to the Parameter DAC originates on the back plane and is brought onto the controller card on the edge connector pin labelled Vr. The current output of the DAC is converted to a voltage by Operational Amplifier IC16 and appears at the Parameter Control Voltage edge connector pin (PACV).

In summary, at any give time the 4 Preset Address lines applied to the memory can be thought of as static and representing one of the 16 presets that the controller card can hold in memory. The Parameter Address lines are dynamic, constantly rotating through the sixteen 4 bit parameter words that constitute a preset. The 4 data lines are dynamic and indicate the value of the parameter whose address is currently specified by the Preset and Parameter Address lines. The Parameter Control Voltage is dynamic and corresponds to the data on the DATA lines. The Parameter Select line (PAS) goes high to indicate to external circuitry (on the PROTEUS Synthesizer card) that the Parameter Address, DATA and Parameter Control Voltage lines are stable.

Internal to the Controller card there are two major "modes" of operation: PROGRAM and NORMAL.

Closing the PROGRAM push-button (S2) causes the bistable built up of two NOR gates from IC8 to produce a state in which pin 10 is low causing Q1 to conduct, which lights the decimal point in the display U14, providing a visual indication of PROGRAM MODE. At the same time, pin 11 is high which causes the pin 10 output of the NAND gate from IC 11 to produce an inverted replica of the PAS line. A low logic level at the output of this pin signals valid and stable address and data and serves as the R/W control line to the memory. The same conrol signal is also used to turn the digitizer on and off as previously discussed. This R/W signal is also inverted by a gate in IC11 and used to control the RAM's Output Enable (OE) pin such that during a write operation the data output lines of the RAM are floating.

In the PROGRAM mode, the DATA and PACV lines reflect the current setting of the panel controls and changes in these settings are immediately passed to the outside world.

Pressing the Preset Advance button (S1) causes the IC8 bistable to switch to its alternate state in which Q1 and consequently the PROGRAM MODE display are off and the R/W line to the RAM is constantly held in the READ (high) state. In this NORMAL state the digitizer is held on all the time by the current flowing from pin 11 of IC11 through R30.

EDIT LEDS

The EDIT LEDS indicate coincidence between the output of the digitizer and the DATA coming from RAM. If these two words agree on a bit by bit basis, none of the outputs from the Exlusive Or gates in IC13 will be high, causing Q2 to remain off. When this transistor is off, current can flow through R28 and the output of the two multiplexer chips IC6 and IC7 selected by the current Parameter Address to turn on one of the EDIT LED drivers Q4 - Q19 which in turn cause the associated LED D3 - D18 to light.

If one or more of the bits do not agree, one or more of IC13's outputs will be high turning on Q2 which shunts to ground the current that would otherwise turn on one of the drive transistors.

NOTES

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