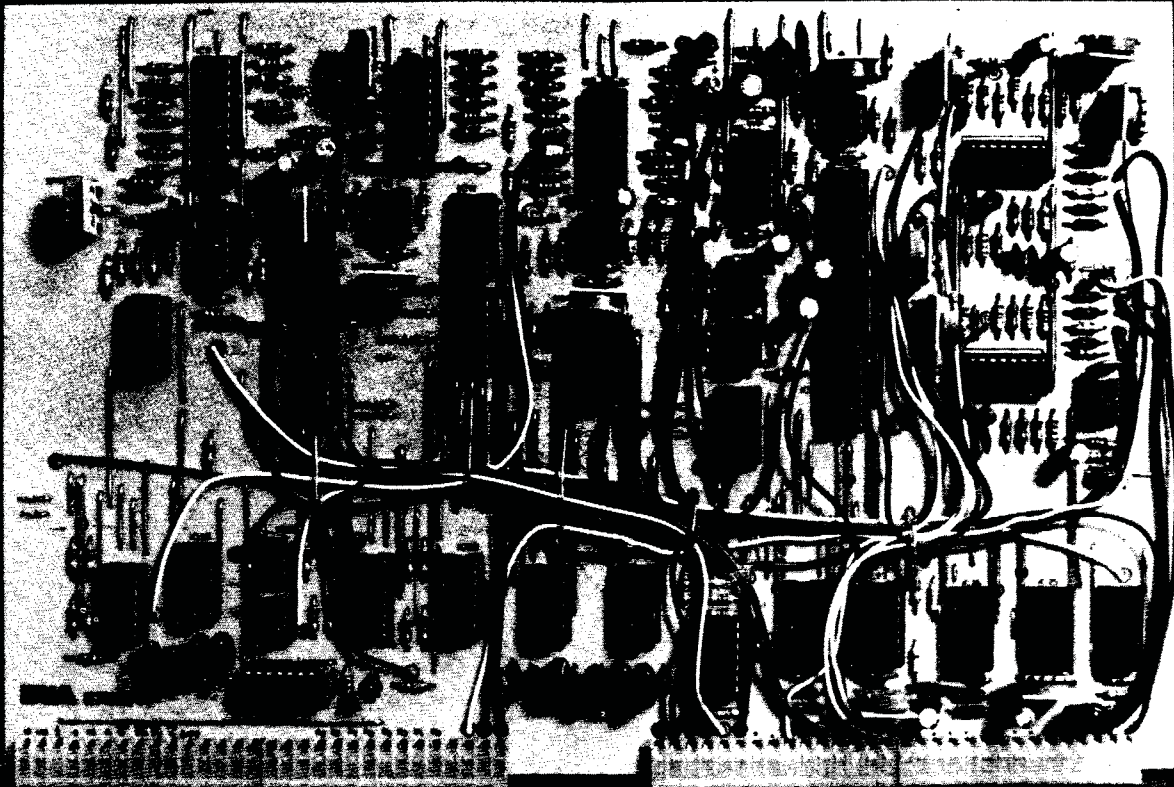


**PROTEUS
VOICE CARD**



The PROTEUS card is a complete monotonic synthesizer voice with two Voltage Controlled Oscillators, Noise source, Voltage Controlled Filter, Voltage Controlled Amplifier, Envelope Generator and Low Frequency Oscillator on a single card. The card is configured for digital control of normalization switching and multiplexing of parameter and pitch control voltages in multiple card configurations.

Prior to beginning assembly, check the supplied parts against the following parts list. Report any missing parts immediately.

PROTEUS CARD parts bag

6	100 ohm 5% resistor	(brown-black-brown)
1	270 ohm 5% resistor	(red-violet-brown)
1	330 ohm 5% resistor	(orange-orange-brown)
9	470 ohm 5% resistor	(yellow-violet-brown)
6	680 ohm 5% resistor	(blue-grey-brown)
2	910 ohm 5% resistor	(white-brown-brown)
11	1K 5% resistor	(brown-black-red)
1	1500 ohm 5% resistor	(brown-green-red)
5	1800 ohm 5% resistor	(brown-grey-red)
9	2200 ohm 5% resistor	(red-red-red)
1	2700 ohm 5% resistor	(red-violet-red)
11	4700 ohm 5% resistor	(yellow-violet-red)
2	5600 ohm 5% resistor	(green-blue-red)
2	6800 ohm 5% resistor	(blue-grey-red)
1	8200 ohm 5% resistor	(grey-red-red)
18	10K 5% resistor	(brown-black-orange)
4	12K 5% resistor	(brown-red-orange)
2	15K 5% resistor	(brown-green-orange)
3	18K 5% resistor	(brown-grey-orange)
2	22K 5% resistor	(red-red-orange)
3	27K 5% resistor	(red-violet-red)
9	33K 5% resistor	(orange-orange-orange)
5	47K 5% resistor	(yellow-violet-orange)
1	51K 5% resistor	(green-brown-orange)
3	56K 5% resistor	(green-blue-orange)
8	68K 5% resistor	(blue-grey-orange)
1	82K 5% resistor	(grey-red-orange)
3	91K 5% resistor	(white-brown-orange)
17	100K 5% resistor	(brown-black-yellow)
5	150K 5% resistor	(brown-green-yellow)
8	220K 5% resistor	(red-red-yellow)
3	270K 5% resistor	(red-violet-yellow)
1	330K 5% resistor	(orange-orange-yellow)
1	390K 5% resistor	(orange-white-yellow)
5	470K 5% resistor	(yellow-violet-yellow)
1	680K 5% resistor	(blue-grey-yellow)
7	1 meg 5% resistor	(brown-black-green)
3	1.2 meg 5% resistor	(brown-red-green)
1	2.2 meg 5% resistor	(red-red-green)
1	3.9 meg 5% resistor	(orange-white-green)
6	301 ohm 1% resistor	(orange-black-brown-black)
11	100K 1% resistor	(brown-black-black-orange)
3	1K pc mount trimmer potentiometer	
10	10K pc mount trimmer potentiometer	
1	2.2 mfd. 16v. electrolytic capacitor	
9	4.7 mfd. 16v. electrolytic capacitor	
2	10 mfd. 16v. electrolytic capacitor	
1	33 mfd. 16v. electrolytic capacitor	

6	100 pf. ceramic disk capacitor
5	.001 ceramic disk capacitor
2	.005 ceramic disk capacitor
10	.01 ceramic disk capacitor
3	.05 mfd ceramic disk capacitor
4	330 pf polystyrene capacitor
2	1200 pf. polystyrene capacitor
5	.01 polyester capacitor
9	.1 mfd polyester capacitor
1	3310 Transient Generator IC
1	3320 Voltage Controlled Filter IC
1	3330 Voltage Controlled Amplifier IC
2	3340 Voltage Controlled Oscillator IC
1	4066 Quad bi-lateral switch IC
1	4011 Quad NAND IC
1	3302 Quad Comparator IC
2	4051 8 channel mux. IC
4	4016 Quad bi-lateral switch IC
3	308 type op-amp IC
5	3080 Trans-conductance IC
5	4042 Quad latch IC
5	4136 Quad op-amp IC
6	4052 Dual 4 chan. mux. IC
1	2N5139 Transistor
1	Noise diode
6	1N4148 type glass signal diode
8	8 pin DIP socket
2	18 pin DIP IC socket
12	14 pin DIP socket
16	16 pin DIP socket
4	15 pin edge connector
4-5'	22 guage insulated wire
18'	bare wire
6'	tubing

PROTEUS CARD ASSEMBLY

SOLDERING

Use care when mounting all components. Use only rosin core solder. Use of acid core solder or paste fluxes will VOID THE WARRANTY of this kit. A proper solder joint has just enough solder to cover the round soldering pad and about 1/16 inch of the lead passing through it. There are two types of improper connections to beware of: Using too little solder will result in a connection which will appear to be soldered when actually there is a layer of flux insulating the component lead from the solder bead. This situation can be cured by reheating the connection and flowing additional solder into the joint. If too much solder is used on a connection, there is a danger of the excess solder flowing between adjacent connections or circuit board paths causing a short circuit. Unintentional bridges can be cleaned off by holding the board up-side down and flowing the excess solder off onto the tip of a clean, hot soldering iron.

Select a soldering IRON with a small tip and a power rating of not more than 35 watts. Soldering GUNS are completely unacceptable for assembling solid state equipment, as the large magnetic field they generate can damage some components. Be sure to KEEP YOUR SOLDERING IRON TIP CLEAN. Before soldering a connection, wipe the tip on a damp sponge or rag. This will aid in heat transfer and prolong tip life.

CIRCUIT BOARD ASSEMBLY

- () Prepare the circuit board for assembly by thoroughly cleaning the conductor side of the circuit board with a scouring cleanser or steel wool pad. Rinse the board with clear water and dry completely. A BRIGHT SHINY BOARD IS ESSENTIAL TO SUCCESSFUL SOLDERING!

JUMPERS

There are three kinds of solid wire jumpers indicated in the parts legend 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.



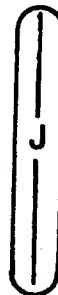
- () Install these jumpers at this time.

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



- () Install these jumpers.

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



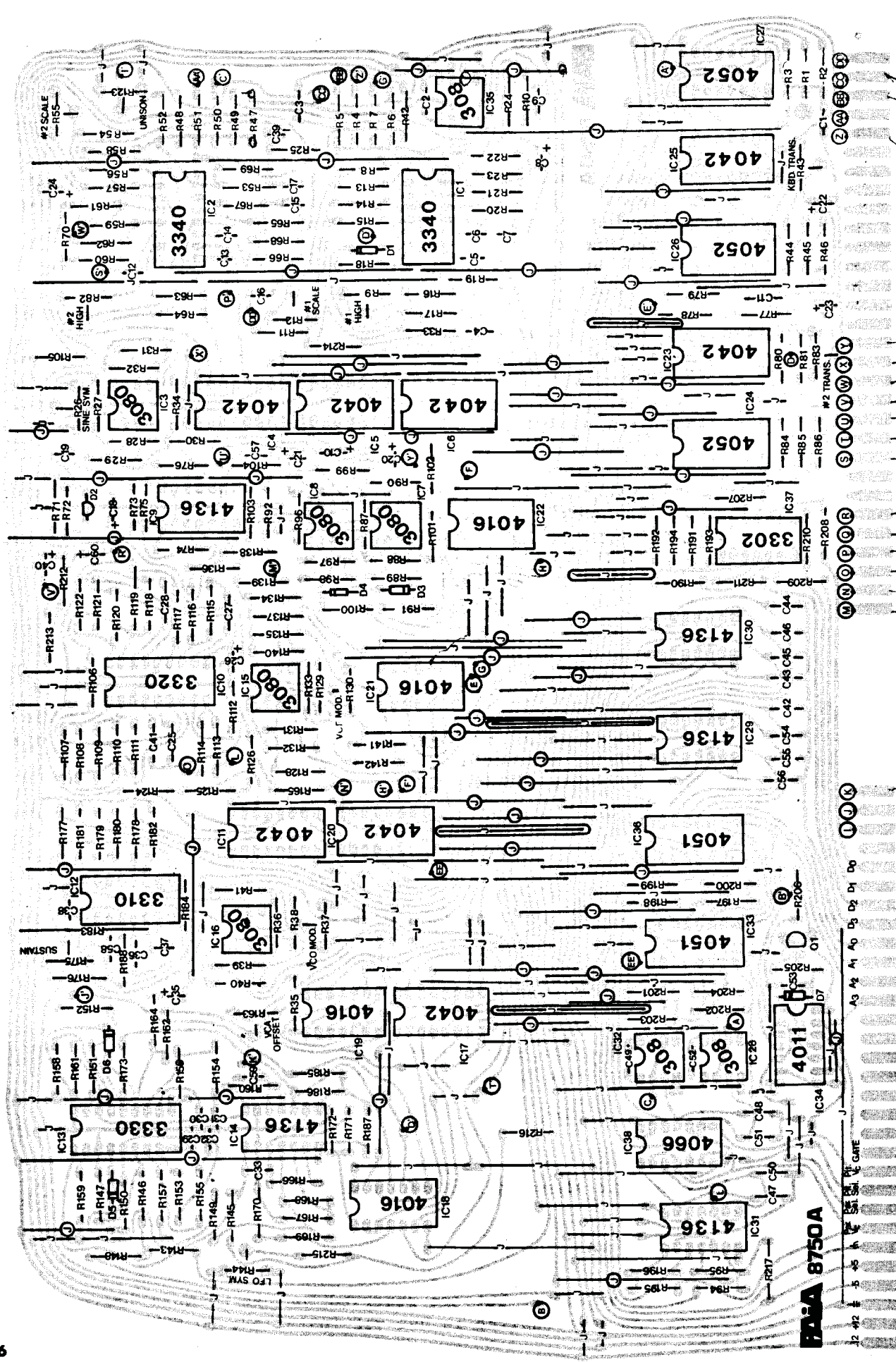
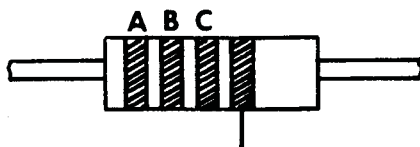


figure 1: Proteus Card parts placement

J1 J2 J3 J4 J5 J6 J7 J8 J9 J10 J11 J12 J13 J14
 J15 J16 J17 J18 J19 J20 J21 J22 J23 J24 J25 J26 J27 J28 J29 J30 J31 J32 J33 J34 J35
 J36 J37 J38 J39 J40 J41 J42 J43 J44 J45 J46 J47 J48 J49 J50 J51 J52 J53 J54 J55 J56 J57 J58 J59 J60 J61 J62 J63 J64 J65 J66 J67 J68 J69 J70 J71 J72 J73 J74 J75 J76 J77 J78 J79 J80 J81 J82 J83 J84 J85 J86 J87 J88 J89 J90 J91 J92 J93 J94 J95 J96 J97 J98 J99 J100 J101 J102 J103 J104 J105 J106 J107 J108 J109 J110 J111 J112 J113 J114 J115 J116 J117 J118 J119 J120 J121 J122 J123 J124 J125 J126 J127 J128 J129 J130 J131 J132 J133 J134 J135 J136 J137 J138 J139 J140 J141 J142 J143 J144 J145 J146 J147 J148 J149 J150 J151 J152 J153 J154 J155 J156 J157 J158 J159 J160 J161 J162 J163 J164 J165 J166 J167 J168 J169 J170 J171 J172 J173 J174 J175 J176 J177 J178 J179 J180 J181 J182 J183 J184 J185 J186 J187 J188 J189 J190 J191 J192 J193 J194 J195 J196 J197 J198 J199 J200 J201 J202 J203 J204 J205 J206 J207 J208 J209 J210 J211 J212 J213 J214 J215 J216 J217 J218 J219 J220 J221 J222 J223 J224 J225 J226 J227 J228 J229 J230 J231 J232 J233 J234 J235 J236 J237 J238 J239 J240 J241 J242 J243 J244 J245 J246 J247 J248 J249 J250 J251 J252 J253 J254 J255 J256 J257 J258 J259 J260 J261 J262 J263 J264 J265 J266 J267 J268 J269 J270 J271 J272 J273 J274 J275 J276 J277 J278 J279 J280 J281 J282 J283 J284 J285 J286 J287 J288 J289 J290 J291 J292 J293 J294 J295 J296 J297 J298 J299 J300 J301 J302 J303 J304 J305 J306 J307 J308 J309 J310 J311 J312 J313 J314 J315 J316 J317 J318 J319 J320 J321 J322 J323 J324 J325 J326 J327 J328 J329 J330 J331 J332 J333 J334 J335 J336 J337 J338 J339 J340 J341 J342 J343 J344 J345 J346 J347 J348 J349 J350 J351 J352 J353 J354 J355 J356 J357 J358 J359 J360 J361 J362 J363 J364 J365 J366 J367 J368 J369 J370 J371 J372 J373 J374 J375 J376 J377 J378 J379 J380 J381 J382 J383 J384 J385 J386 J387 J388 J389 J390 J391 J392 J393 J394 J395 J396 J397 J398 J399 J400 J401 J402 J403 J404 J405 J406 J407 J408 J409 J410 J411 J412 J413 J414 J415 J416 J417 J418 J419 J420 J421 J422 J423 J424 J425 J426 J427 J428 J429 J430 J431 J432 J433 J434 J435 J436 J437 J438 J439 J440 J441 J442 J443 J444 J445 J446 J447 J448 J449 J450 J451 J452 J453 J454 J455 J456 J457 J458 J459 J460 J461 J462 J463 J464 J465 J466 J467 J468 J469 J470 J471 J472 J473 J474 J475 J476 J477 J478 J479 J480 J481 J482 J483 J484 J485 J486 J487 J488 J489 J490 J491 J492 J493 J494 J495 J496 J497 J498 J499 J500 J501 J502 J503 J504 J505 J506 J507 J508 J509 J510 J511 J512 J513 J514 J515 J516 J517 J518 J519 J520 J521 J522 J523 J524 J525 J526 J527 J528 J529 J530 J531 J532 J533 J534 J535 J536 J537 J538 J539 J540 J541 J542 J543 J544 J545 J546 J547 J548 J549 J550 J551 J552 J553 J554 J555 J556 J557 J558 J559 J560 J561 J562 J563 J564 J565 J566 J567 J568 J569 J570 J571 J572 J573 J574 J575 J576 J577 J578 J579 J580 J581 J582 J583 J584 J585 J586 J587 J588 J589 J590 J591 J592 J593 J594 J595 J596 J597 J598 J599 J600 J601 J602 J603 J604 J605 J606 J607 J608 J609 J610 J611 J612 J613 J614 J615 J616 J617 J618 J619 J620 J621 J622 J623 J624 J625 J626 J627 J628 J629 J630 J631 J632 J633 J634 J635 J636 J637 J638 J639 J640 J641 J642 J643 J644 J645 J646 J647 J648 J649 J650 J651 J652 J653 J654 J655 J656 J657 J658 J659 J660 J661 J662 J663 J664 J665 J666 J667 J668 J669 J670 J671 J672 J673 J674 J675 J676 J677 J678 J679 J680 J681 J682 J683 J684 J685 J686 J687 J688 J689 J690 J691 J692 J693 J694 J695 J696 J697 J698 J699 J700 J701 J702 J703 J704 J705 J706 J707 J708 J709 J710 J711 J712 J713 J714 J715 J716 J717 J718 J719 J720 J721 J722 J723 J724 J725 J726 J727 J728 J729 J730 J731 J732 J733 J734 J735 J736 J737 J738 J739 J740 J741 J742 J743 J744 J745 J746 J747 J748 J749 J750 J751 J752 J753 J754 J755 J756 J757 J758 J759 J760 J761 J762 J763 J764 J765 J766 J767 J768 J769 J770 J771 J772 J773 J774 J775 J776 J777 J778 J779 J780 J781 J782 J783 J784 J785 J786 J787 J788 J789 J790 J791 J792 J793 J794 J795 J796 J797 J798 J799 J800 J801 J802 J803 J804 J805 J806 J807 J808 J809 J810 J811 J812 J813 J814 J815 J816 J817 J818 J819 J820 J821 J822 J823 J824 J825 J826 J827 J828 J829 J830 J831 J832 J833 J834 J835 J836 J837 J838 J839 J840 J841 J842 J843 J844 J845 J846 J847 J848 J849 J850 J851 J852 J853 J854 J855 J856 J857 J858 J859 J860 J861 J862 J863 J864 J865 J866 J867 J868 J869 J870 J871 J872 J873 J874 J875 J876 J877 J878 J879 J880 J881 J882 J883 J884 J885 J886 J887 J888 J889 J890 J891 J892 J893 J894 J895 J896 J897 J898 J899 J900 J901 J902 J903 J904 J905 J906 J907 J908 J909 J910 J911 J912 J913 J914 J915 J916 J917 J918 J919 J920 J921 J922 J923 J924 J925 J926 J927 J928 J929 J930 J931 J932 J933 J934 J935 J936 J937 J938 J939 J940 J941 J942 J943 J944 J945 J946 J947 J948 J949 J950 J951 J952 J953 J954 J955 J956 J957 J958 J959 J960 J961 J962 J963 J964 J965 J966 J967 J968 J969 J970 J971 J972 J973 J974 J975 J976 J977 J978 J979 J980 J981 J982 J983 J984 J985 J986 J987 J988 J989 J990 J991 J992 J993 J994 J995 J996 J997 J998 J999 J1000

Solder each of the 1/4 watt 5% tolerance 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 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. The 1% tolerance resistors and trimmer potentiometers will be installed in later steps, so not all resistor numbers are used at this time.



Silver or gold disregard this band

DESIGNATION	VALUE	COLOR CODE A-B-C
() R1	47K	yellow-violet-orange
() R2	220K	red-red-yellow
() R3	1 meg	brown-black-green
() R7	220K	red-red-yellow
() R8	1 meg	brown-black-green
() R10	470 ohm	yellow-violet-brown
() R11	10K	brown-black-orange
() R13	27K	red-violet-orange
() R14	5600 ohm	green-blue-red
() R15	6800 ohm	blue-grey-red
() R16	10K	brown-black-orange
() R17	4700 ohm	yellow-violet-red
() R18	10K	brown-black-orange
() R19	10K	brown-black-orange
() R20	470 ohm	yellow-violet-brown
() R21	1800 ohm	brown-grey-red
() R22	1.2 meg	brown-green-red
() R23	270K	red-violet-yellow
() R24	100 ohm	brown-black-brown
() R25	100 ohm	brown-black-brown
() R27	100K	brown-black-yellow
() R28	330 ohm	orange-orange-brown
() R29	2700 ohm	red-violet-red
() R30	68K	blue-grey-orange
() R31	18K	brown-grey-orange
() R32	4700 ohm	yellow-violet-red
() R33	1800 ohm	brown-grey-red
() R34	1K	brown-black-red
() R35	15K	brown-green-orange
() R36	8200 ohm	grey-red-red
() R38	47K	yellow-violet-orange
() R39	270 ohm	red-violet-brown
() R40	100 ohm	brown-black-brown
() R41	15K	brown-green-orange
() R42	100K	brown-black-yellow

() R50	390K	orange-white-yellow
() R52	270K	red-violet-yellow
() R53	470 ohm	yellow-violet-brown
() R54	10K	brown-black-orange
() R56	27K	red-violet-orange
() R57	5600 ohm	green-blue-red
() R58	1 meg	brown-black-green
() R59	56K	green-blue-orange
() R60	10K	brown-black-orange
() R61	6800 ohm	blue-grey-red
() R62	10K	brown-black-orange
() R63	10K	brown-black-orange
() R64	4700 ohm	yellow-violet-red
() R65	470 ohm	yellow-violet-brown
() R66	10K	brown-black-orange
() R67	1800 ohm	brown-grey-red
() R68	1.2 meg	brown-red-green
() R69	470K	yellow-violet-yellow
() R70	1800 ohm	brown-grey-red
() R71	100 ohm	brown-black-brown
() R72	1 meg	brown-black-green
() R73	100K	brown-black-yellow
() R74	1 meg	brown-black-green
() R75	150K	brown-green-yellow
() R76	1 meg	brown-black-green
() R77	470K	yellow-violet-yellow
() R78	100K	brown-black-yellow
() R79	33K	orange-orange-orange
() R80	1 meg	brown-black-green
() R81	220K	red-red-yellow
() R87	33K	orange-orange-orange
() R88	470 ohm	yellow-violet-brown
() R89	470 ohm	yellow-violet-brown
() R90	12K	brown-red-orange
() R91	1K	brown-black-red
() R92	10K	brown-black-orange
() R94	100K	brown-black-yellow
() R95	100K	brown-black-yellow
() R96	33K	orange-orange-orange
() R97	470 ohm	yellow-violet-brown
() R98	470 ohm	yellow-violet-brown
() R99	12K	brown-red-orange
() R100	1K	brown-black-red
() R101	470 ohm	yellow-violet-brown
() R102	1K	brown-black-red
() R103	10K	brown-black-orange
() R104	22K	red-red-orange
() R105	10K	brown-black-orange
() R106	91K	white-brown-orange
() R107	47K	yellow-violet-orange

() R108	100K	brown-black-yellow
() R109	91K	white-brown-orange
() R110	220K	red-red-yellow
() R111	100K	brown-black-yellow
() R112	51K	green-brown-orange
() R113	68K	blue-grey-orange
() R114	100K	brown-black-yellow
() R115	1800 ohm	brown-grey-red
() R116	100K	brown-black-yellow
() R117	1500 ohm	brown-green-red
() R118	100K	brown-black-yellow
() R119	220K	red-red-yellow
() R120	91K	white-brown-orange
() R121	100K	brown-black-yellow
() R122	220K	red-red-yellow
() R124	68K	blue-grey-orange
() R125	68K	blue-grey-orange
() R126	68K	blue-grey-orange
() R128	18K	brown-grey-orange
() R129	47K	yellow-violet-orange
() R131	100 ohm	brown-black-brown
() R132	100 ohm	brown-black-brown
() R133	33K	orange-orange-orange
() R134	56K	green-blue-orange
() R137	68K	blue-grey-orange
() R140	470K	yellow-violet-yellow
() R141	100K	brown-black-yellow
() R142	22K	red-red-orange
() R143	1K	brown-black-red
() R145	3.9 meg	orange-white-green
() R146	12K	brown-red-orange
() R147	680 ohm	blue-grey-brown
() R148	910 ohm	white-brown-brown
() R149	220K	red-red-yellow
() R150	680 ohm	blue-grey-brown
() R151	910 ohm	white-brown-brown
() R152	220K	red-red-yellow
() R153	10K	brown-black-orange
() R154	1K	brown-black-red
() R155	1K	brown-black-red
() R156	150K	brown-green-yellow
() R157	680K	blue-grey-yellow
() R158	150K	brown-green-yellow
() R159	150K	brown-green-yellow
() R160	150K	brown-green-yellow
() R161	4700 ohm	yellow-violet-red
() R162	2.2 meg	red-red-green
() R164	100K	brown-black-yellow
() R165	1K	brown-black-red
() R166	56K	green-blue-orange

() R167	68K	blue-grey-orange
() R168	330K	orange-orange-yellow
() R169	68K	blue-grey-orange
() R170	47K	yellow-violet-orange
() R171	10K	brown-black-orange
() R172	33K	orange-orange-orange
() R173	18K	brown-grey-orange
() R176	2200 ohm	red-red-red
() R177	12K	brown-red-orange
() R178	10K	brown-black-orange
() R179	10K	brown-black-orange
() R180	680 ohm	blue-grey-brown
() R181	680 ohm	blue-grey-brown
() R182	680 ohm	blue-grey-brown
() R184	82K	grey-red-orange
() R185	470K	yellow-violet-yellow
() R186	470K	yellow-violet-yellow
() R187	1.2 meg	brown-red-green
() R188	10K	brown-black-orange
() R190	1K	brown-black-red
() R191	4700 ohm	yellow-violet-red
() R192	4700 ohm	yellow-violet-red
() R193	4700 ohm	yellow-violet-red
() R194	4700 ohm	yellow-violet-red
() R195	100K	brown-black-yellow
() R196	100K	brown-black-yellow
() R197	2200 ohm	red-red-red
() R198	2200 ohm	red-red-red
() R199	2200 ohm	red-red-red
() R200	2200 ohm	red-red-red
() R201	2200 ohm	red-red-red
() R202	2200 ohm	red-red-red
() R203	2200 ohm	red-red-red
() R204	2200 ohm	red-red-red
() R205	1K	brown-black-red
() R206	10K	brown-black-orange
() R207	1K	brown-black-red
() R208	33K	orange-orange-orange
() R209	33K	orange-orange-orange
() R210	33K	orange-orange-orange
() R211	33K	orange-orange-orange
() R212	4700 ohm	yellow-violet-red
() R213	4700 ohm	yellow-violet-red
() R214	27K	red-violet-orange
() R215	270K	red-violet-yellow
() R216	4700 ohm	yellow-violet-red
() R217	100K	brown-black-yellow

- () Install R183, 680 ohms (blue-grey-brown) by cutting a 3/4 inch (2 cm.) length of the clear plastic sleeving provided and slipping this sleeving over one of the leads of the resistor.

Install each of the 1/4w. 1% tolerance fixed resistors following the parts placement designators printed on the circuit board. Note that these resistors have 5 color bands, of which 4 are significant



disregard this band.

color code A-B-C-D

DESIGNATION	VALUE	COLOR CODE A-B-C-D
() R4	100K	brown-black-black-orange
() R5	100K	brown-black-black-orange
() R6	100K	brown-black-black-orange
() R44	301 ohm	orange-black-brown-black
() R45	301 ohm	orange-black-brown-black
() R46	301 ohm	orange-black-brown-black
() R47	100K	brown-black-black-orange
() R48	100K	brown-black-black-orange
() R49	100K	brown-black-black-orange
() R51	100K	brown-black-black-orange
() R84	301 ohm	orange-black-brown-black
() R85	301 ohm	orange-black-brown-black
() R86	301 ohm	orange-black-brown-black
() R135	100K	brown-black-black-orange
() R136	100K	brown-black-black-orange
() R138	100K	brown-black-black-orange
() R139	100K	brown-black-black-orange

Install the ceramic disk capacitors. Without exception the value will be marked on the body of the part or the part will be bagged separately with the value marked on the bag.

DESIGNATION	VALUE	ALTERNATE MARKINGS
() C2	100 pf.	
() C3	.005 mfd.	502
() C4	.001 mfd.	102
() C5	.001 mfd.	102
() C7	.01 mfd.	103
() C9	.01 mfd.	103
() C11	.05 mfd.	503
() C12	.01 mfd.	103
() C13	.01 mfd.	103
() C15	.01 mfd.	103



ceramic disk capacitor

() C16	.01 mfd.	103
() C17	.01 mfd.	103
() C19	.05 mfd.	503
() C29	.001 mfd.	102
() C30	.001 mfd.	102
() C31	.01 mfd.	103
() C32	.01 mfd.	103
() C33	.05 mfd.	503
() C36	.005 mfd.	502
() C37	.01 mfd.	103
() C49	100 pf.	100K
() C52	100 pf.	100K
() C53	.001 mfd.	102
() C57	100 pf.	100K
() C58	100 pf.	100K
() C59	100 pf.	100K

Install the polyester capacitors. These capacitors will have their value marked on the body of the part, or will be bagged separately with the value marked on the bags.

DESIGNATION	VALUE
() C1	.1 mfd.
() C38	.01 mfd.
() C42	.01 mfd.
() C43	.1 mfd.
() C44	.01 mfd.
() C45	.1 mfd.
() C46	.1 mfd.
() C47	.1 mfd.
() C48	.1 mfd.
() C50	.1 mfd.
() C51	.1 mfd.
() C54	.1 mfd.
() C55	.01 mfd.
() C56	.01 mfd.

polyester capacitor



Install the polystyrene capacitors. These will have their values marked on the body of the part, or will be bagged separately with the values marked on the bags.

DESIGNATION	VALUE
() C6	1200 pf.
() C14	1200 pf.
() C25	330 pf.
() C27	330 pf.
() C28	330 pf.
() C41	330 pf.

polystyrene capacitor



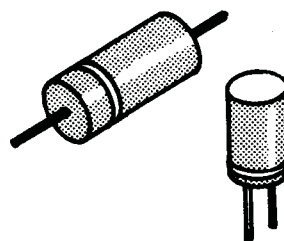
Up to this point all components have been non-polarized and either lead could be placed in either of the holes provided without affecting the operation of the unit. Electrolytic capacitors are polarized and must be mounted so that the "+" lead of the capacitor goes through the "+" hole in the circuit board. In the event that the "-" lead rather than the "+" lead of the capacitor is marked it is to go through the unmarked hole on the circuit board.

Note that the operating voltage (v.) specified for a capacitor is the minimum acceptable rating. Capacitors supplied with specific kits may have a higher voltage rating than that specified and may be used despite this difference. For instance, a 100 mfd. 25v. capacitor may be used in place of a 100 mfd. 16v. capacitor without affecting the operation of the circuit.

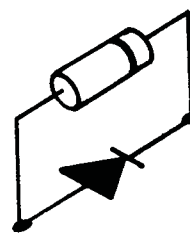
Mount the following electrolytic capacitors and solder them in place. Their values, voltage rating and polarization are marked on the body of the part.

DESIGNATION	DESCRIPTION
() C8	4.7 mfd. 16v.
() C10	4.7 mfd. 16v.
() C18	33 mfd. 16v.
() C20	4.7 mfd. 16v.
() C21	4.7 mfd. 16v.
() C22	10 mfd. 16v.
() C23	10 mfd. 16v.
() C24	2.2 mfd. 16v.
() C26	4.7 mfd. 16v.
() C35	4.7 mfd. 16v.
() C39	4.7 mfd. 16v.
() C40	4.7 mfd. 16v.
() C60	4.7 mfd. 16v.

electrolytic capacitor



Next install the diodes. Note that all semiconductors are heat sensitive and may be damaged if allowed to get too hot while soldering. To be on the safe side, heat sink each diode lead during the soldering operation by grasping it with a pair of needlenose pliers or a small alligator type clip at a point between the circuit board and the body of the component. When mounting the diodes, note that they are polarized by a colored band around one end of the diode body. This coding relates to the circuit board designators as shown in the accompanying drawing.



diode

Note all diodes are identical, 1N914 or 1N4148 type signal diodes. Install and solder in place. Trim excess leads.

DESIGNATION	TYPE NUMBER
() D1	1N4148 or 1N914
() D3	1N4148 or 1N914
() D4	1N4148 or 1N914
() D5	1N4148 or 1N914
() D6	1N4148 or 1N914
() D7	1N4148 or 1N914

Note that the middle lead of one of the transistors has been removed. This transistor has been selected for its noise generating characteristics and is intended for use as D2. Install the transistor as shown.

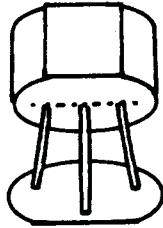
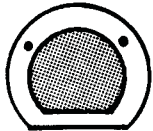


() D2 noise diode

noise diode

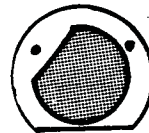
Install the 2N5139 transistor, Q1. This transistor may be in one of two different case styles. If the transistor supplied with your kit has in-line leads, bend the center lead slightly toward the flat face of the case so that the leads will match the triangular hole pattern on the circuit board.

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.

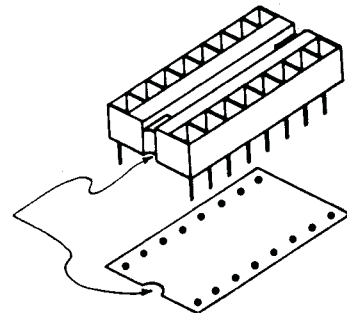
() Q1 2N5139

Install the Integrated Circuit sockets. Note that four socket sizes have been supplied; 8 pin, 14 pin, 16 pin, and 18 pin. DO NOT INSTALL ANY IC's AT THIS TIME. Some sockets will have a small notch at one end. This should correspond to the notch on the parts placement graphics.

Install 8 pin sockets in the following locations;

- | | | |
|---------|----------|----------|
| () IC3 | () IC15 | () IC32 |
| () IC7 | () IC16 | () IC35 |
| () IC8 | () IC28 | |

NOTE KEY



IC socket

Install 14 pin sockets in the following locations;

- | | | | |
|----------|----------|----------|----------|
| () IC9 | () IC19 | () IC29 | () IC34 |
| () IC14 | () IC21 | () IC30 | () IC37 |
| () IC18 | () IC22 | () IC31 | () IC38 |

Install 16 pin sockets in the following locations;

- | | | | |
|---------|----------|----------|----------|
| () IC1 | () IC6 | () IC20 | () IC26 |
| () IC2 | () IC11 | () IC23 | () IC27 |
| () IC4 | () IC12 | () IC24 | () IC33 |
| () IC5 | () IC17 | () IC25 | () IC36 |

Install 18 pin sockets in the locations for IC10 and IC13.

- () IC10
() IC13

Install the trimmer potentiometers;

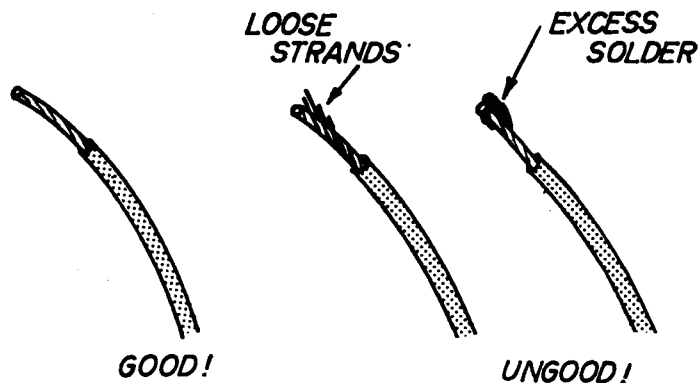
DESIGNATION	VALUE
() R9	10K
() R12	10K
() R26	10K
() R37	10K
() R43	1K
() R55	10K
() R82	10K
() R83	1K
() R123	10K
() R130	10K
() R144	10K
() R163	10K
() R175	1K



trimmer potentiometer

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 (5mm) of insulation from both ends. Twist the exposed wire strands tightly together and "tin" them by melting a small amount of solder into the strands. Make sure that your soldering tip is **VERY CLEAN WHILE TINNING**. The ends of the wire should be nice and cylindrical, without loose strands or excess solder (see below).

DESIGNATION	LENGTH
() A to A'	9.5"(24cm)
() B to B'	5.0"(13cm)
() C to C'	12.5"(31cm)
() D to D'	4.5"(12cm)
() E to E'	4.5"(12cm)
() F to F'	5.0"(13cm)
() G to G'	7.5"(19cm)
() H to H'	4.75"(12cm)
() I to I'	12.0"(30cm)
() J to J'	8.0"(20cm)
() K to K'	7.0"(18cm)
() L to L'	7.25"(19cm)
() M to M'	5.75"(15cm)
() N to N'	9.5"(24cm)
() O to O'	7.25"(18cm)
() P to P'	8.5"(22cm)
() Q to Q'	7.5"(19cm)
() R to R'	7.0"(18cm)
() S to S'	7.5"(19cm)
() T to T'	7.75"(20cm)
() U to U'	7.5"(19cm)
() V to V'	8.0"(20cm)
() W to W'	7.5"(19cm)
() X to X'	6.5"(17cm)
() Y to Y'	5.25"(14cm)
() Z to Z'	5.25"(14cm)
() AA to AA'	6.25"(16cm)
() BB to BB'	5.0"(13cm)
() CC to CC'	5.5"(15cm)
() DD to DD'	8.0"(20cm)
() EE to EE'	2.75"(7cm)



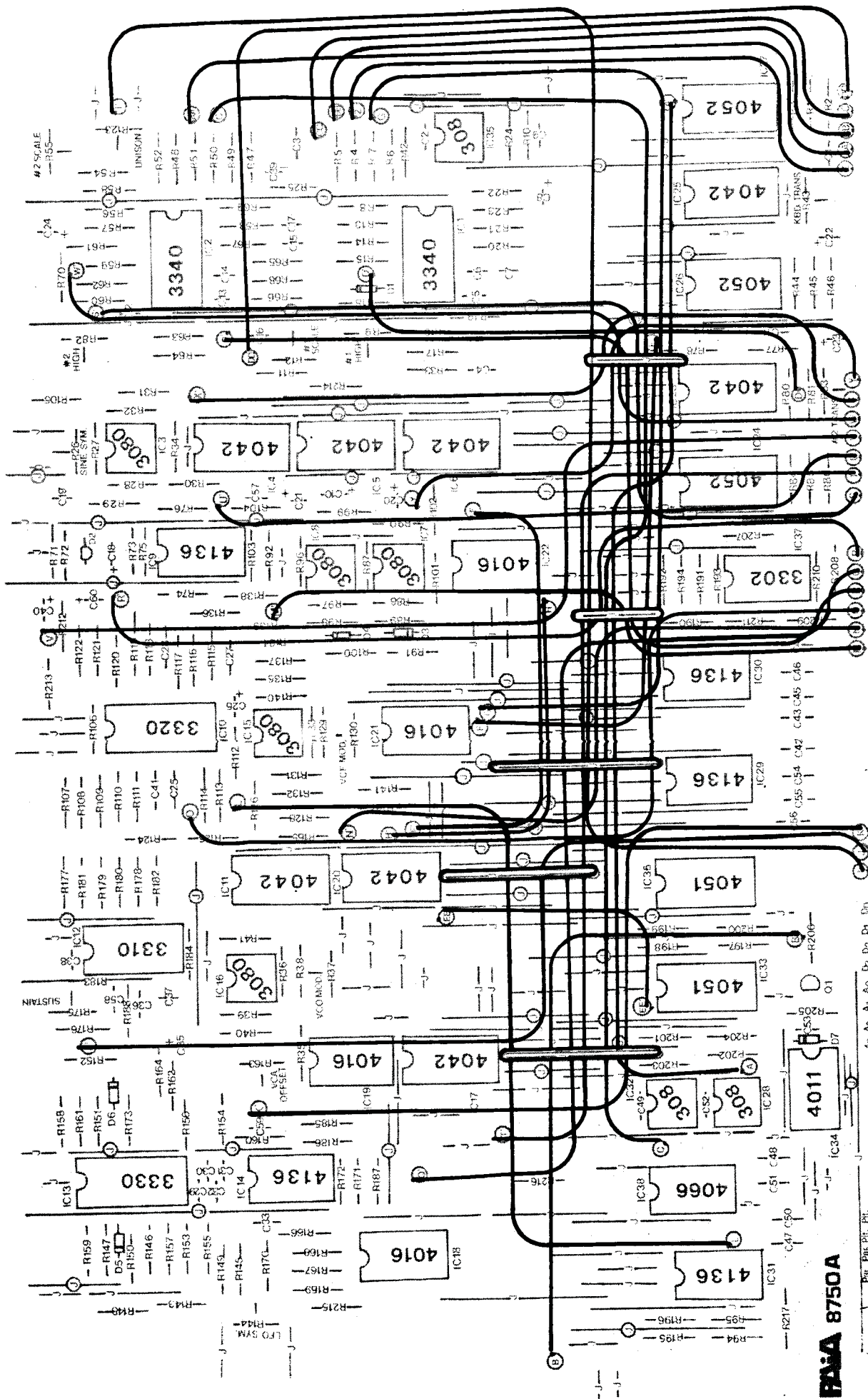
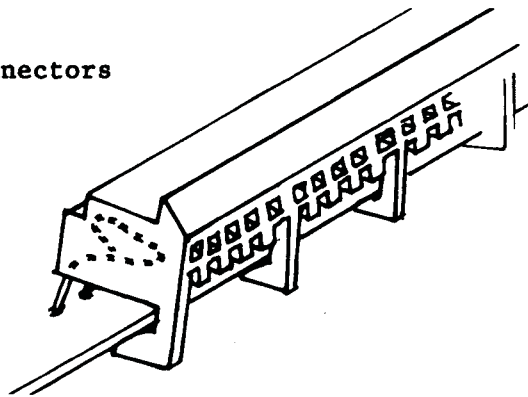


figure 2: wire routing

() Referring to figure 2, the last of the solid wire jumpers should now be installed. These should ALL be insulated with an appropriate length of clear plastic tubing. As wire hold downs, these jumpers should gather the stranded wire jumpers into bundles for neatness. These wire hold downs need not be extremely tight or pulled flat against the circuit board.

() Install the four 15 pin Molex edge connectors as shown in the figure.



We are now ready to begin installing the integrated circuits. Open the integrated circuit package and install the integrated circuits in their respective sockets. Notice that the orientation of the Integrated Circuits is keyed by a semi-circular notch at one end of the device, and that the position of this notch should correspond with the notch that is part of the circuit board graphics.

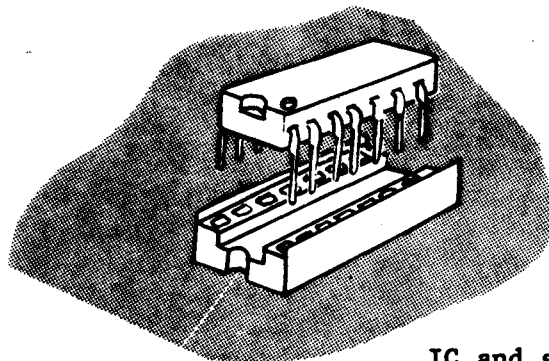
WARNING CMOS CIRCUITS

Some of the integrated circuits used in this kit are Complementary Metallic Oxide Semiconductors (CMOS). While state of the art internal protection is provided, these circuits are still susceptible to damage from STATIC ELECTRICITY. You should not experience any difficulties if you observe the following precautions.

- 1) The circuits are supplied to you inserted in blocks of conductive foam. Leave them in these blocks until you are ready to install the part.
- 2) Do not install the parts in sequence other than that called for in the instructions.
- 3) Do not wear synthetic clothing (e.g. nylon) while handling these parts.

Observing polarization markings, install the following CMOS ICs in their sockets.

DESIGNATION	TYPE NO.
() IC4	4052
() IC5	4052
() IC6	4042
() IC11	4052
() IC17	4042
() IC18	4016
() IC19	4016
() IC20	4042
() IC21	4016
() IC22	4016



IC and socket

() IC23	4042
() IC24	4052
() IC25	4042
() IC26	4052
() IC27	4052
() IC33	4051
() IC34	4011
() IC36	4051
() IC38	4066

Next, observing polarizing markings, install the remaining integrated circuits in their respective sockets.

DESIGNATION	TYPE NO.
() IC1	3340
() IC2	3340
() IC3	3080
() IC7	3080
() IC8	3080
() IC9	4136
() IC10	3320
() IC12	3310
() IC13	3330
() IC14	4136
() IC15	3080
() IC16	3080
() IC28	308
() IC29	4136
() IC30	4136
() IC31	4136
() IC32	308
() IC35	308
() IC37	3302

NORMALIZATION ANALYSIS

The PROTEUS card is a complete monotonic synthesizer voice with two Voltage Controlled Oscillators, Noise source, Voltage Controlled Filter, Voltage Controlled Amplifier, Envelope Generator and Low Frequency Oscillator on a single card. The card is configured for digital control of normalization switching and multiplexing of parameter and pitch control voltages in multiple card configurations.

As can be seen from the normalization block diagram in figure 3 below, the signal and control voltage flow through the PROTEUS card is fairly straight-forward. A pair of Voltage Controlled Oscillators offer a variety of waveforms which may be individually selected and mixed to provide a signal to the 24 db/oct Low Pass Filter. The unmodified input to the filter and the filtered output may be selected or mixed as the input to the Voltage Controlled Amplifier.

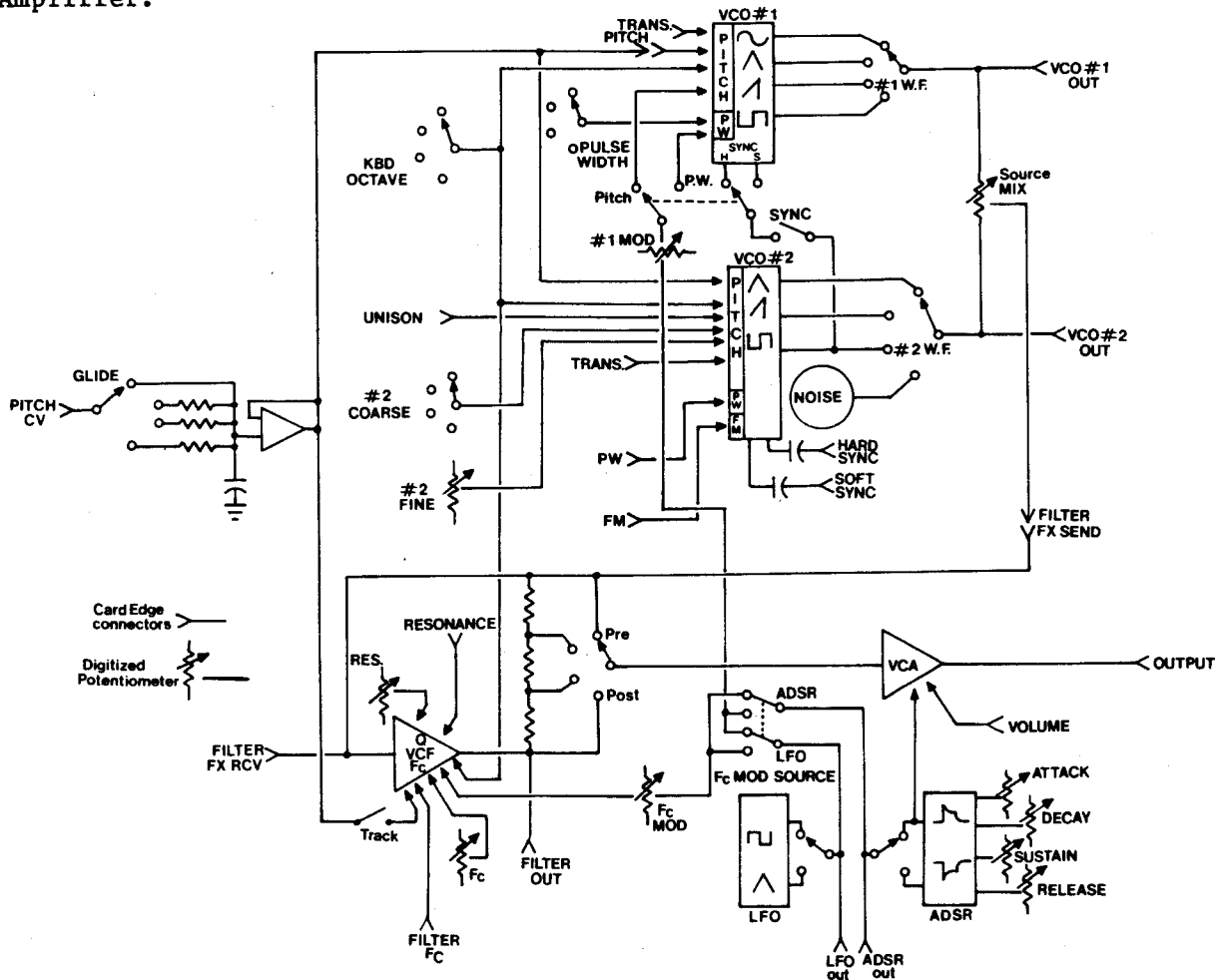


figure 3: Normalization Block Diagram

The ADSR Envelope Generator is hard-wired to the VCA to provide control of dynamics as well as being available in either a normal or inverted form as a VCO or VCF modulation source. The Low Frequency Oscillator is the second modulation source which has repeating square or triangle waveforms available. VCO or VCF destination of the modulation source is selected by the single Fc MOD SOURCE switch and is arranged so that when the ADSR is selected as the filter modulator, the LFO is automatically selected to modulate VCO #1. Conversely, when the ADSR is modulating the oscillator, the LFO is selected for the filter.

NORMALIZATION

At VCO #1, the action of the selected source can be switch selected to be either Pitch Modulation or Pulse Width Modulation. While sync has a separate switch to enable it, Hard Sync or Soft Sync is automatically selected at the same time that VCO modulation destination is. Selecting Pitch Modulation produces Hard Sync, while P.W. Modulation selects Soft Sync.

CIRCUIT DESIGN ANALYSIS

Two major groups of controlling signals enter the PROTEUS card on the edge connector: Pitch control voltage and multiplexed parameter data and address. See figure 4 below.

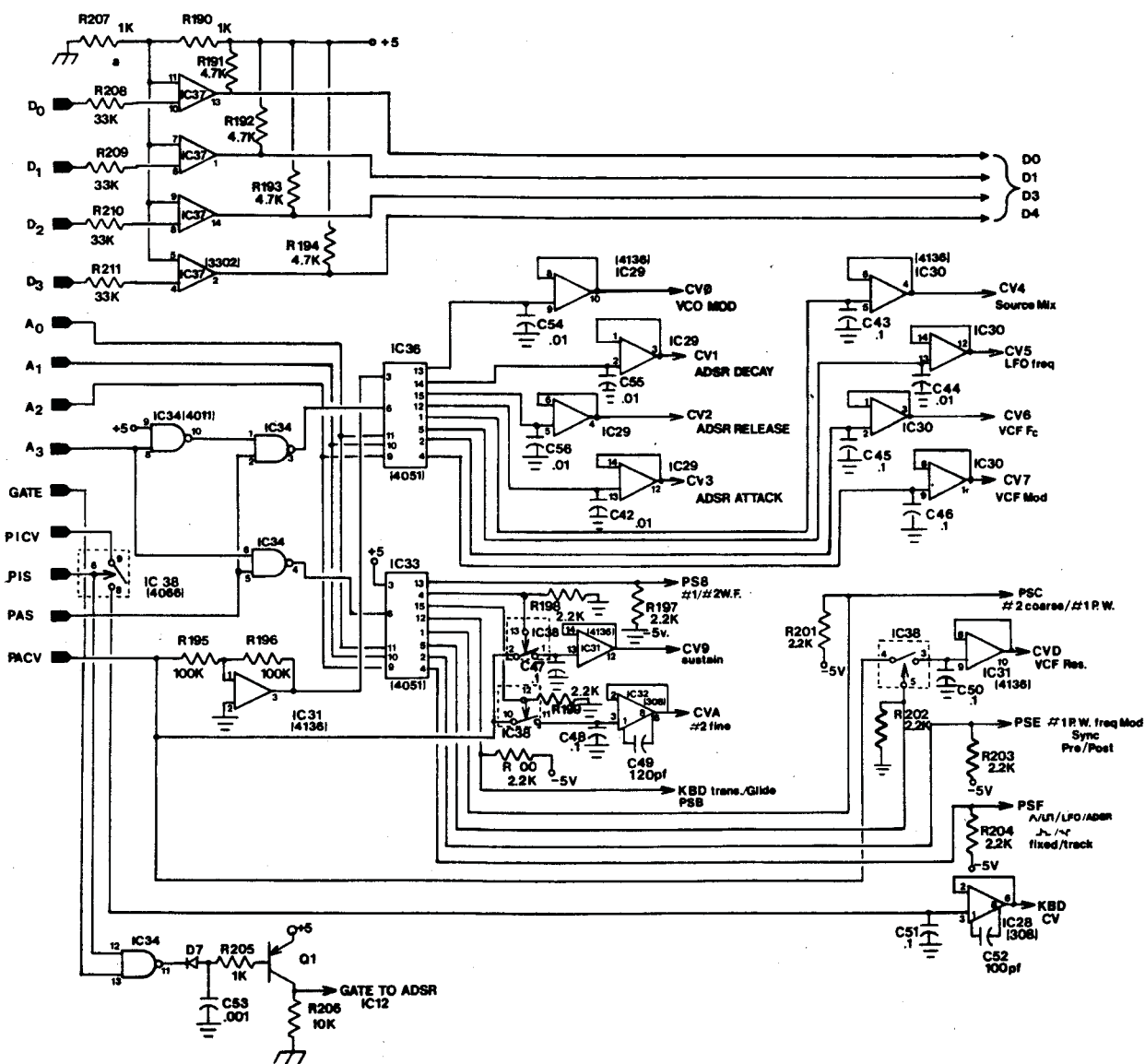


figure 4: Pitch and Parameter De-Multiplexing

PITCH C.V. DE-MULTIPLEXING

After entering the card on edge connector pin 10, the Pitch Control Voltage (PICV) is routed through one of the four bi-lateral switch sections of IC38 which, under control of the Pitch Select (PIS) signal on edge connector pin 9, allows for multiplexing of this control signal in multiple card configurations. When the PIS line is high, the switch is on, allowing the control voltage to be applied to the Sample and Hold circuit comprising the op-amp IC28 and holding capacitor C51.

The PIS control line also allows for the multiplexing of the GATE signal which accompanies PICV. The GATE signal is an indication of the state of the AGO key corresponding to the pitch control voltage. When the key corresponding to the pitch is down, GATE is at a high logic level and correspondingly, when the key is up, GATE is low. The GATE signal is de-multiplexed by being applied to one of the inputs of one of the NAND gate sections of IC34. The other input of the NAND gate is the PIS control line. When both the PIS and GATE signals are high the output of the gate responds by going low. This low output is inverted by Q1 and provides a signal which, when high, produces the appropriate response from the Envelope Generator and its associated circuitry. Also involved with the de-multiplexing of the gate signal is the slight time delay produced by the network consisting of D7, C53 and R205.

In single card configurations, PIS is simply tied to a high logic level, allowing PICV and GATE continual access to the card.

PARAMETER DATA DE-MULTIPLEXING

Parameter data enters the card in equivalent digital and analog forms, both of which are time-multiplexed even in single card configurations. At any given instant in time, a 4 bit digital word, a Parameter Control Voltage (PACV) and a 4 bit parameter address all appear on their respective control lines. Whether the analog voltage or digital data will be used for any given address is hard-wired into the Proteus card de-multiplexing logic.

The DATA lines coming onto the card are buffered by the Quad comparator IC37 and simultaneously level shifted from the 0 to 5v. logic levels at the card edge inputs to the -5v. (logic 0) to +5v. (logic 1) levels required by the bipolar analog processing elements used throughout the card. One final line, Parameter Select (PAS) is a signal which when high signifies that the other lines represent valid data, i.e. that an appropriate settling time has expired between the last parameter and the current one.

As is indicated by the Parameter Address map in figure 5, the 16 mixed digital and analog parameters entering the card can be thought of as being divided into two groups of 8 parameters each. The first group of 8 is de-multiplexed by IC36 while the second group is handled by IC33. Three gates from IC34 are used to logically separate these two groups by decoding the most significant address line A0 and to allow the selected de-multiplexer to be enabled only when the PAS line is high.

The first group of parameters (0-7) are exclusively control voltages and, unlike the PACV signal which appears at the edge connector, are "negative going". That is, their allowable range of values is from ground (0v.) to -5v. To allow for this, the input of de-multiplexer IC36 is driven from the output of the unity gain inverter comprising one of the op-amp stages of IC31 and resistors R195 and R196. Each of these parameters, as they are selected, are stored in one of the

8 S/H circuits built around the quad op-amps IC29 and IC30 and associated holding capacitors and from there are distributed to the appropriate points in the synthesizer circuitry.

Address	PARAMETERS			
	D ₃	D ₂	D ₁	D ₀
0	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	KBD TRANSPOSE		GLIDE	
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 Λ / Λ1

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

figure 5: Parameter Address Map

The second group of 8 parameters are a hybrid mix of control voltage and digital (switch) signals and because of this the de-multiplexer responsible for these parameters has at its input only a high logic level. The select line coming from pin 13 is typical in that it terminates in resistor R197 which returns to the -5v. supply, consequently, when address \$8 is specified and selected, a short duration +5v. pulse appears across this resistor. This pulse is subsequently used to strobe the data into a latch; in this specific example IC6, which in turn selects the output waveform from the two VCO's. Three of the parameters in this group of 8 (\$9, \$A and \$D) are positive going (0 to +5v.) control voltages which are switched into the appropriate S/H circuits by using the strobe signals from the de-multiplexer to turn on switch sections from IC38.

SIGNAL SOURCES

The PROTEUS card's primary signal sources are Voltage Controlled Oscillators built around CEM 3340 type VCO ICs. See figure 6. The Pitch controlling voltage coming from the previously described keyboard control voltage S/H (IC28) is first applied to the input of one section of the 4052 type 4 channel multiplexer chip IC27 which under control of D0 and D1 of control word \$B selects one of 4 glide determining time constants (R1, R2, R3, C1). IC38 buffers this control voltage before it is distributed to the oscillators and filter (when the filter is selected to track the keyboard).

D2 and D3 of control word \$B are applied to the 4 channel multiplexer IC26 which acts as a switch to select one of the octavely related control voltages

originating at the voltage divider consisting of R43 - R46. The voltage selected from this divider string is applied to the VCOs and VCF where it serves the function of raising or lowering all pitch related parameters of the card in octave increments. This has the effect of transposing the AGO keyboard.

A total of four control voltages determine the Pitch of VCO #1; the KBD control voltage as it appears at the output of the Glide buffer IC35, the KBD Transpose voltage from IC26, the pitch modulation voltage (when selected) from IC16 and the off-card transpose voltage which comes in on R4. Of particular note is the fact that the KBD Pitch Control Voltage passes through two edge connector fingers before going to the VCO so that this oscillator can be disconnected from the Pitch Control Voltage if desired.

Bits D0 and D1 of word \$C are applied to the multiplexer chip IC24 which selects one of the octavely related control voltages generated by the divider string R83 - R86. This control voltage is applied to VCO #2 only where it provides a means to offset the pitch of this oscillator by octaves. Only VCO #2 is affected.

The fine (semi-tone) offset of VCO #2 is determined by the control voltage derived from word \$A which is applied to R50. Again, only VCO #2 is affected.

D2 and D3 of word \$C control the simple R-2R type Digital to Analog Converter (R77 - R81 at the output of the 4042 latch IC23) the output voltage of which is applied to the Pulse Width input of VCO #1 (IC1). When P.W. modulation of this oscillator is selected, it is implemented by modulating the output of this DAC by applying the control voltage to the junction of R78 and R79.

Either pulse width modulation (as discussed above) or Pitch Modulation (by way of R7) of VCO #1 is selected by word \$E's bit D0 which, depending on its state, causes either of two switches in IC21 to be on. The transconductance amplifier IC16 is used as an electronic attenuator under the control of the analog voltage represented by word \$0 to set the amount of modulating signal available.

On-card sync is controlled by the 4 switch section in IC22. The sync is turned on by the section represented by pin 13 under control of D1 of word \$E. The switch section represented by pin 5 of this IC is driven from D1's complement so that when sync is not selected the sensitive soft sync input of VCO#1 is grounded to prevent interference from stray signals.

Hard Sync or Soft Sync is determined by turning on the switch section of IC22 controlled by either pin 12 or pin 6 respectively. These switches work in conjunction with the VCO #1 modulation destination switching (D0 of word \$E) so that when Pitch Modulation is invoked, Hard Sync is selected and when P.W. Modulation is invoked Soft Sync is selected.

A sine wave output from VCO #1 is derived by using this oscillator's triangle waveform to slightly overdrive the transconductance amplifier IC3 causing the triangle peaks to round off into a approximation of a sine wave. This sine wave, along with VCO #1's triangle, ramp and pulse wave outputs are routed to the 4 channel multiplexer (IC5) where one of them is selected as the final oscillator output. Selection is controlled by D0 and D1 of word \$8.

The noise source associated with VCO #2 is produced by the avalanching reverse biased base-emitter junction of D2. Shot Noise generated by this process is buffered and amplified by two cascaded inverting amplifiers comprising two op-amp stages from IC9 and R73 - R76.

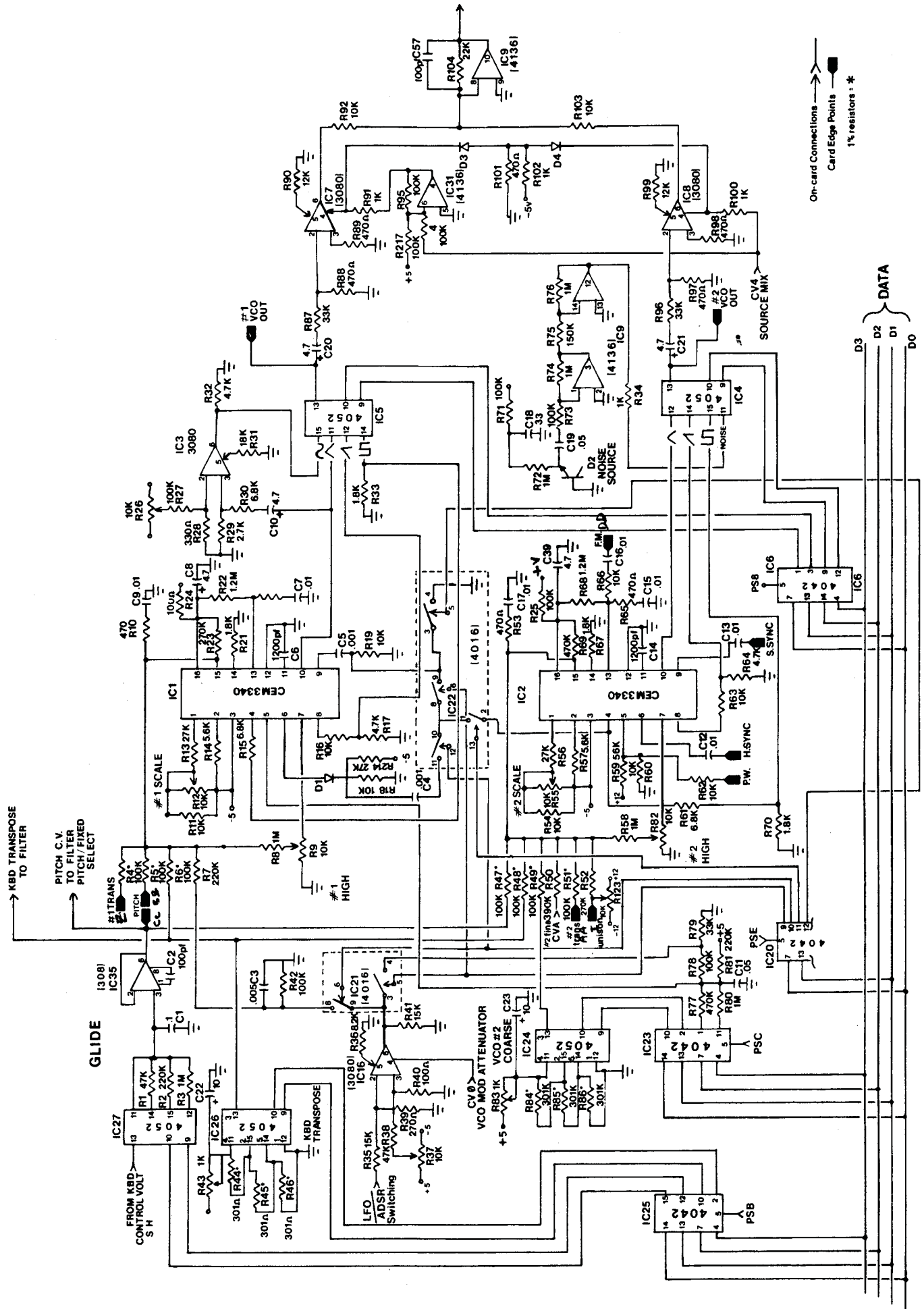


figure 6: Signal Sources

The noise output along with the triangle, ramp and square wave outputs of VCO #2 are applied to the inputs of the 4 channel multiplexer IC4 where D2 and D3 of word \$8 select one of the four as the final output of this source.

Six inputs set the pitch of VCO #2; keyboard C.V. from IC35, KBD Transpose from IC26, VCO #2 Coarse from IC2, VCO #2 Fine from IC35, the off-card transpose C.V. and the off-card Unison voltage.

SOURCE MIX

Mixing of the two sources is controlled by transconductance amplifiers IC7 and IC8 under control of the voltage corresponding to word \$4. This control voltage is applied directly to the control input of IC8. The same control voltage is also inverted and offset by the inverter consisting of one stage of IC31 and associated components before being applied to the control input of IC7. The net result is that as control voltage \$4 decreases to turn on IC8 (this is one of the negative going control voltages) the pin 4 output of IC 31 rises from a negative value to turn off IC7, producing a cross fader action. Diodes D3 and D4 serve as soft clamps on the control voltages to IC7 and IC8 to approximate the logarithmic response of the ear so that subjective volume level is constant regardless of the mix.

The current outputs of IC7 and IC8 are summed and converted to a voltage by IC9 whose output is then routed to the input of the Low Pass Filter.

LOW PASS FILTER

The 24 db/oct Voltage Controlled Filter consists of IC10 (CEM 3310) and associated components (see figure 7). Disregarding modulation and keyboard tracking control voltage inputs, the initial frequency of the filter is set by the control voltage corresponding to word \$6. Resonance is set by the control voltage corresponding to word \$D.

The output of the source mixer is hard-wired to the input of the filter and the action of the filter (how much effect of the filter can be heard) is controlled by selecting and mixing the audio signal as it goes into the filter (Pre) with the output of the filter (Post). This mixing is accomplished with the resistor string R124 - R126. The signal at the top of R124 is completely without filtering, while that at the bottom or R126 is only filter output. The two taps in between have a mix of the filtered and the non-filtered signals. Selection of one of these 4 signals is accomplished by the 4 channel multiplexer in IC11 under control of bits D2 and D3 of control word \$E.

The output of the filter Pre/Post selection is hardwired to the input of the PROTEUS card main VCA (IC13 pin 13) by C35 and R164. The current output of the Curtis VCA is converted to a voltage and buffered by R160 and one of the op-amp stages in IC14 whose output is the main audio output of the card.

Altogether 5 variable control voltages can be summed to set the corner frequency of the filter; the output of the modulation attenuator IC15, the voltage from the track/fixed switch IC21, the front panel corner frequency represented by control word \$6, the keyboard transpose control voltage from IC26, and an external control voltage from the Filter Fc edge connection fingers.

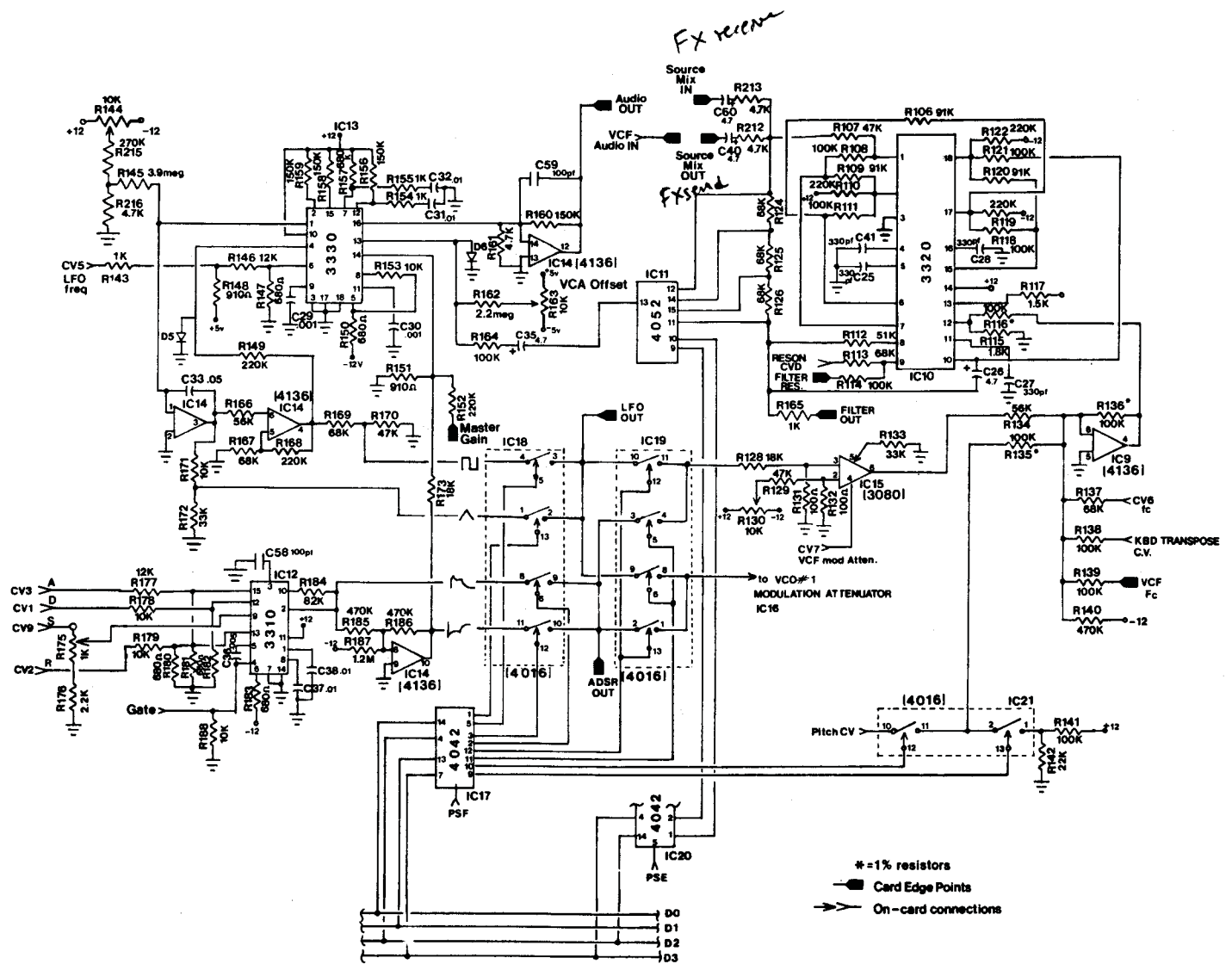


figure 7: Filter, VCA, and Modulation Sources

ENVELOPE GENERATOR

The envelope generator design uses a CEM 3310 ADSR chip (IC12). Attack time is set by the control voltage corresponding to word \$3. Initial Decay is set by word \$1. Sustain level is set by word \$9 and final Release controlled by word \$2. The trigger for the ADSR is derived from the pitch control voltage de-multiplexing circuitry as described earlier.

The output of the transient generator is inverted and level shifted by one of the op-amp stages in IC14 and R185 - R187 and hard wired to the control input of one of the two Voltage Controlled Amplifiers in the CEM 3330 VCA which serves to control dynamics.

LOW FREQUENCY OSCILLATOR

The second VCA stage in IC14 is used as the exponential response voltage controlled element in the PROTEUS card's Low Frequency Oscillator. The LFO design is a common configuration consisting of an integrator comprising C33 and one op-amp stage from IC14 followed by a Schmitt trigger comprising R167 and R168 and a second section of IC14. The output of the Schmitt trigger feeds what would ordinarily be the audio input of the VCA (pin 4), while the current into the integrator comes from the VCA output (pin 1). The control input of this VCA section is driven by the analog control voltage corresponding to word \$5.

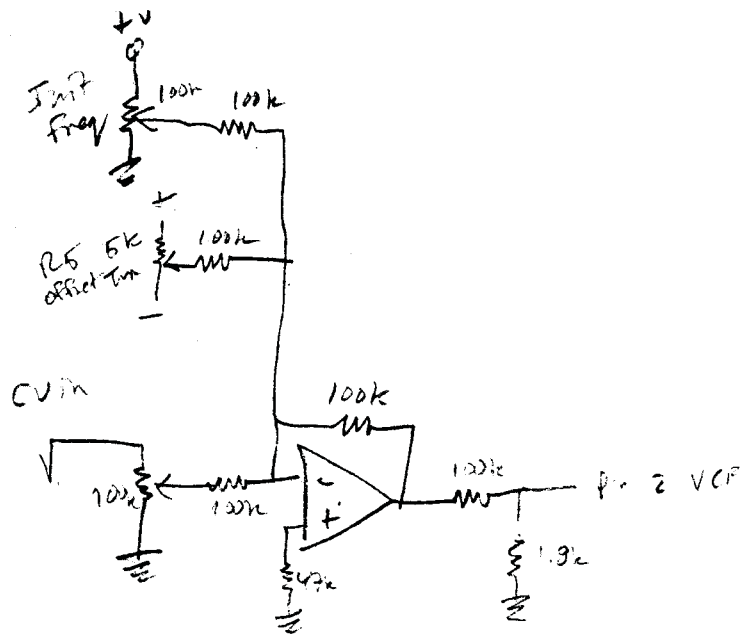
MODULATION SELECTION

Either the triangle waveform from the junction of R171 and R172 at the output of the integrator or the square wave from the junction of R169 and R170 at the output of the Schmitt trigger is selected by turning on one or the other of the IC18 switch sections represented by pins 13 and 5. These two switches are under control of D0 and its complement $\bar{D}0$ of word \$F.

Similarly, either the normal envelope generator waveform available at pin 2 of IC12 or its inverted replica at pin 10 of IC14 is selected by one of the remaining two switch sections in IC18 under control of D2 of word \$F. The selected LFO and envelope generator waveforms are routed to the four switch sections in IC19. Under control of D1 of word \$F these switches either route the LFO to modulate the #1 VCO while the envelope generator modulates the filter (when D1 is a logical 1) or vice-versa (when D0 is low).

The remaining bit of word \$F (D3), when set, causes the corner frequency of the filter to track the keyboard by turning on the switch section of IC21 represented by control pin 12. When this bit is low, the switch represented by pin 13 is off causing the filter F_c to ignore the keyboard control voltage changes.

NOTES



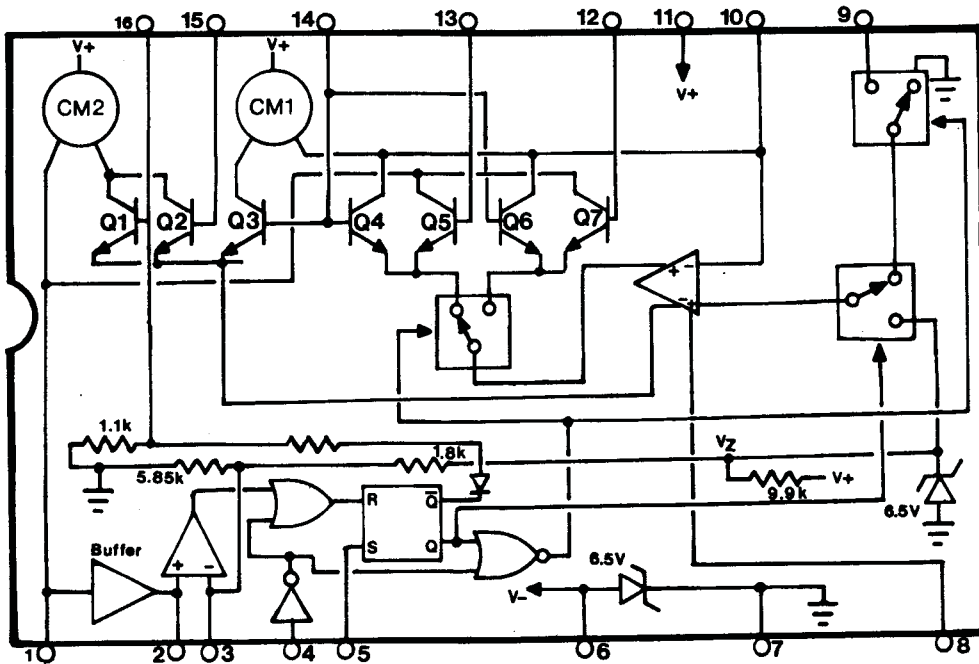
PROTEUS CARD CALIBRATION

Calibration of the PROTEUS synthesizer card is covered in detail in the applications manual for the device which uses the card, but in the interest of completeness calibration objectives will be reviewed here.

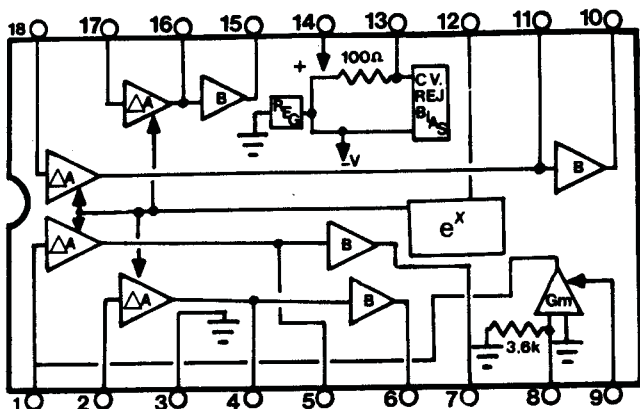
NAME	PART #	CALIBRATION
SUSTAIN	R175	Adjust so that the voltage at pin 9 of IC12 is the same as the voltage reached at the end of the Envelope Generator's Attack cycle.
#1 SCALE	R12	Adjust to set control response to lv./oct. (or other exponential scale response as desired).
#1 HIGH	R9	Adjust to compensate for the tendency of the CEM 3340 VCO chips to go slightly flat at frequencies above 5 kHz.
#2 SCALE	R55	Same as #1 SCALE above.
#2 HIGH	R82	Same as #1 HIGH above.
UNISON	R123	Adjust so that the frequencies of VCO #1 and VCO #2 are the same when parameter word \$C is \$2 (0010 in binary) and parameter word \$A is \$0 (0000 in binary).
KBD Trans.	R43	Adjust for octave changes in frequency of VCO #2 (pin 10, IC2) as transpose is increased.
VCO #2 Trans.	R83	Adjust for octave changes in output frequency of VCO #2 (pin 10, IC2) as transpose is increased.
LFO Symmetry	R144	Adjust for symmetrical triangle at pin 4 of IC14 or for 50% duty factor of the square wave at pin 3 of IC14. Since symmetry errors are most prominent at low current flows from the VCA stage used as the LFO control element, adjust at the lowest frequency possible.
VCA Offset	R163	Adjust so that the output waveform remains balanced about ground as volume is increased or when ADSR Envelope Generator is triggered.
VCO Modulation	R37	Select LFO modulation of VCO #1. Set R37 so that the waveform which appears at pin 6 IC16 is balanced about ground as modulation level is increased.
VCF Modulation	R130	Select LFO modulation of Filter. Set R130 so that the waveform which appears at pin 6 IC15 is balanced about ground as modulation level is increased.
SINE sym.	R26	Adjust for lowest distortion sine wave at pin 6 IC3.

CURTIS SYNTHESIZER CHIP SET

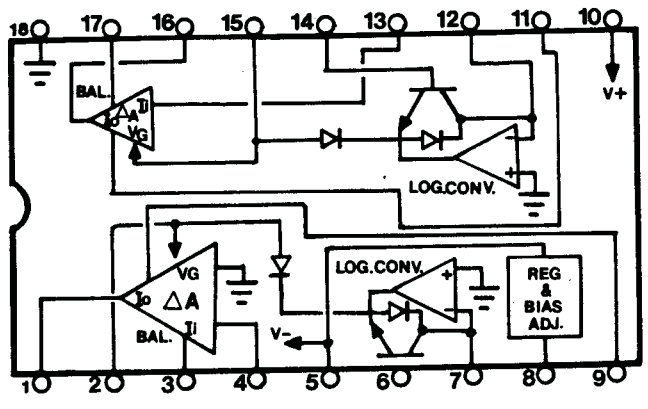
PIN-OUTS



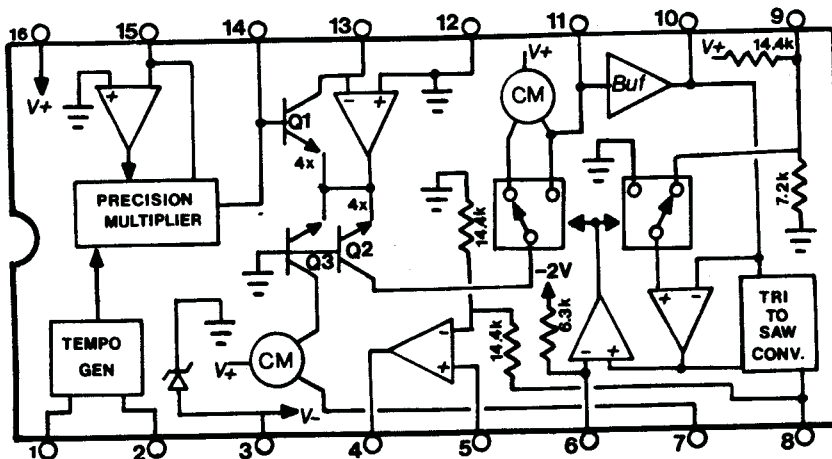
CEM 3310 VOLTAGE CONTROLLED ENVELOPE GENERATOR



CEM 3320 VOLTAGE CONTROLLED FILTER



CEM 3330 DUAL VOLTAGE CONTROLLED AMPLIFIER



CEM 3340 VOLTAGE CONTROLLED OSCILLATOR