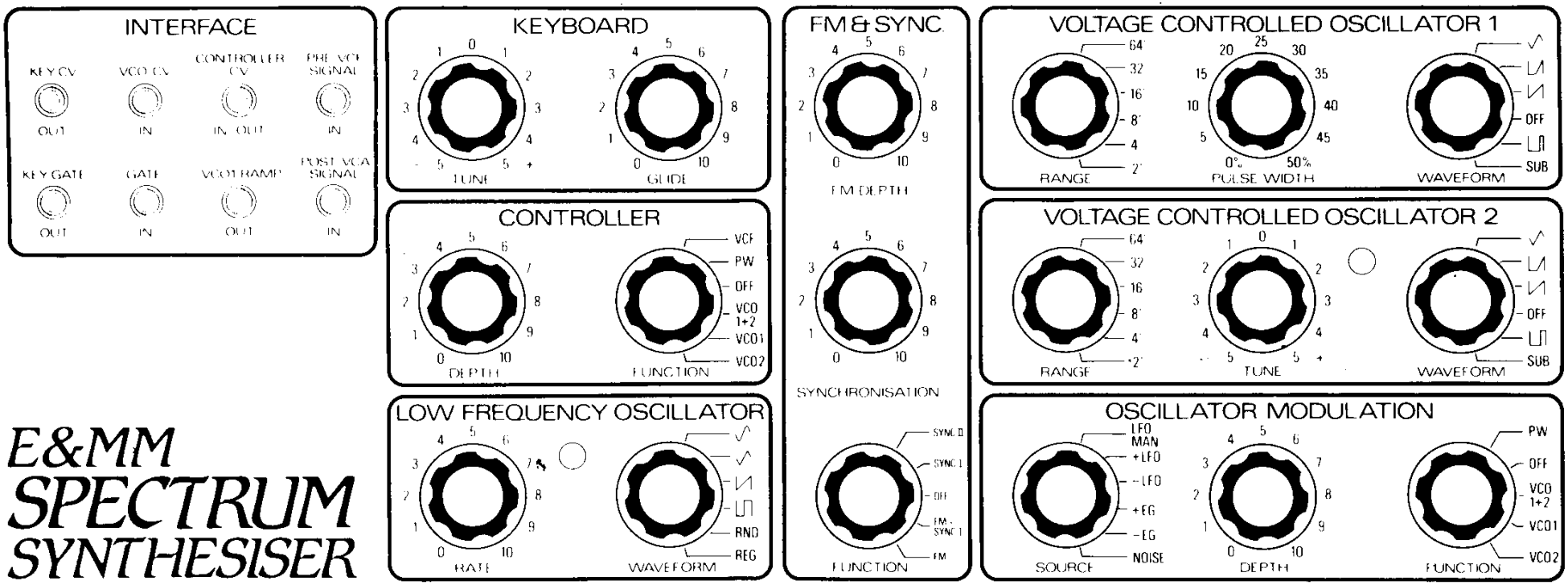
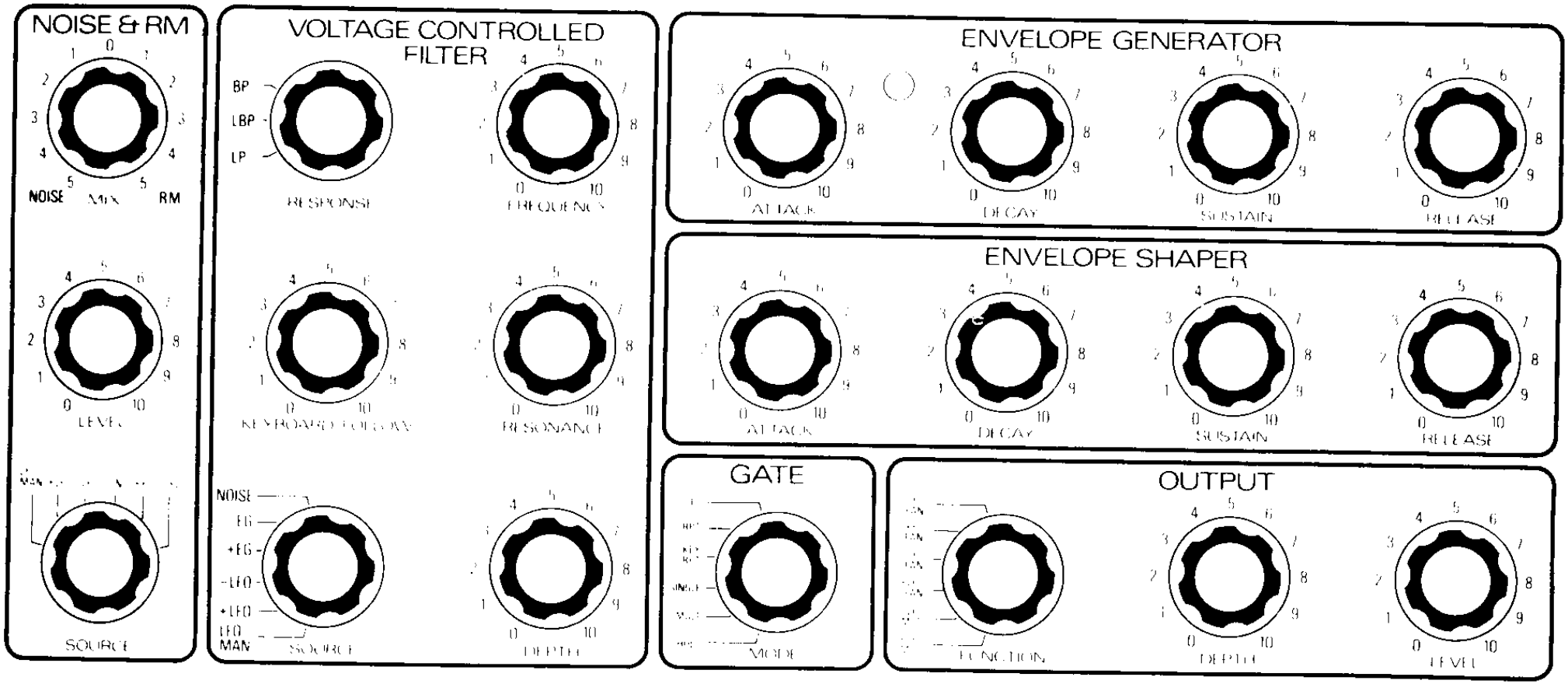
The SPECTRUM SYNTHESISER

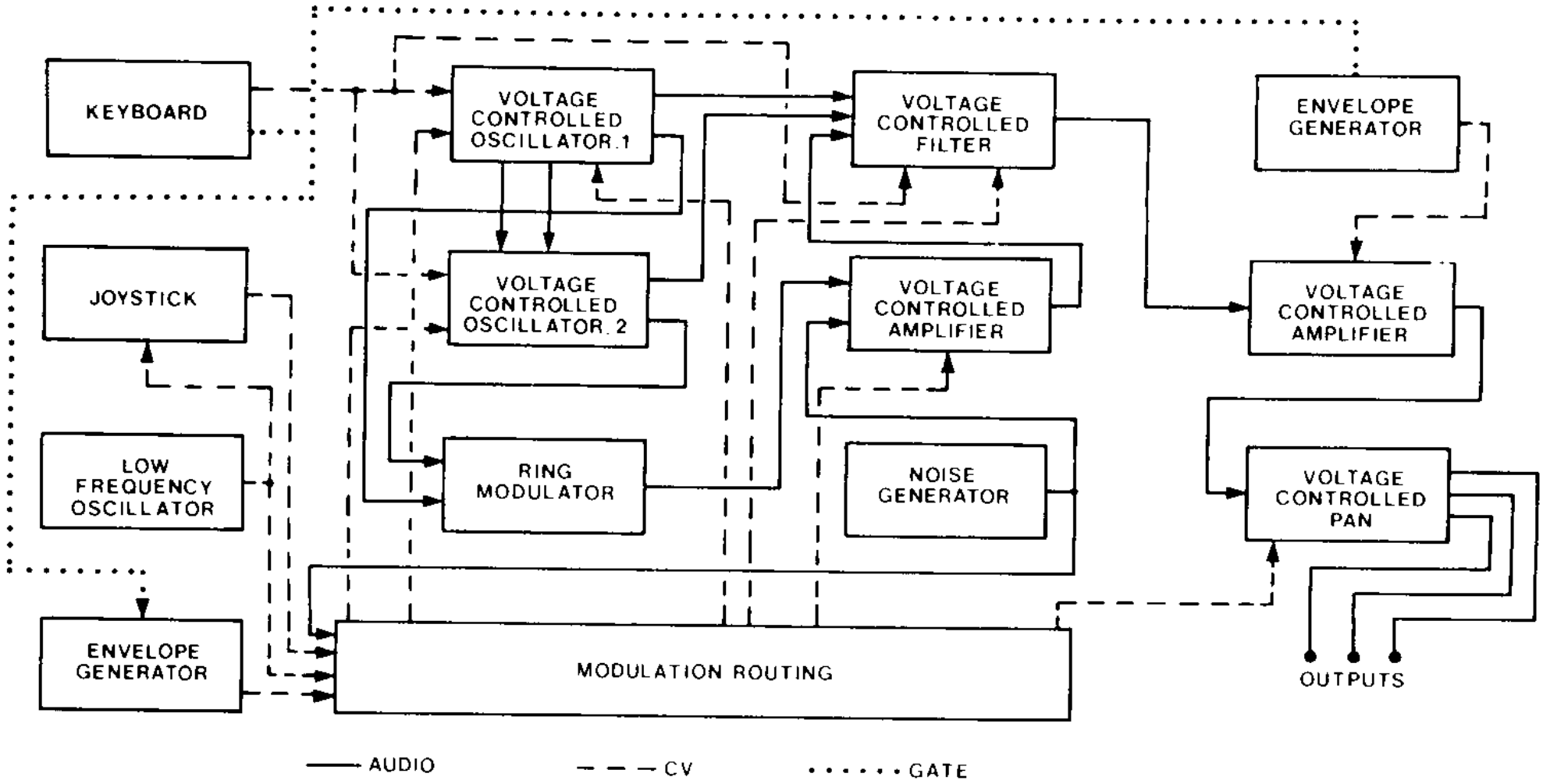


★ Low Cost
★ FM and Sync.
★ Stereo Outputs
★ Sequencer Effects
★ Easy to Construct
★ Interface Facilities
★ Four Octave Keyboard
★ Performance Controller



E&MM SPECTRUM SYNTHESISER


NOISE & RM
NOISE
MIX
RM
LEVEL
SOURCE
VOLTAGE CONTROLLED FILTER
BP
LBP
LP
RESPONSE
FREQUENCY
KEYBOARD FOLLOW
RESONANCE
NOISE
EG
+EG
-EG
+LFO
LFO MAN
SOURCE
DEPTH
ENVELOPE GENERATOR
ATTACK
DECAY
SUSTAIN
RELEASE
ENVELOPE SHAPER
ATTACK
DECAY
SUSTAIN
RELEASE
GATE
MODE
OUTPUT
FUNCTION
DEPTH
LEVEL


KEYBOARD
VOLTAGE CONTROLLED OSCILLATOR 1
VOLTAGE CONTROLLED FILTER
ENVELOPE GENERATOR
JOYSTICK
VOLTAGE CONTROLLED OSCILLATOR 2
VOLTAGE CONTROLLED AMPLIFIER
VOLTAGE CONTROLLED AMPLIFIER
LOW FREQUENCY OSCILLATOR
RING MODULATOR
NOISE GENERATOR
VOLTAGE CONTROLLED PAN
ENVELOPE GENERATOR
MODULATION ROUTING
OUTPUTS
AUDIO
CV
GATE

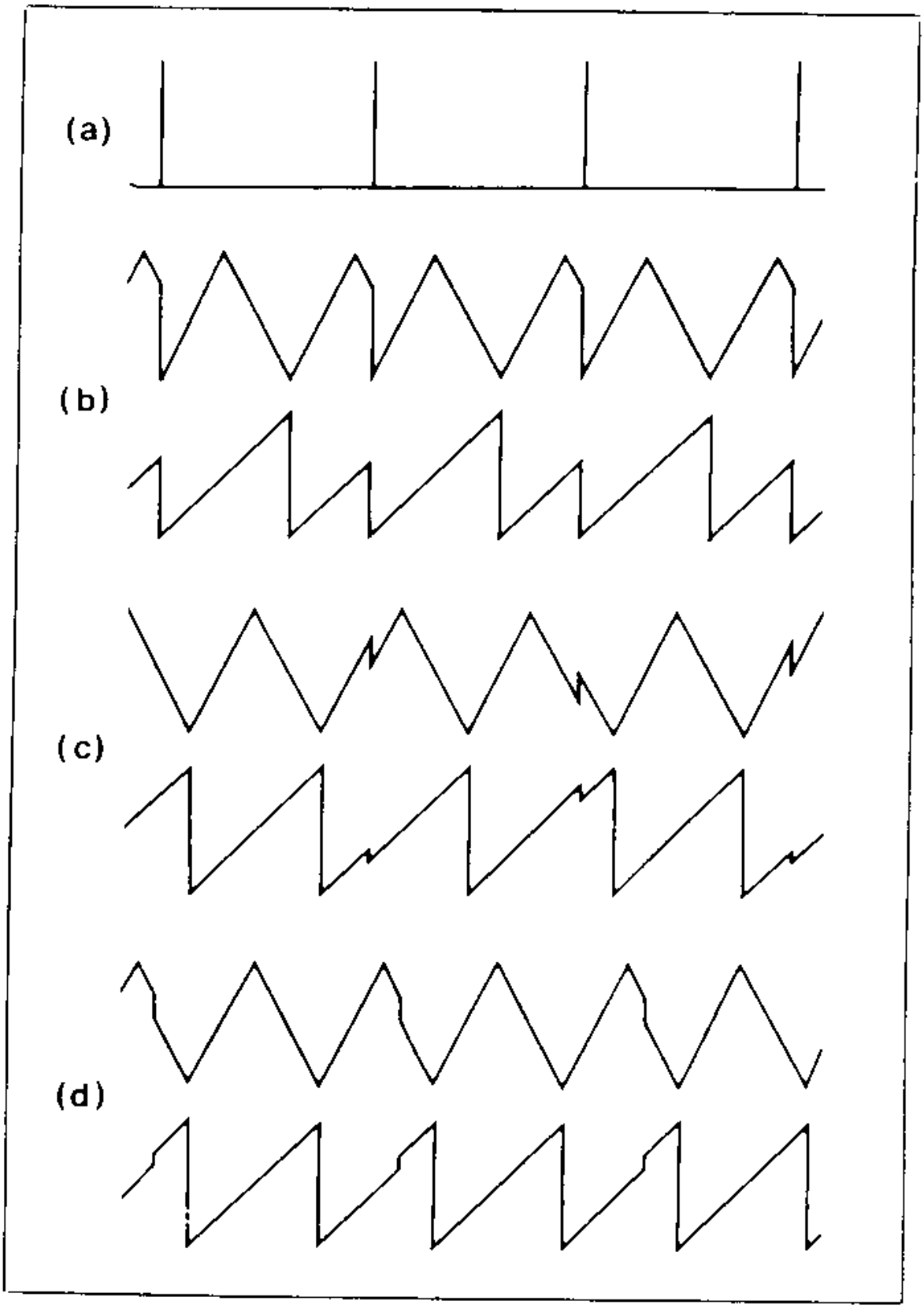


Figure 2. Sync. waveforms. (a) Sync. pulses. (b) Sync. I. (c) Sync. II. (d) Sync. II with decreased VCO1 frequency.

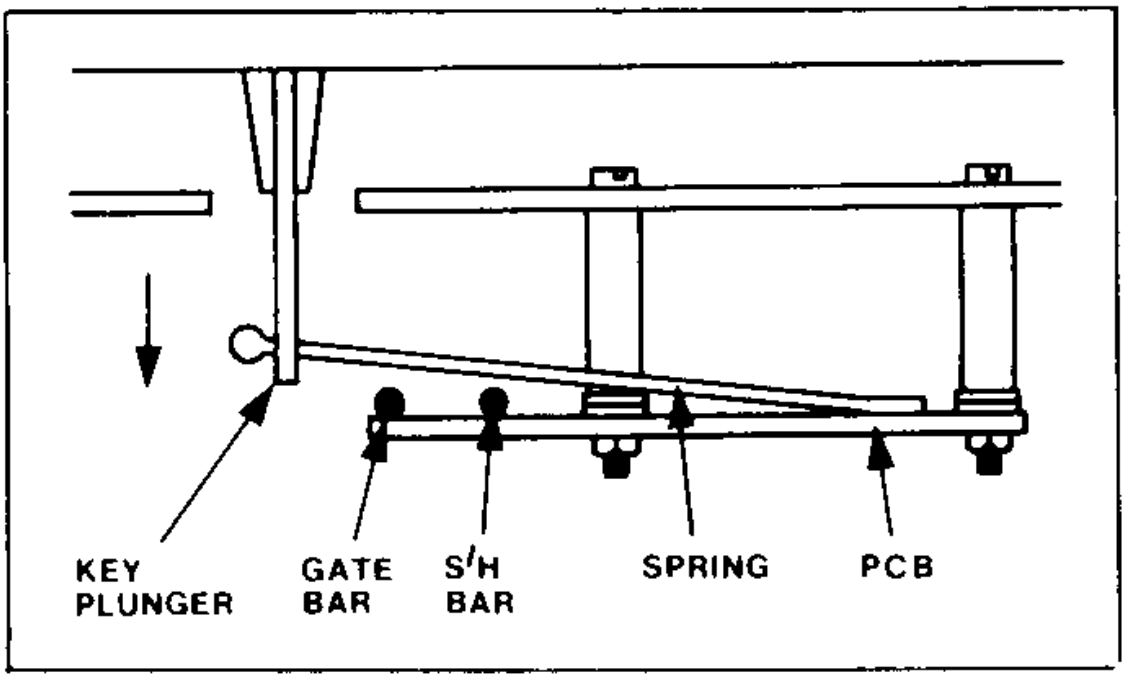


Figure 3. Key contact construction.

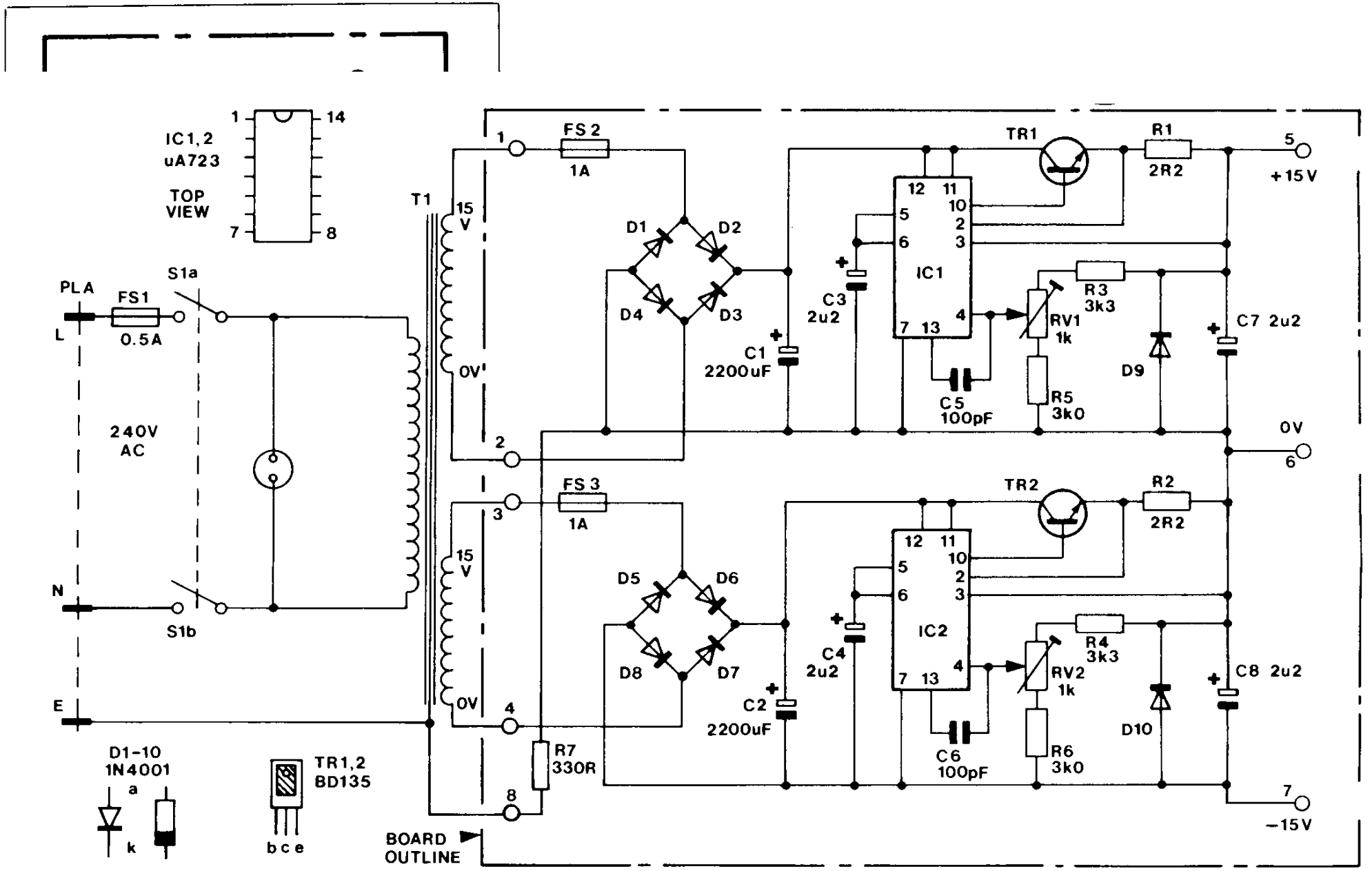


Figure 5. Power supply circuit.

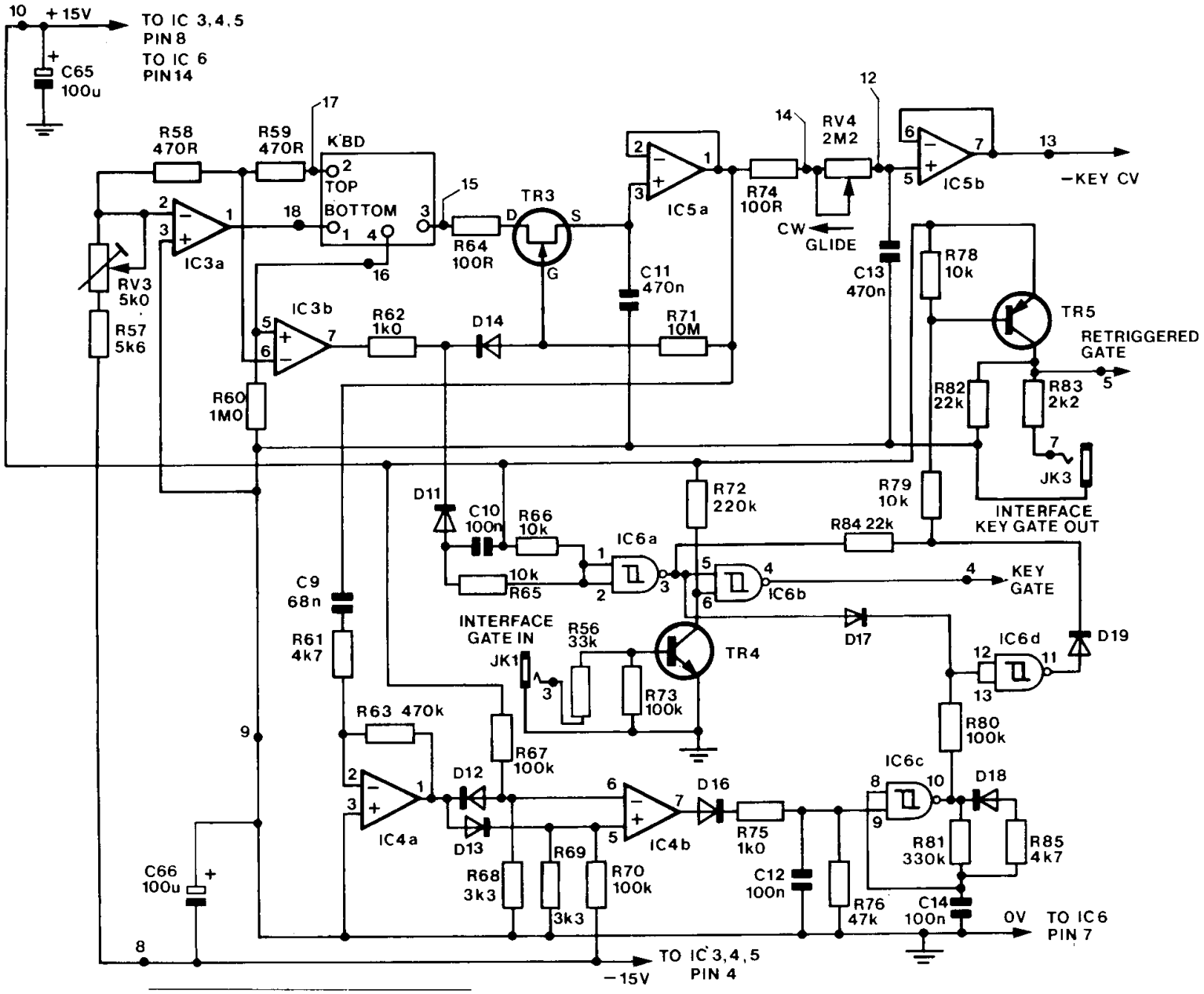


Figure 6. Keyboard controller circuit.

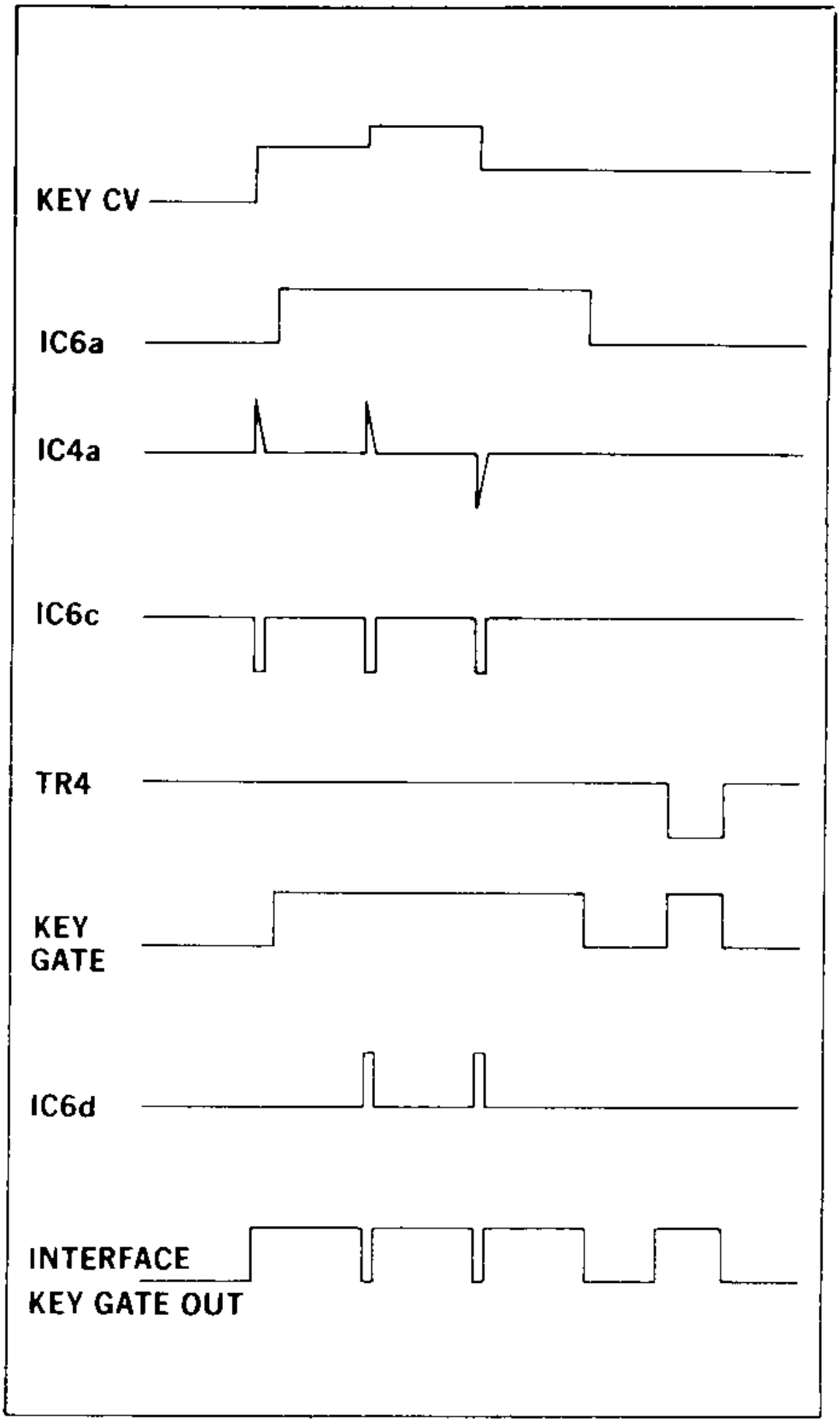


Figure 7. Keyboard controller signals.

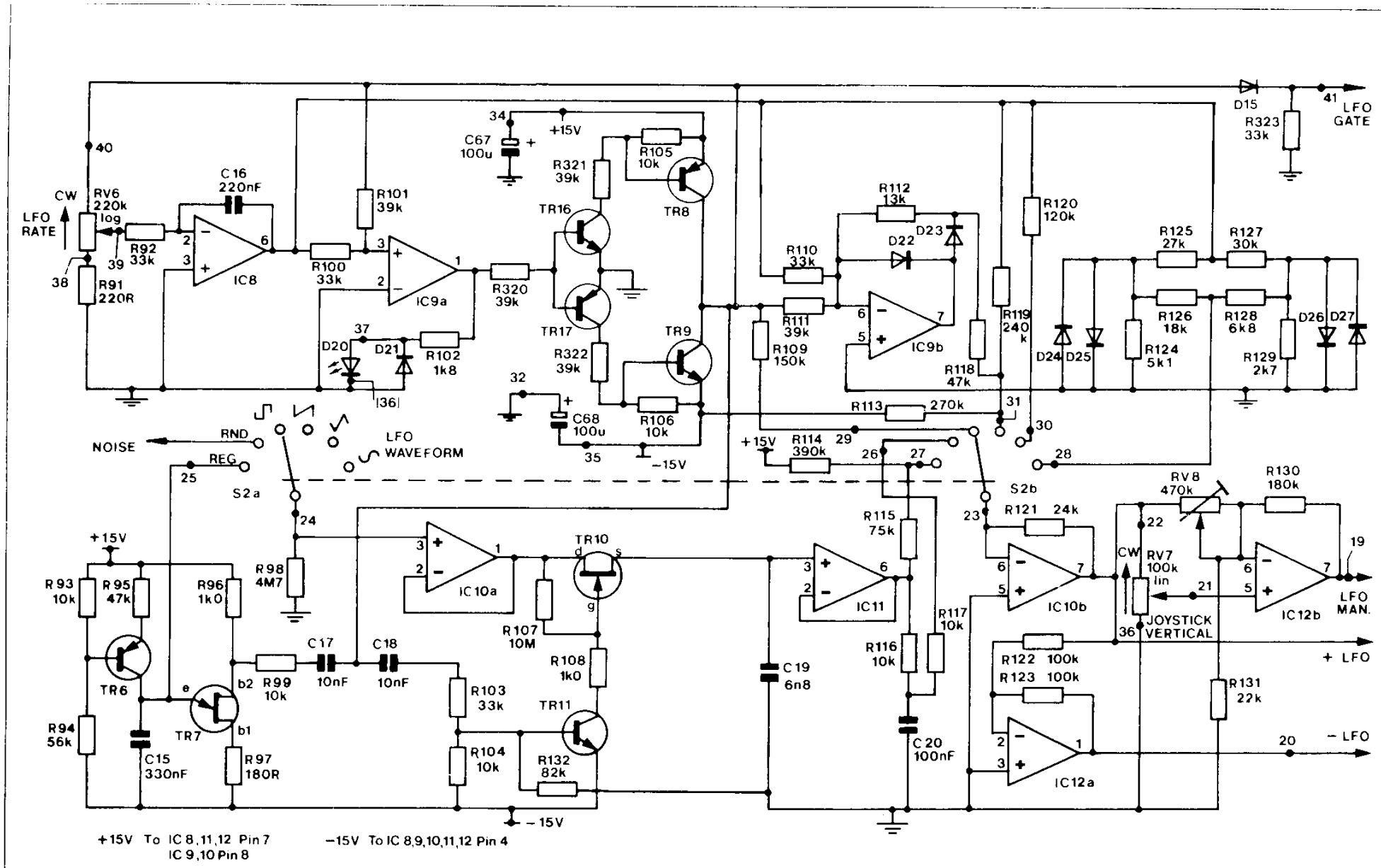


Figure 8. Low frequency oscillator circuit diagram.

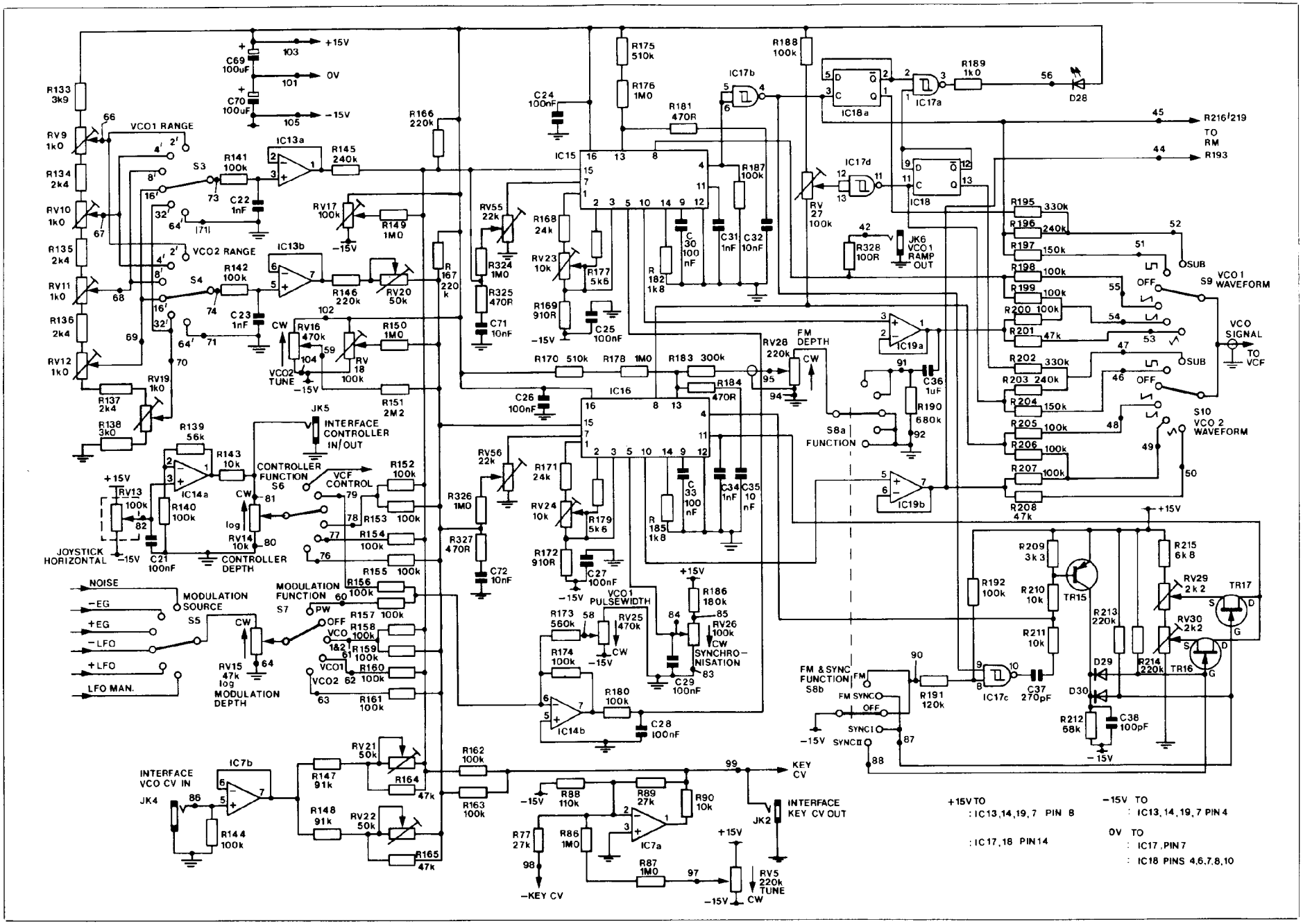
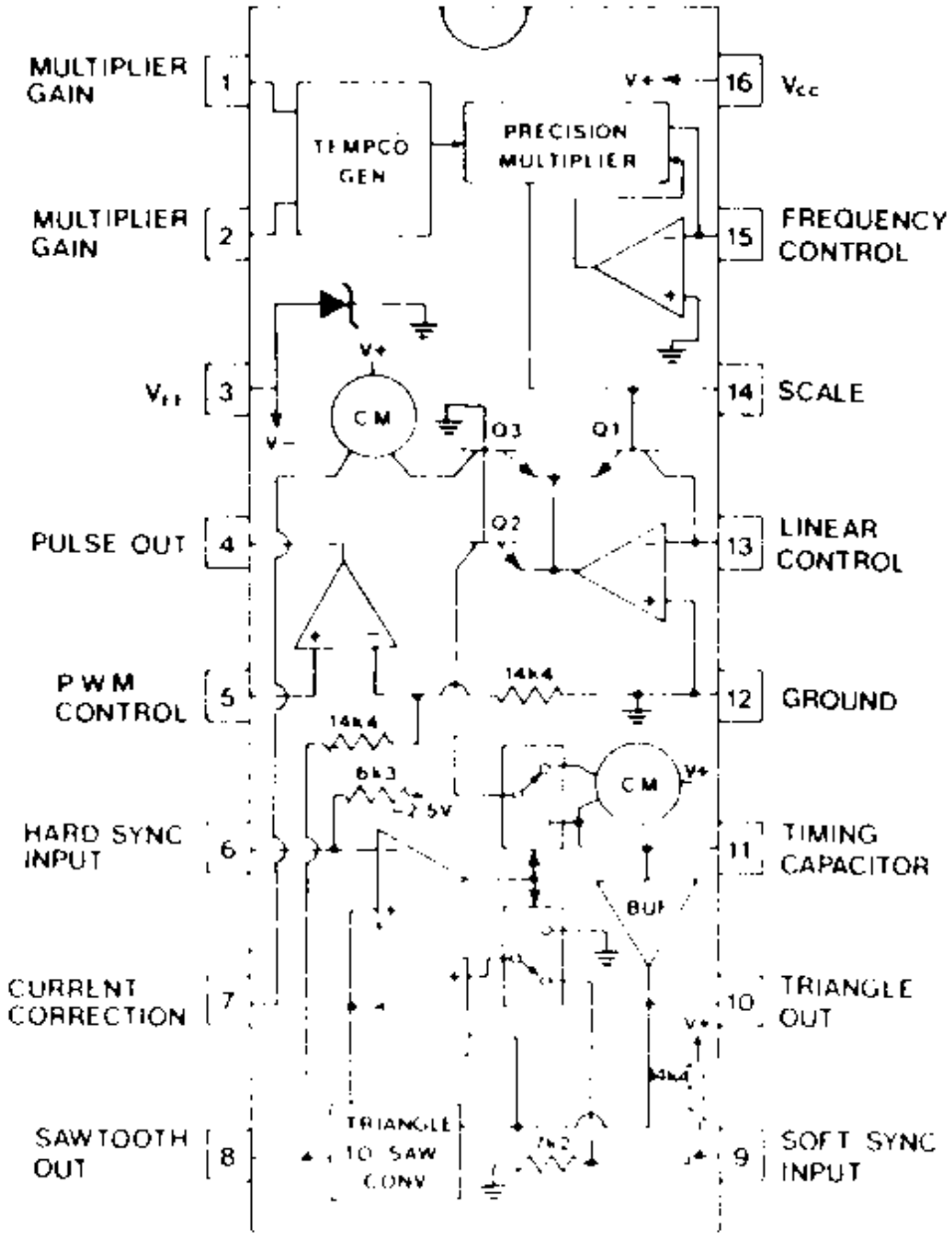


Figure 9. VCOs and their associated circuits.



CEM 3340 V.C.O.

Figure 10. The CEM 3340.

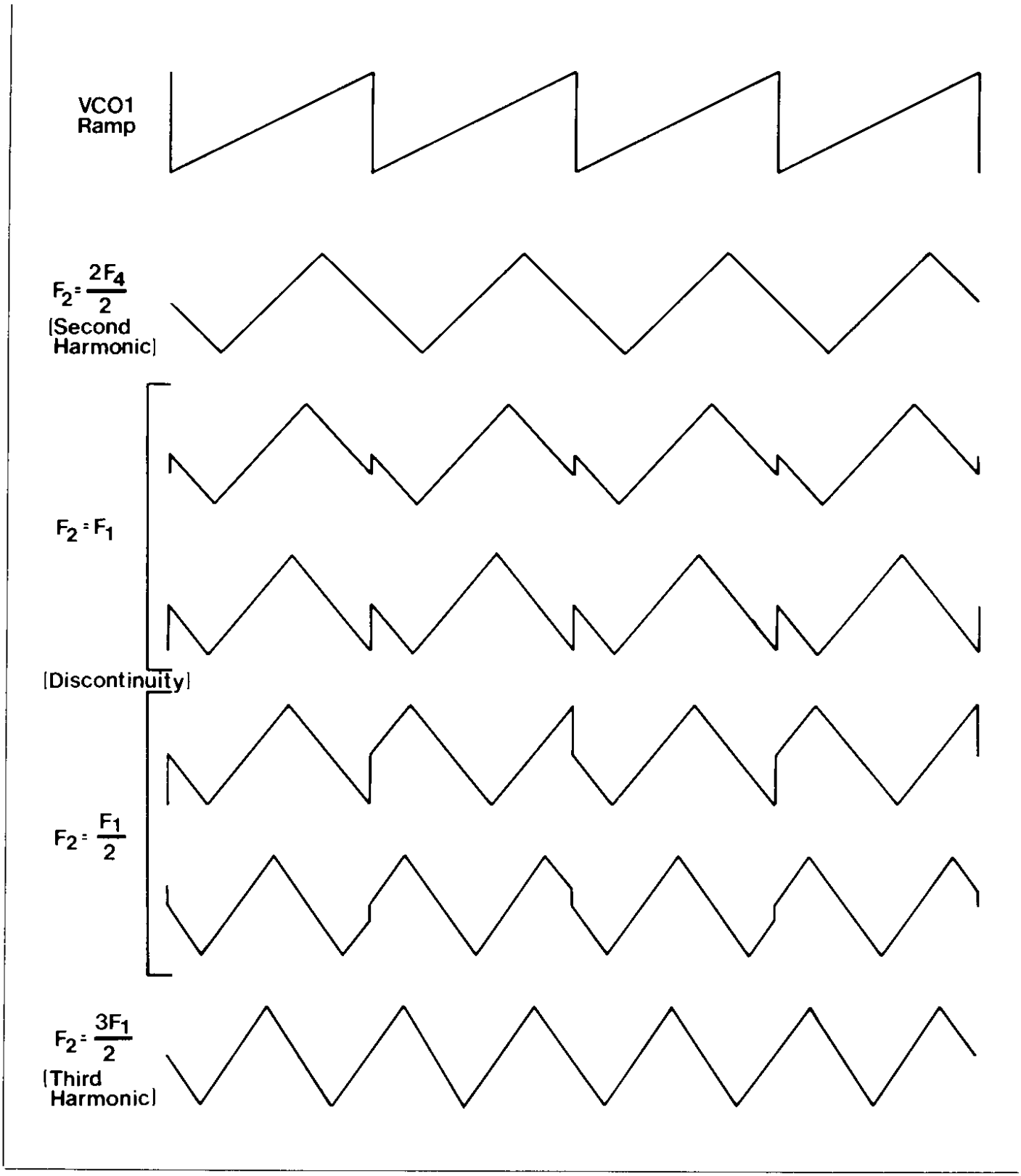


Figure 11. Sync. II.

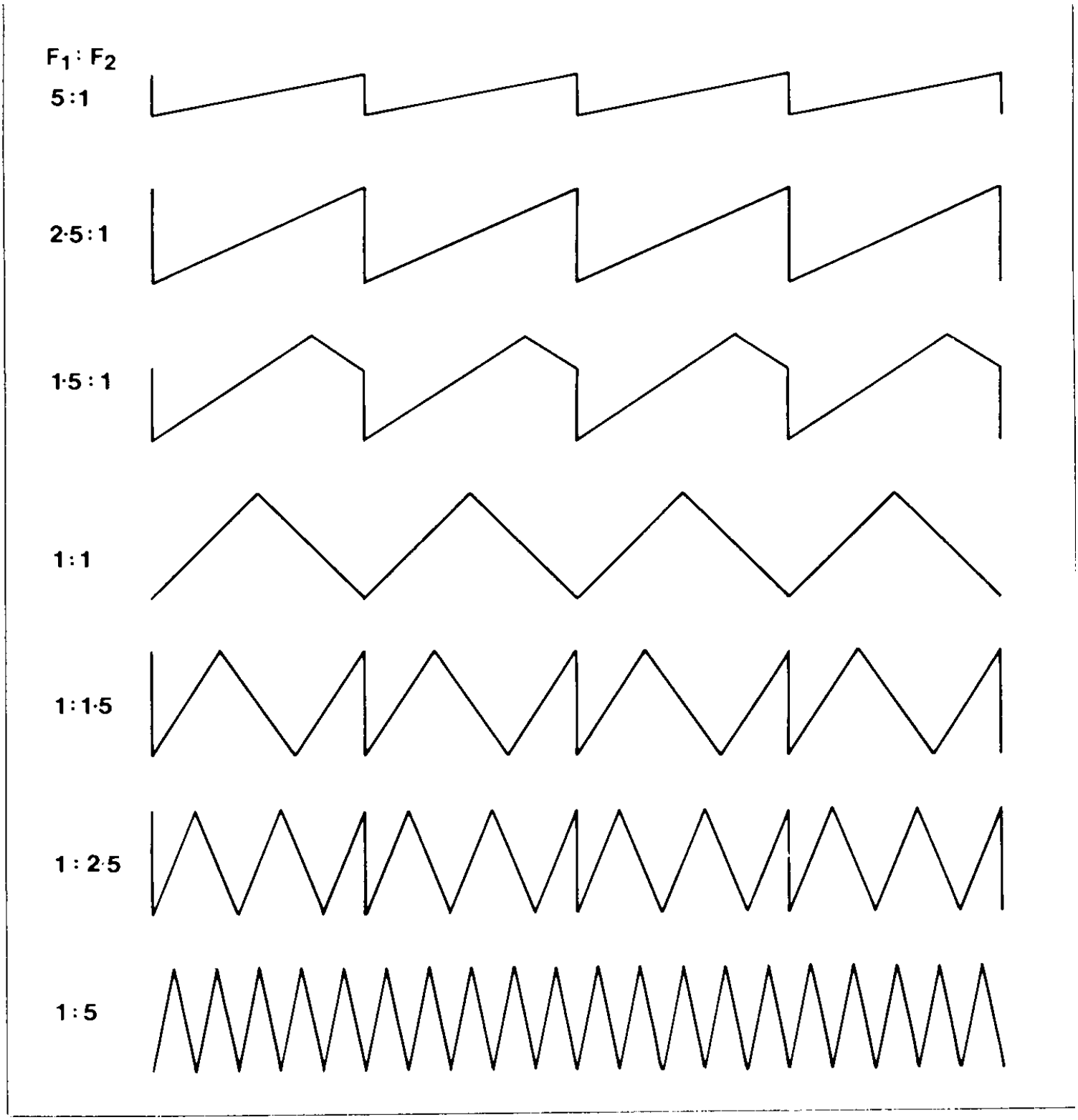


Figure 12. Sync. I.

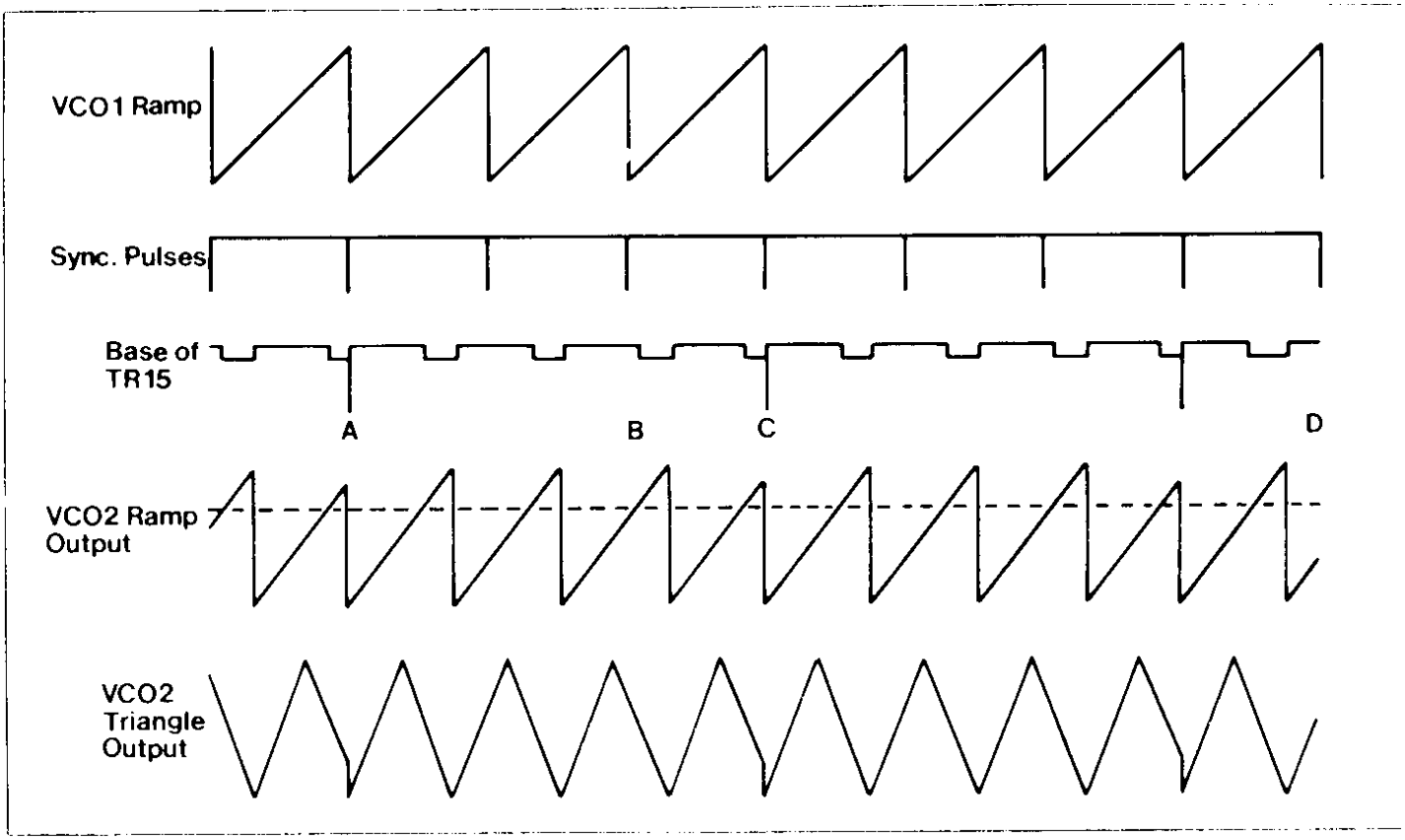


Figure 13. Soft synchronisation.

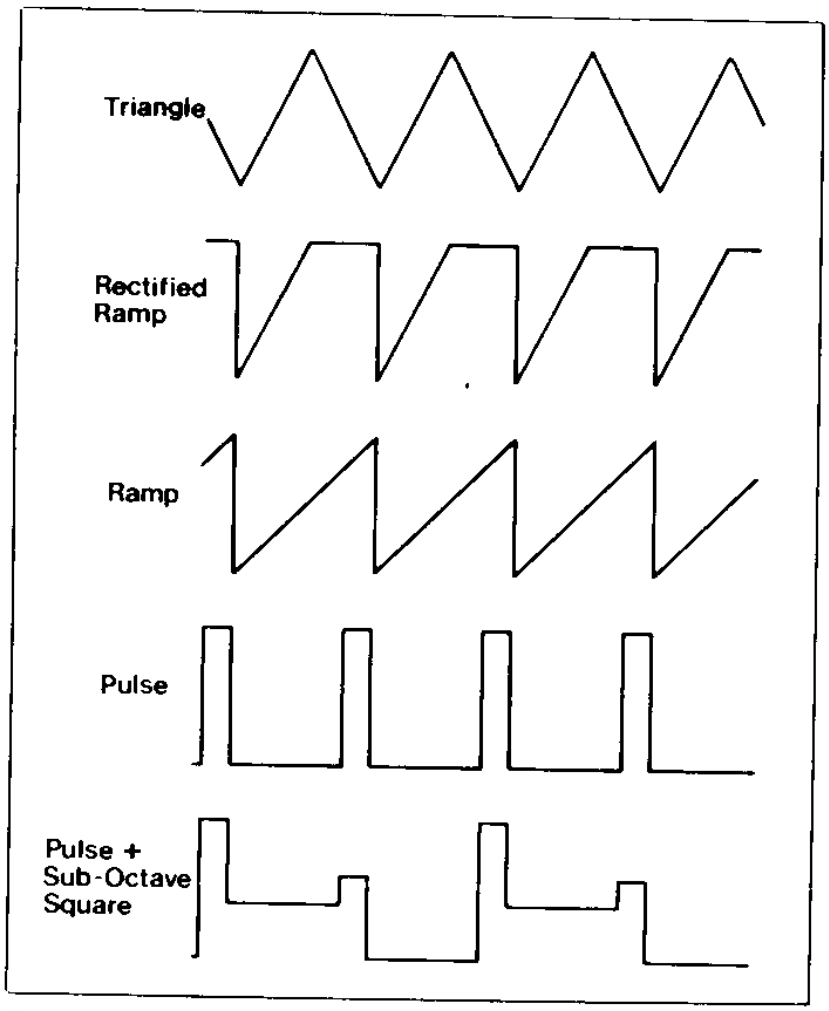


Figure 14. Basic oscillator waveforms.

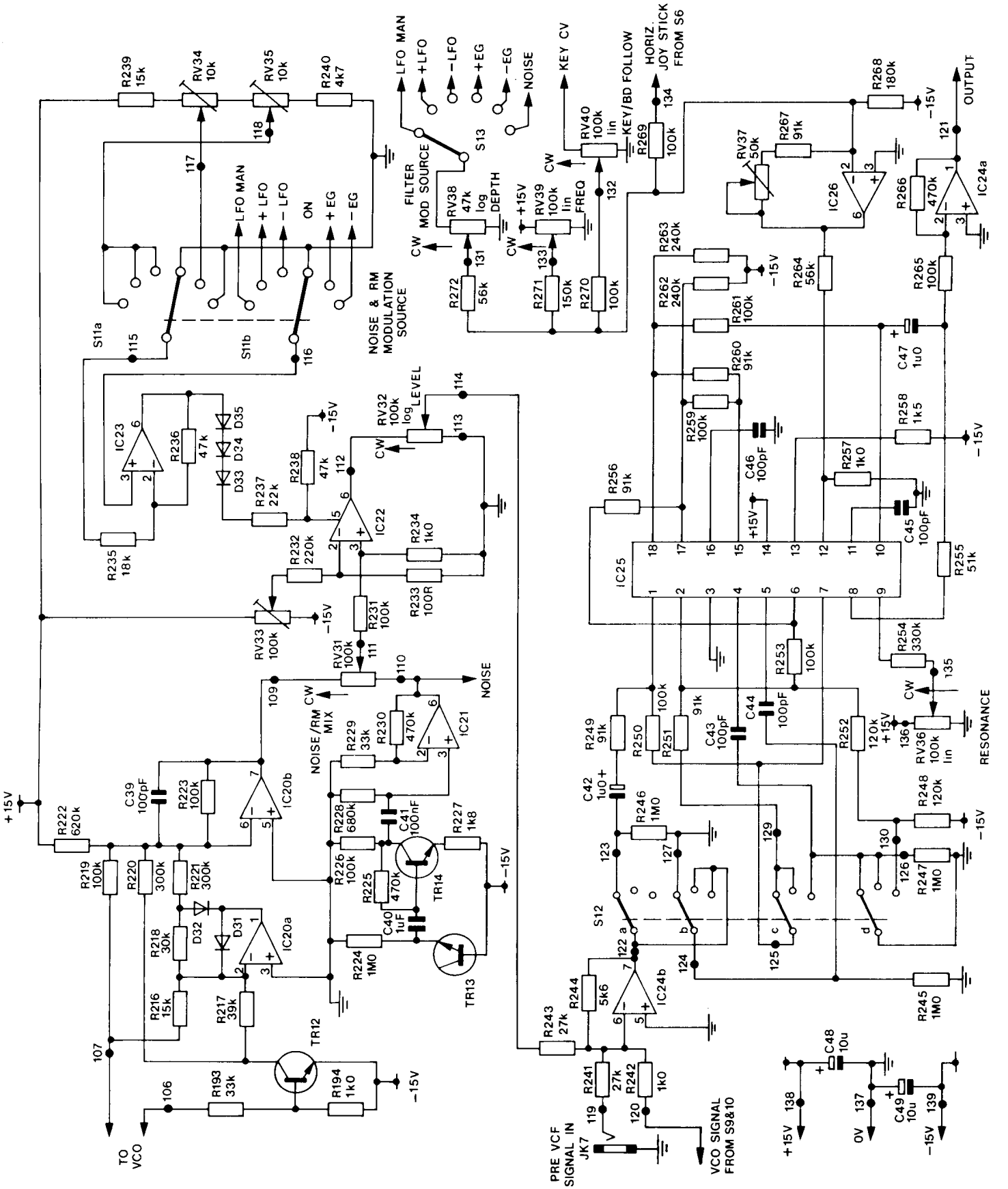


Figure 15. Circuit of the ring modulator, noise generator and filter.

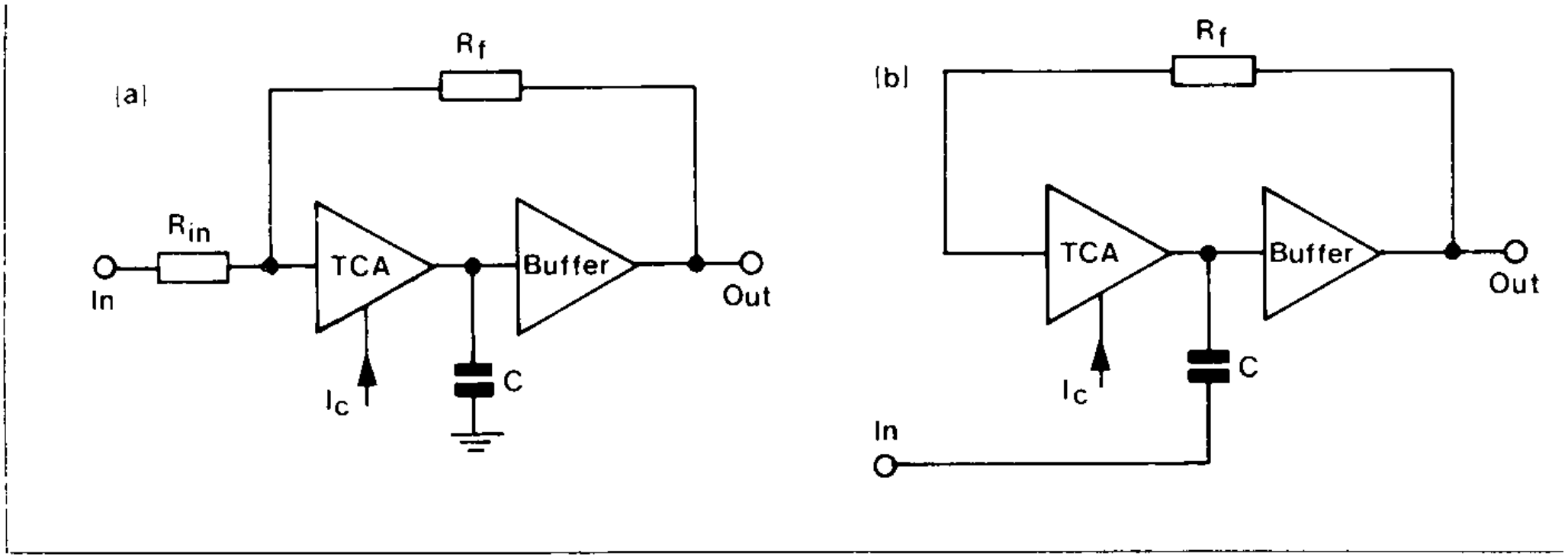


Figure 16. Single filter element of the CEM 3320. a) Low-pass. b) High-pass.

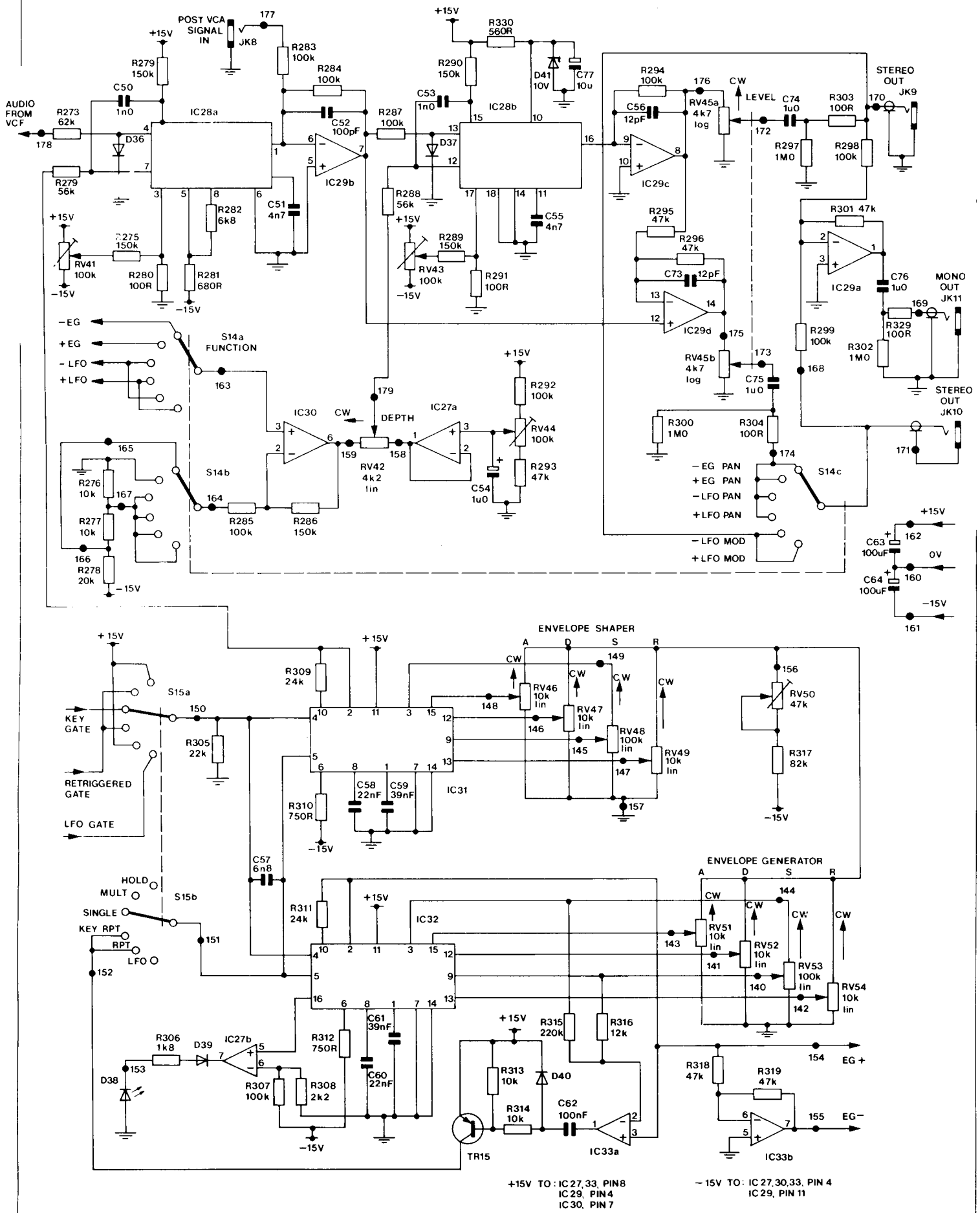


Figure 17. VCAs and envelope generators circuit diagram.

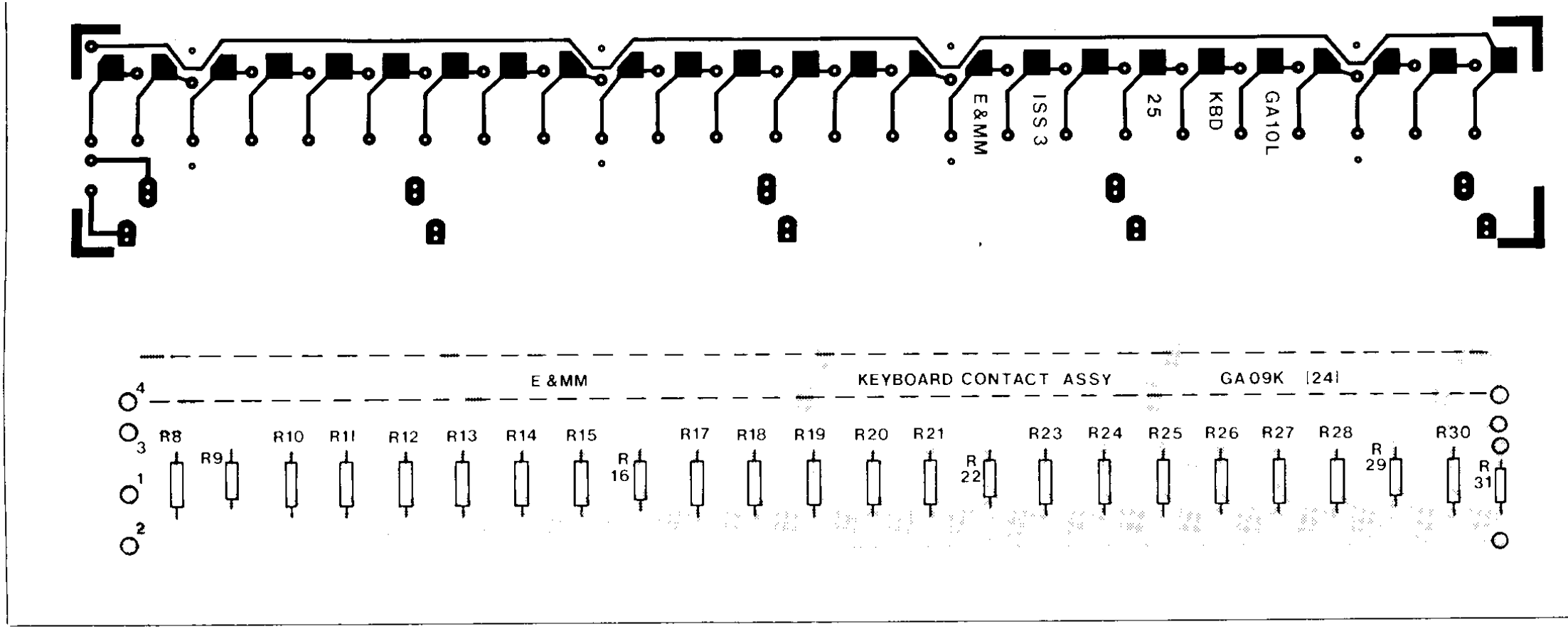
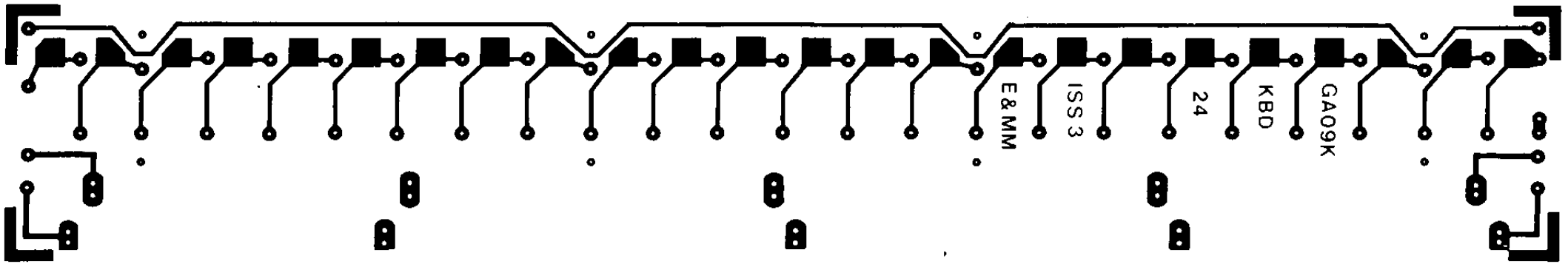
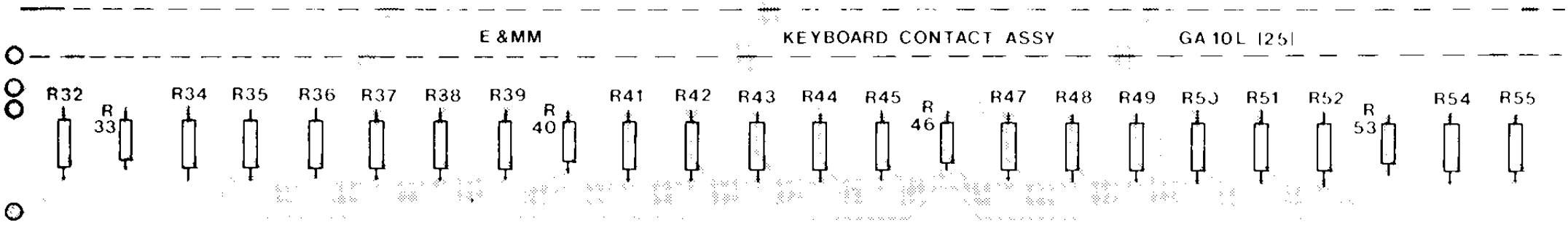


Figure 18. Keyboard PCBs reproduced half size.


E&MM
ISS 3
24
KBD
GA09K


E &MM
KEYBOARD CONTACT ASSY
GA 10L 1251
R32
R 33
R34
R35
R36
R37
R38
R39
R 40
R41
R42
R43
R44
R45
R 46
R47
R48
R49
R50
R51
R52
R 53
R54
R55

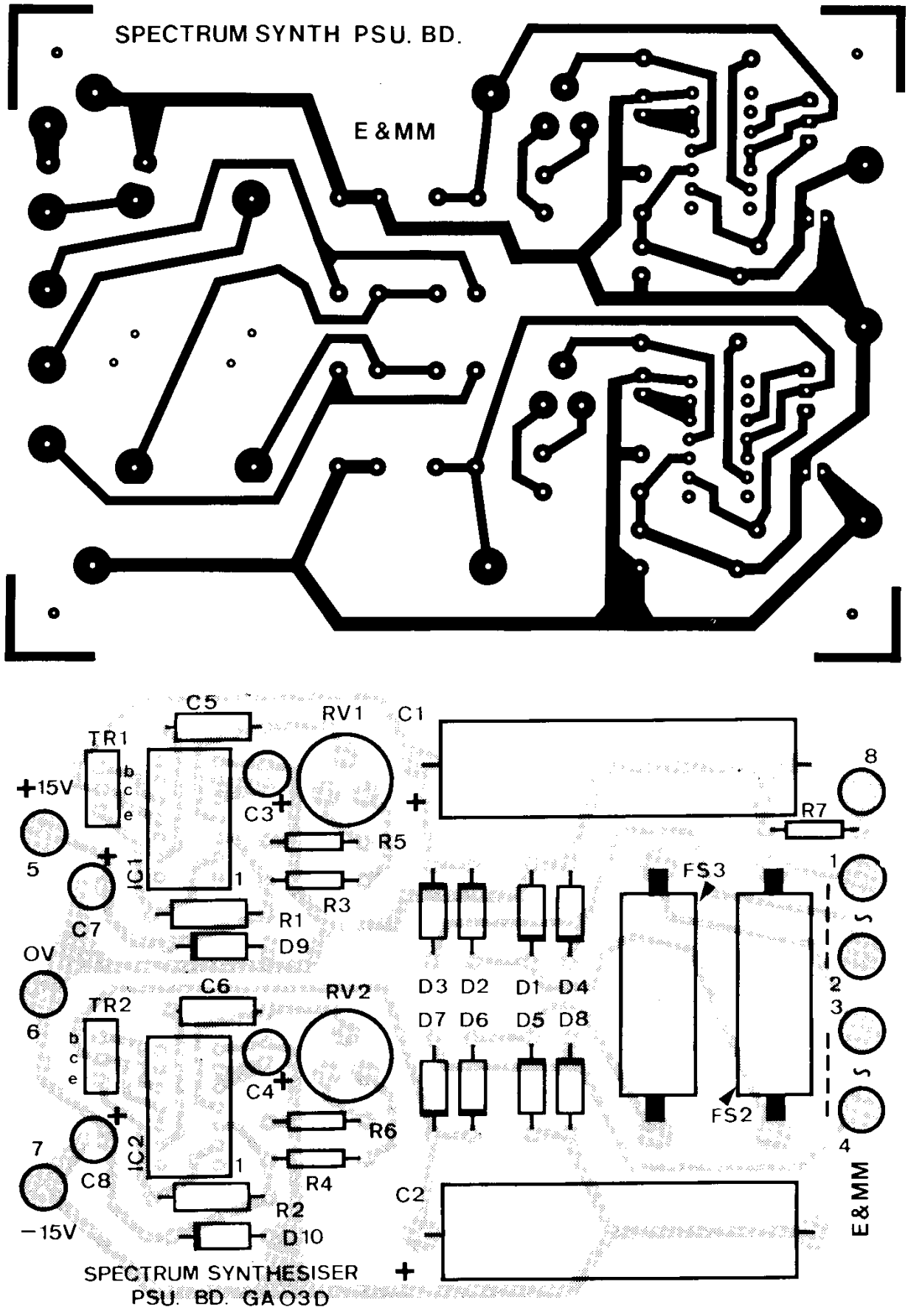


Figure 19. PSU PCB.

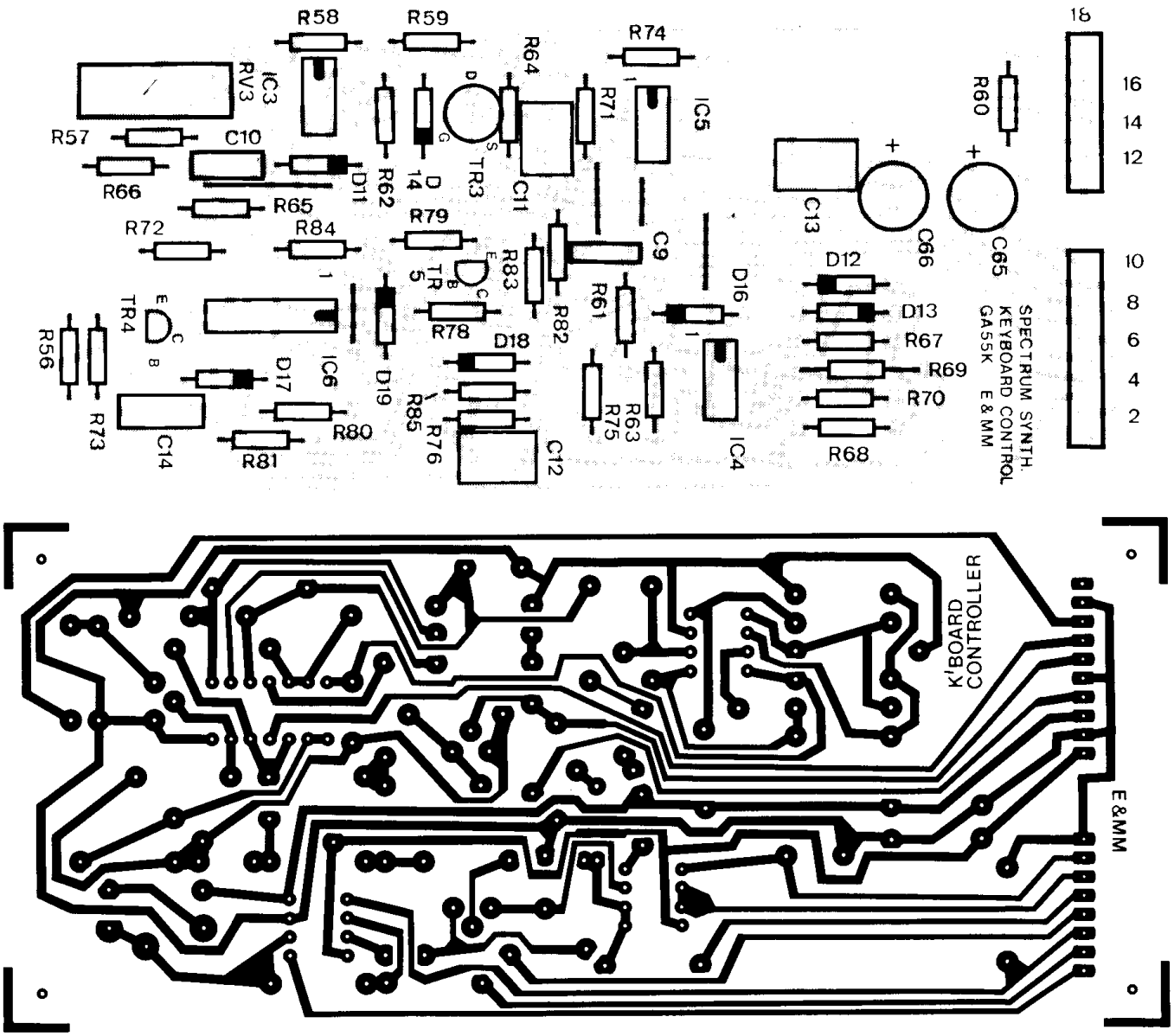


Figure 20. Keyboard controller PCB.

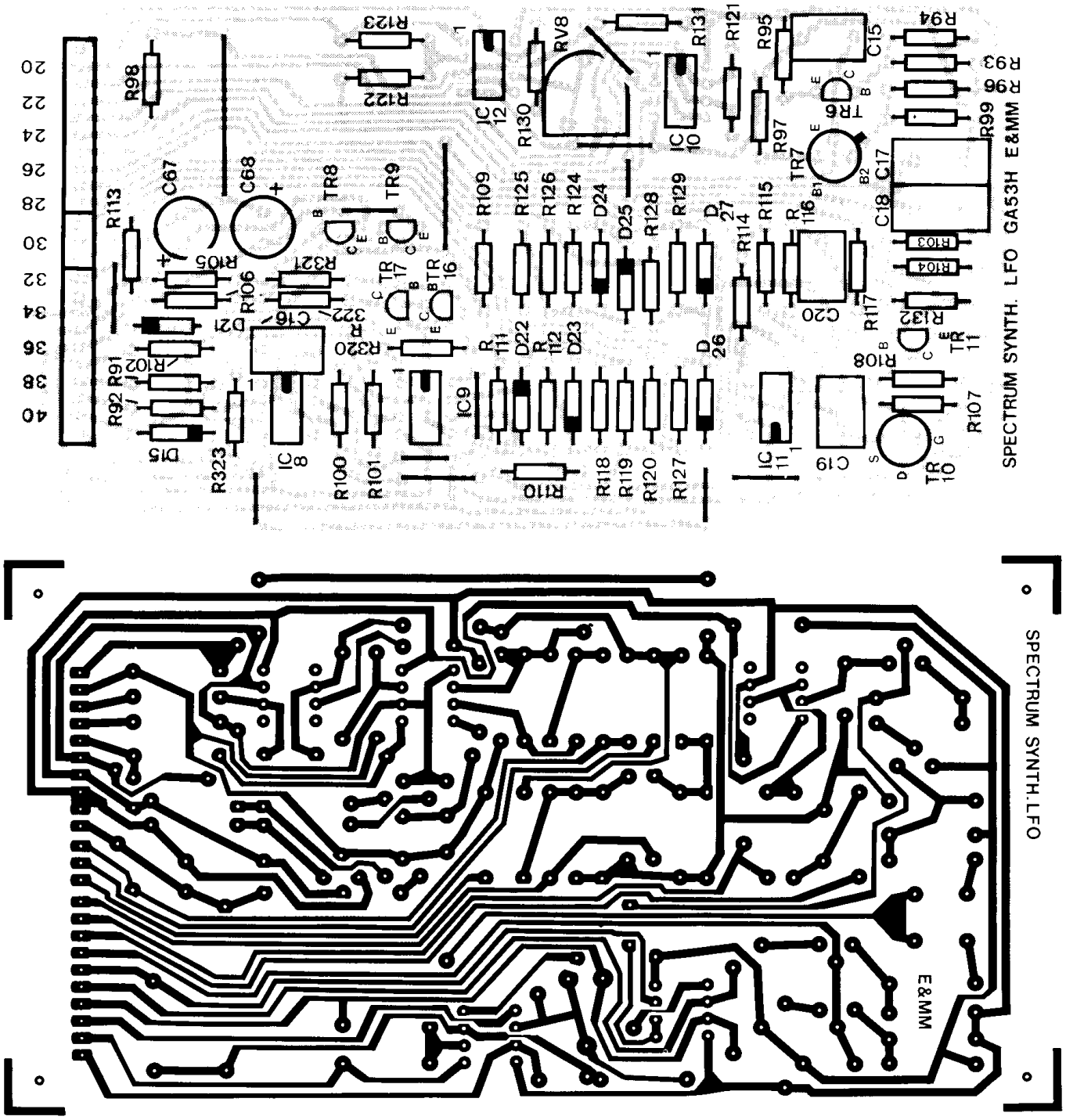


Figure 21. LFO PCB.

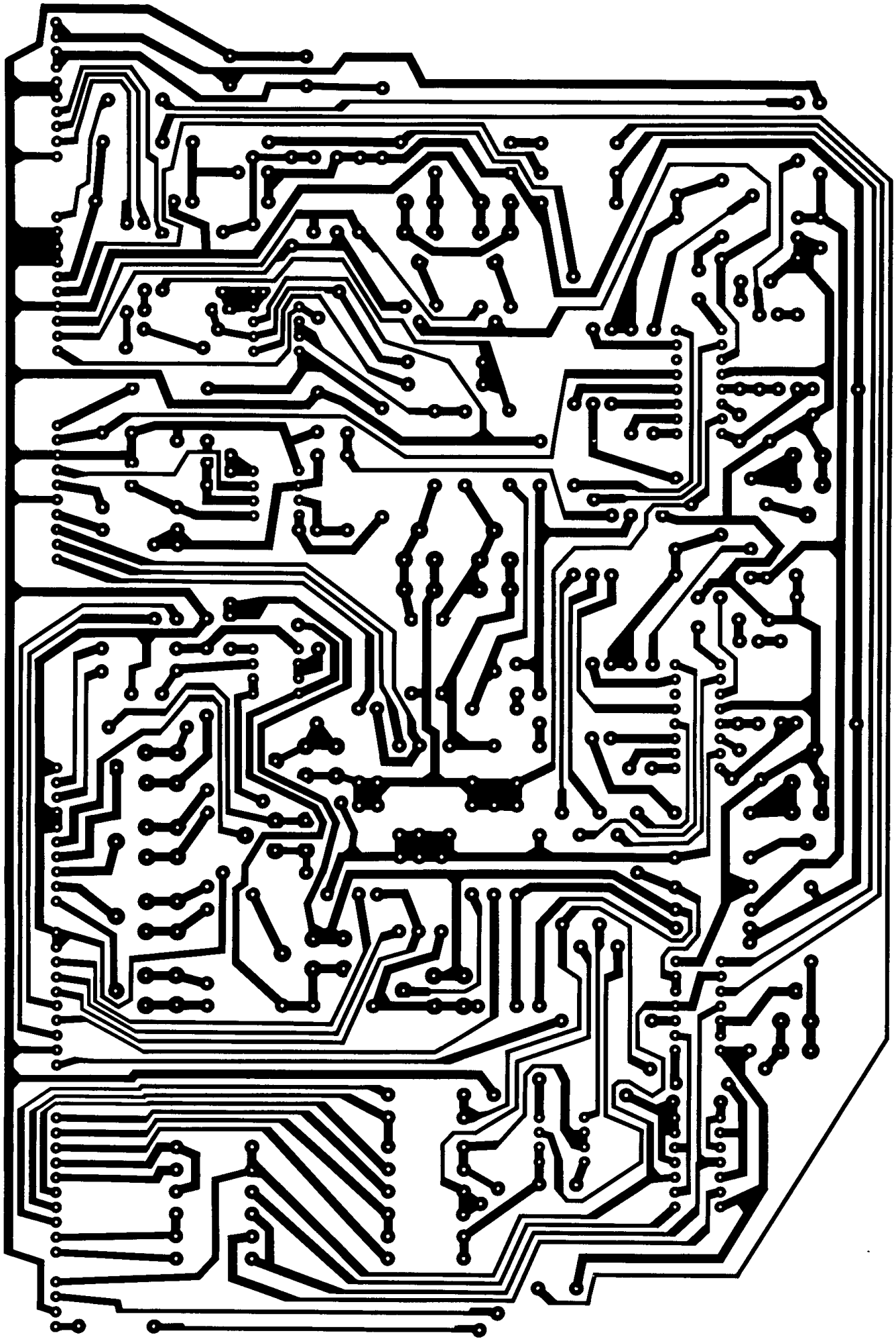
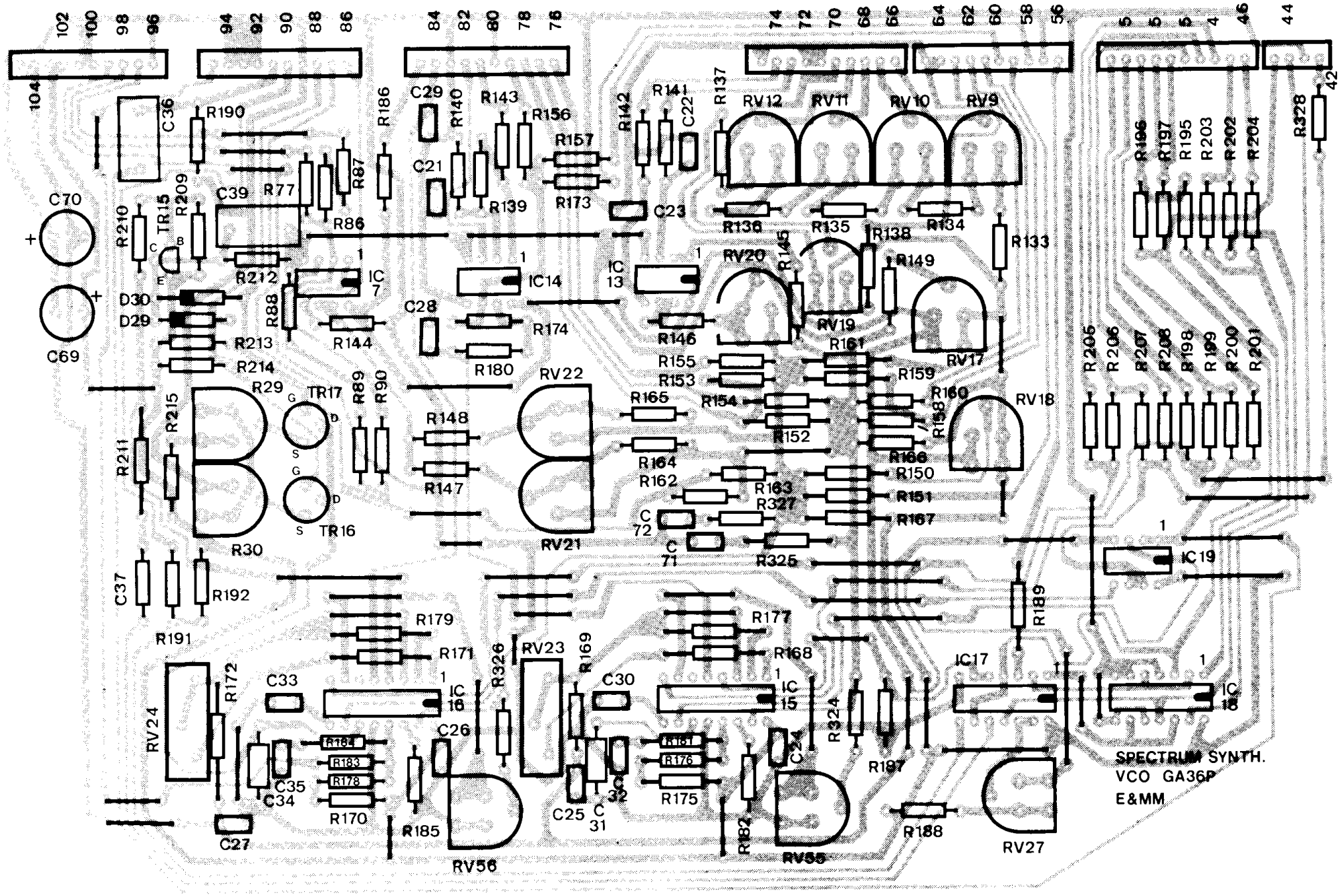
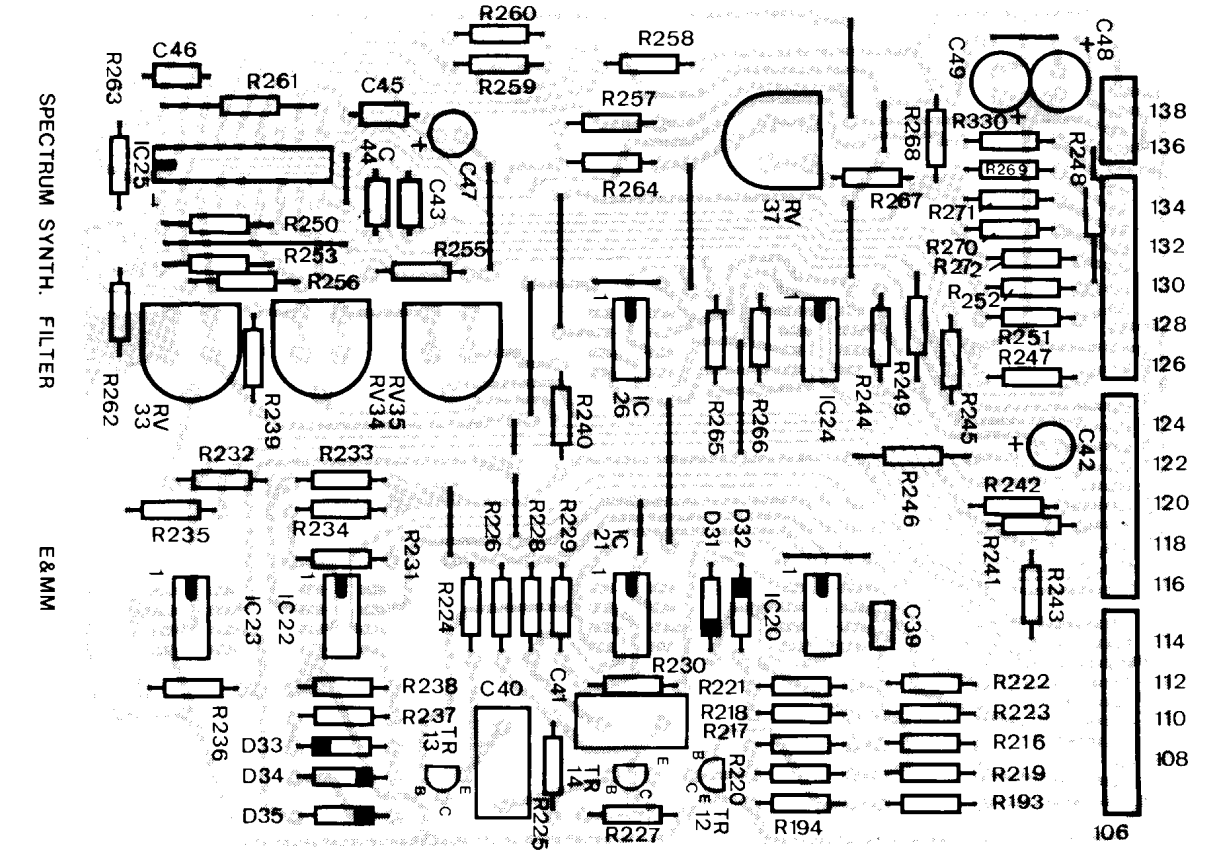


Figure 22. VCO PCB.


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VCO GA36P
E&MM



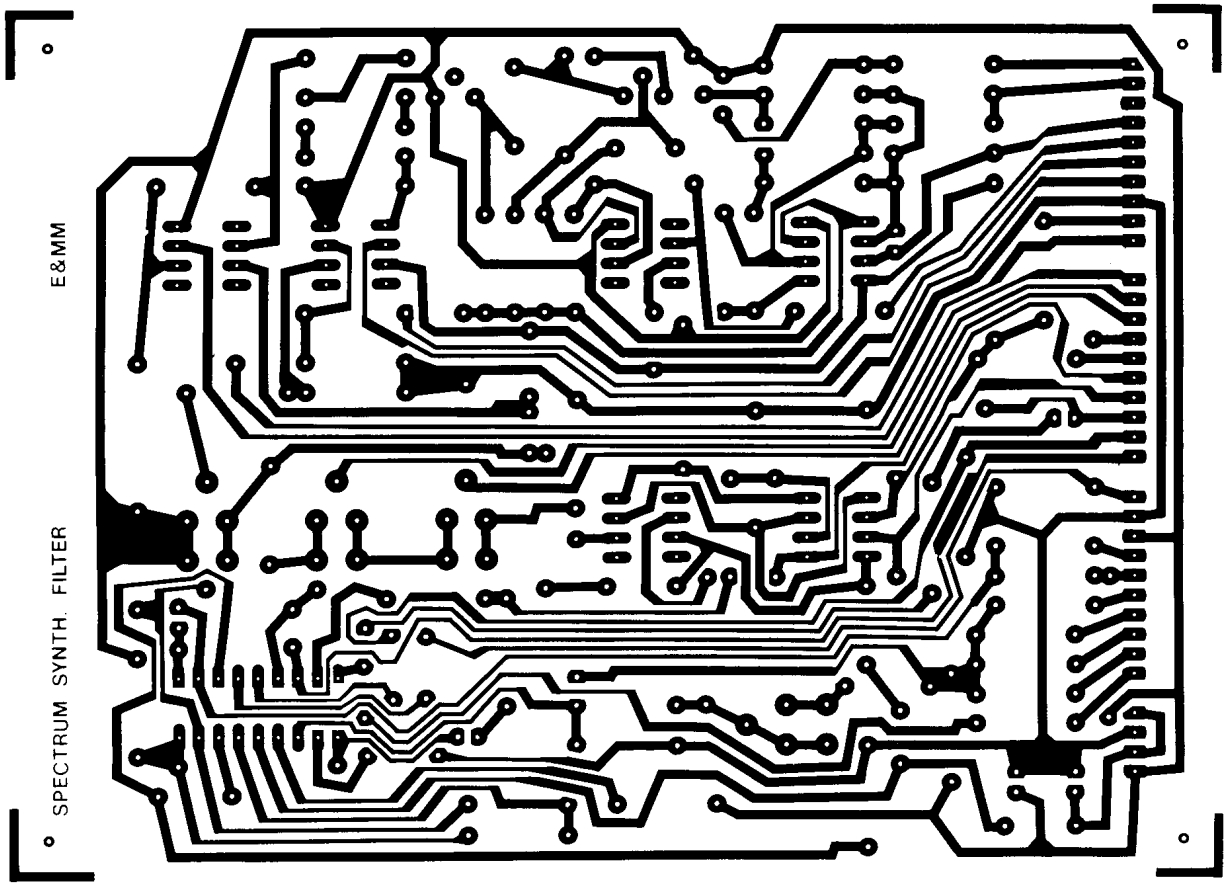
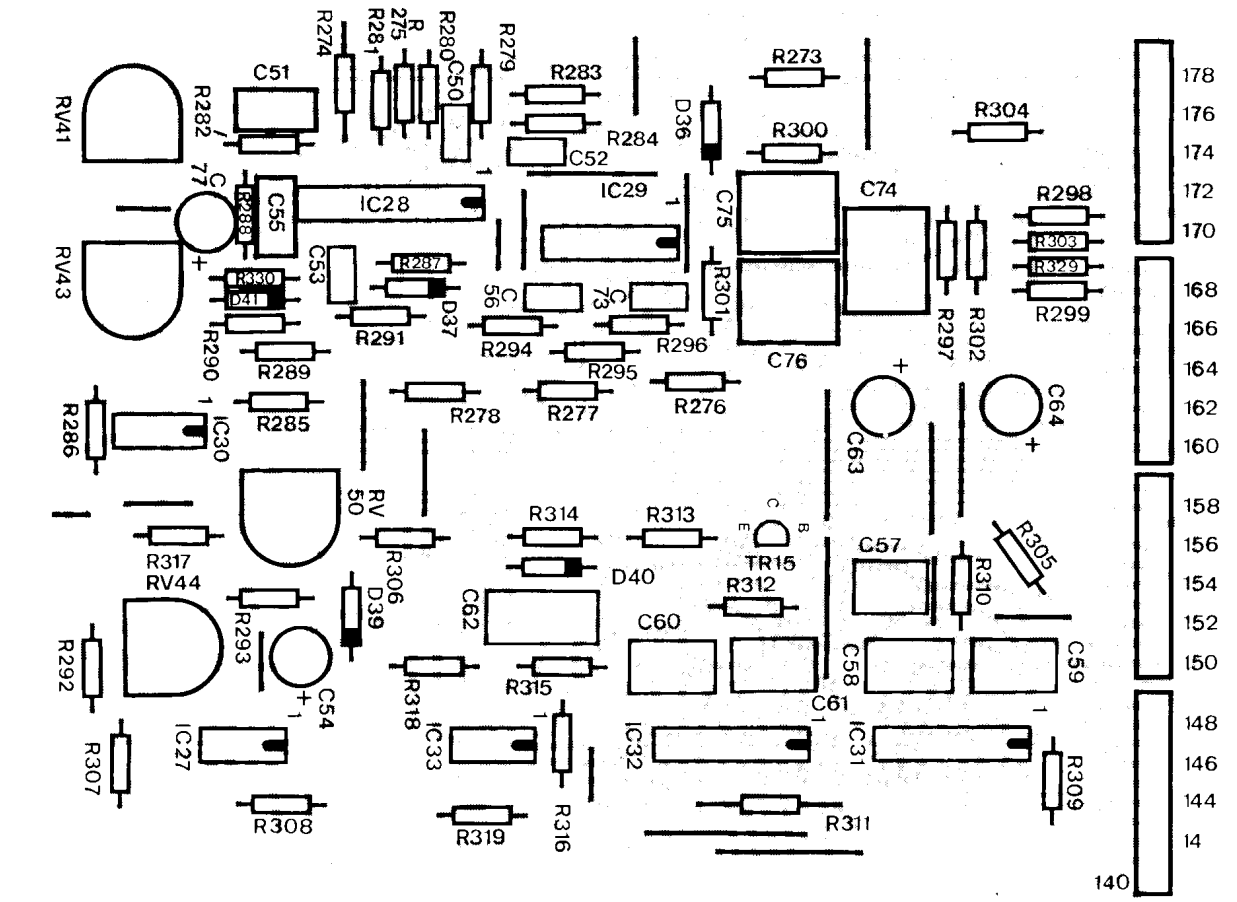


Figure 23. Noise, RM and Filter PCB.



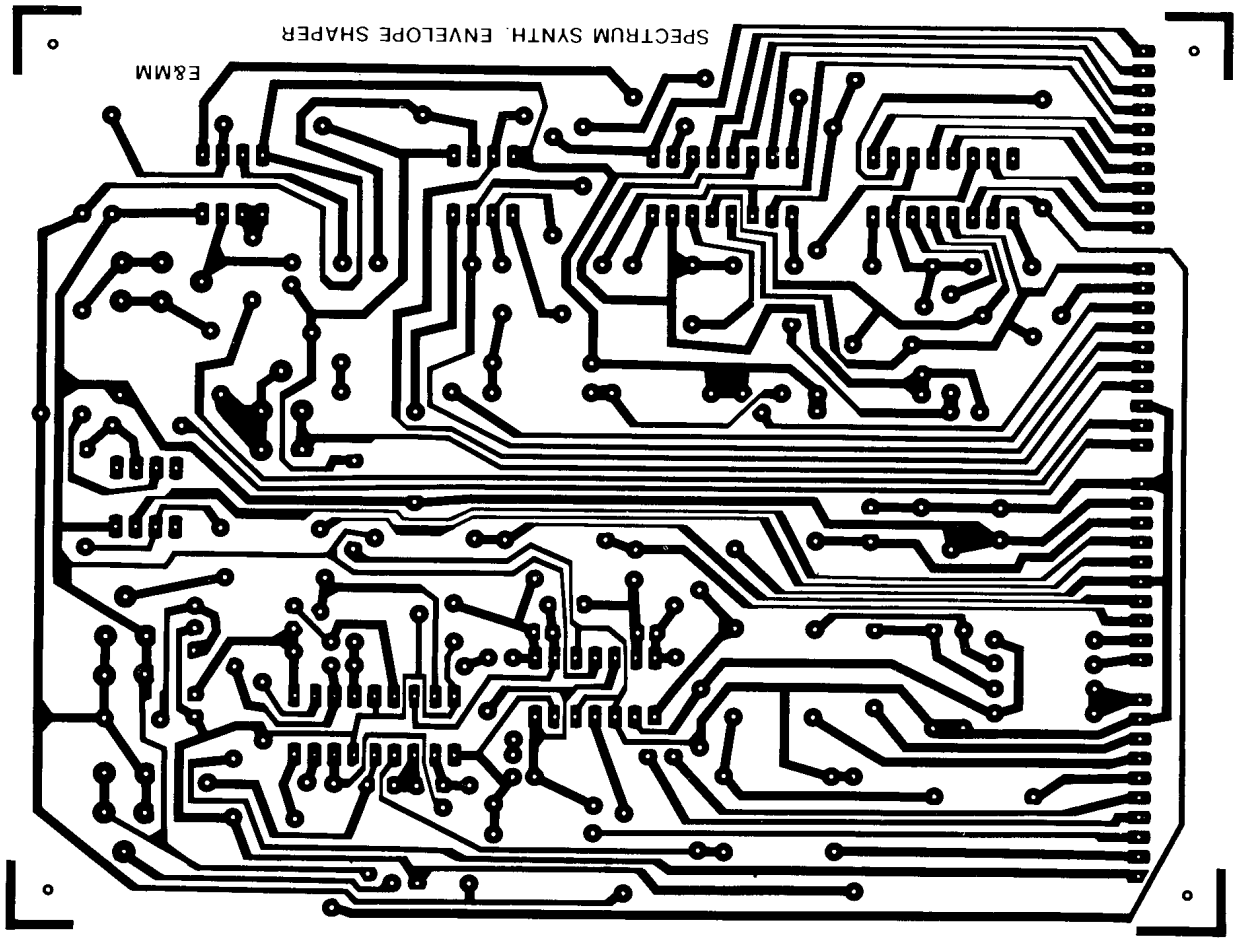
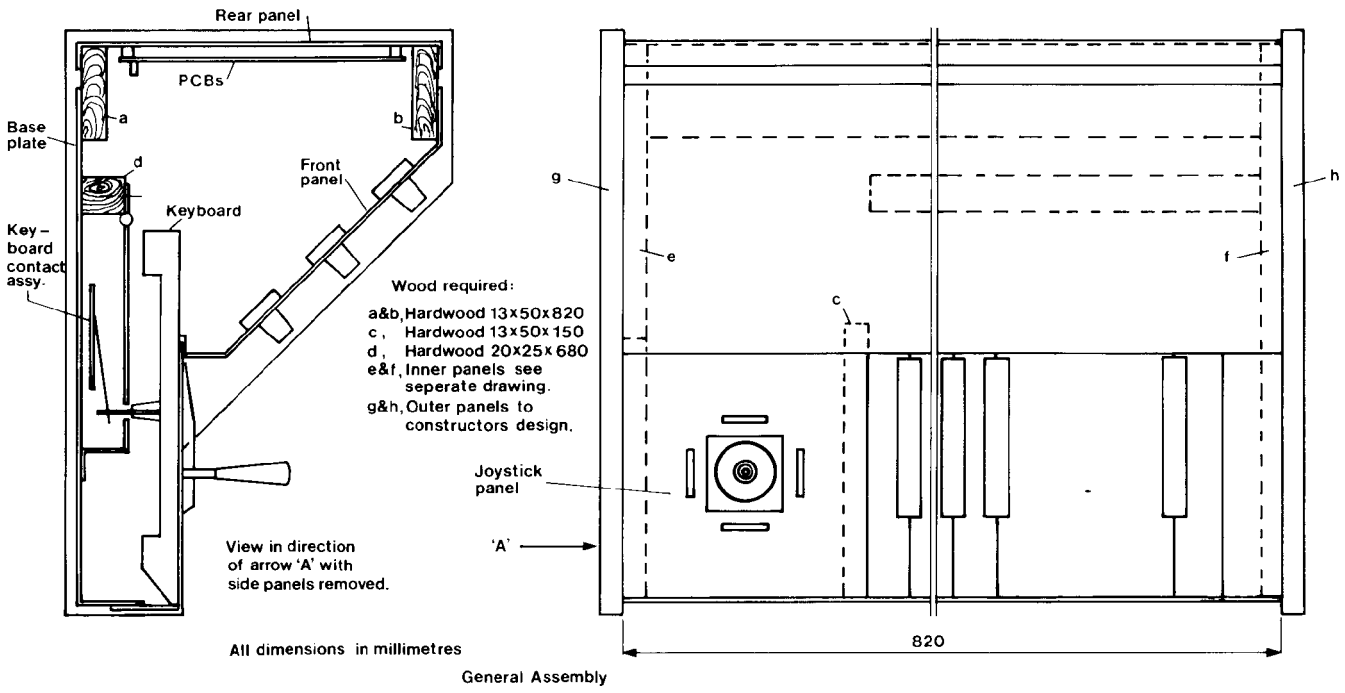
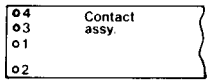
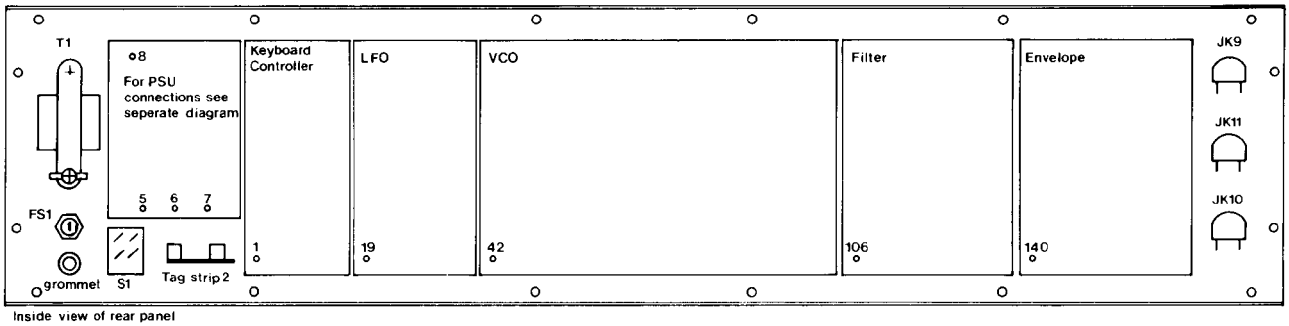


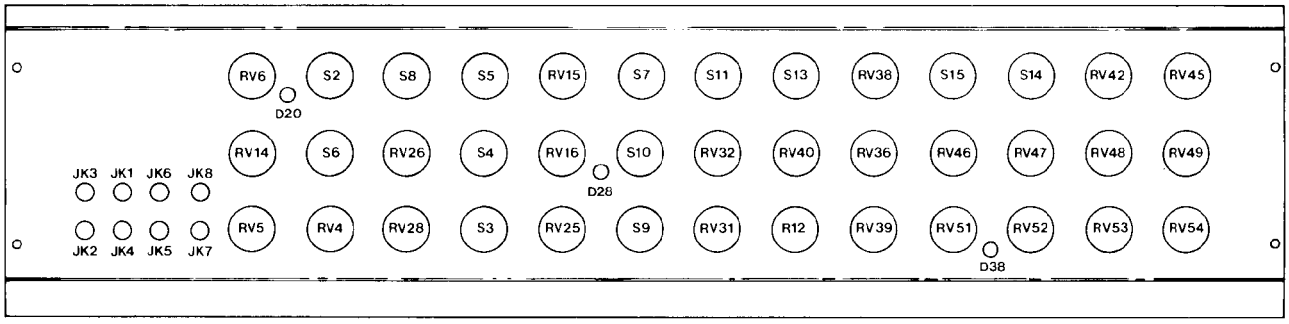
Figure 24. Envelope generator and VCA PCB.







Inside view of rear panel



Inside view of front panel

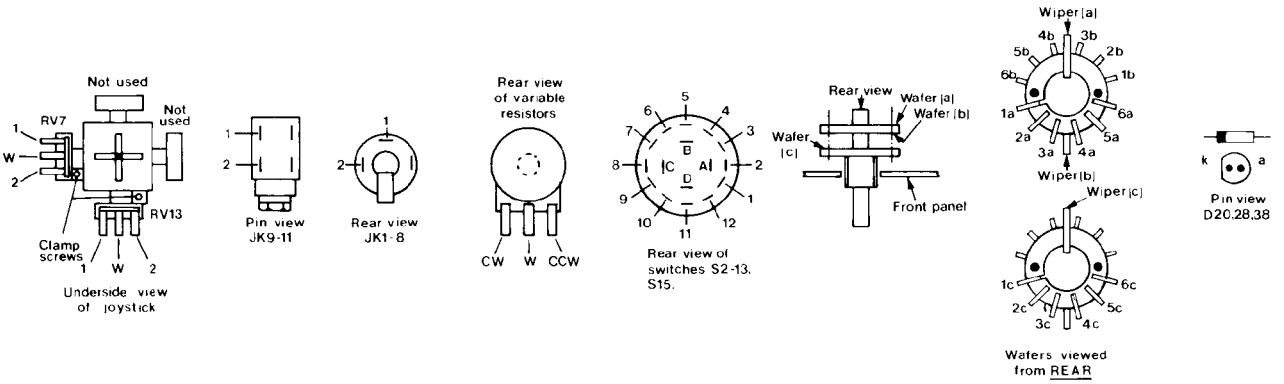
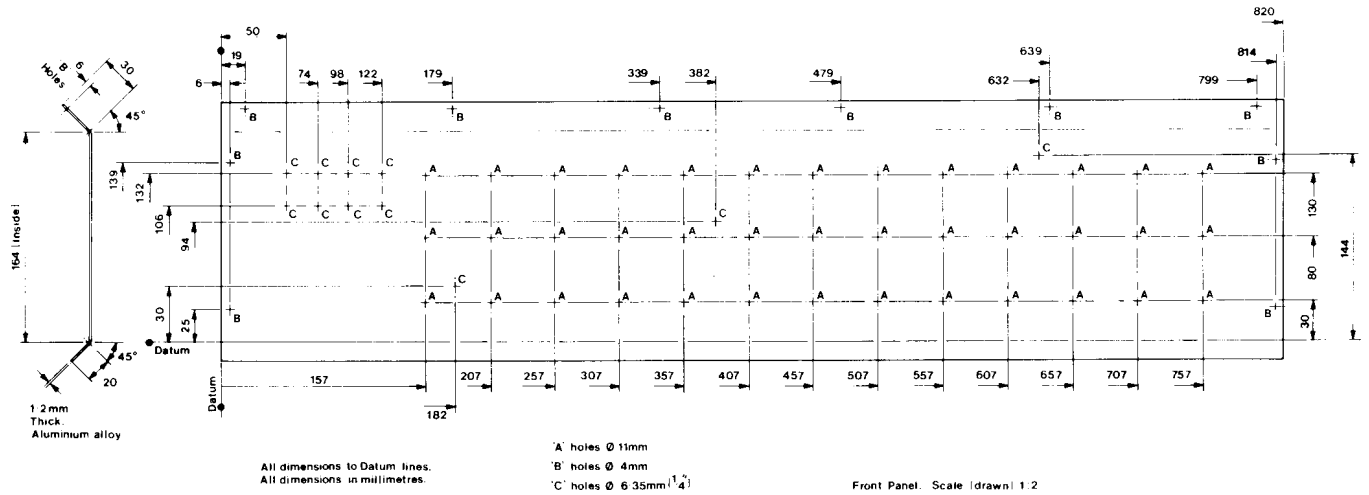
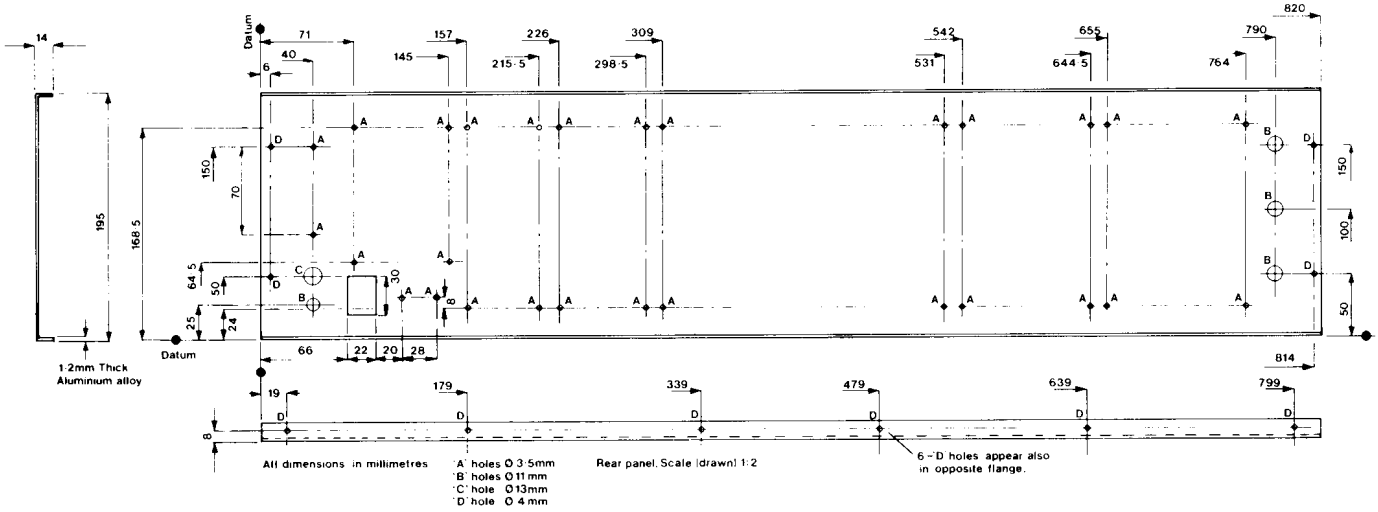


Figure 25. Cabinet construction and panel mounting components.





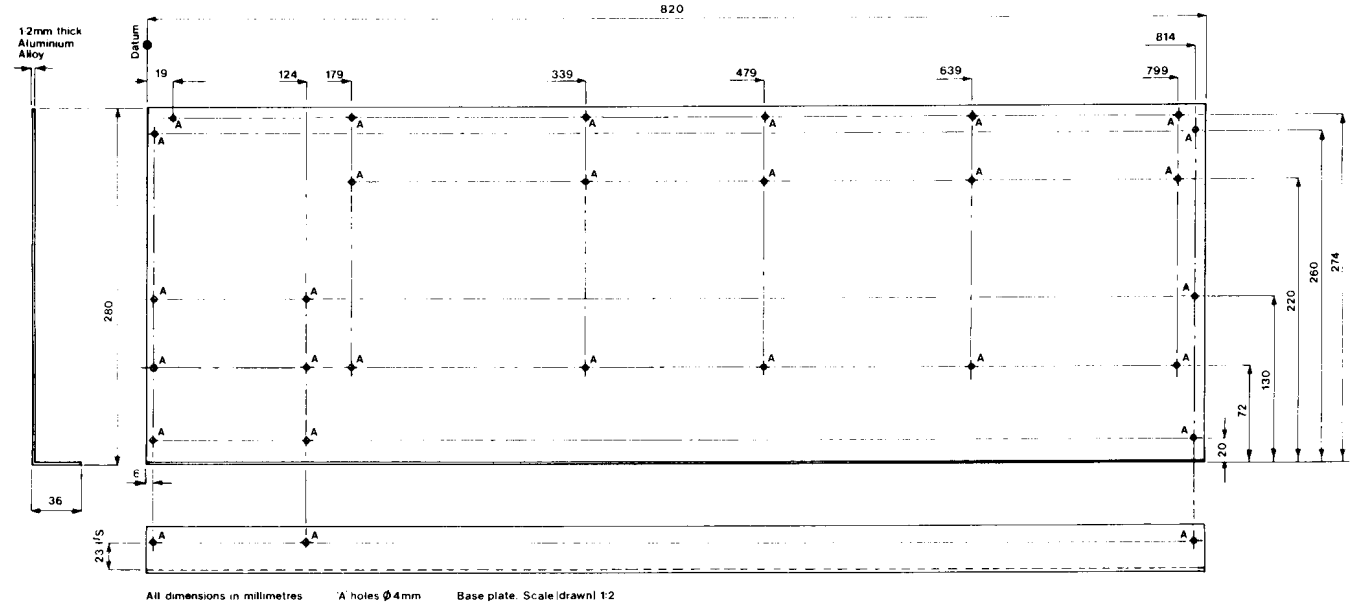
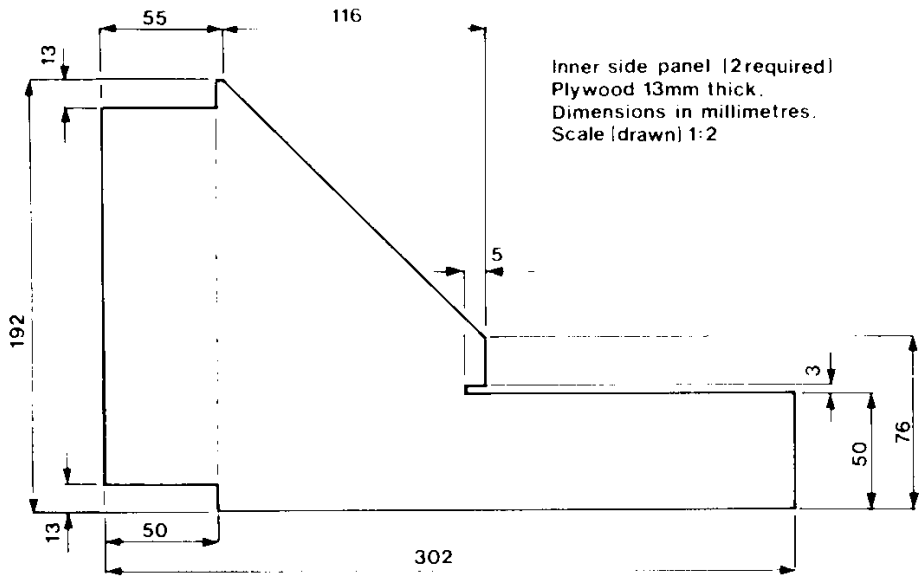
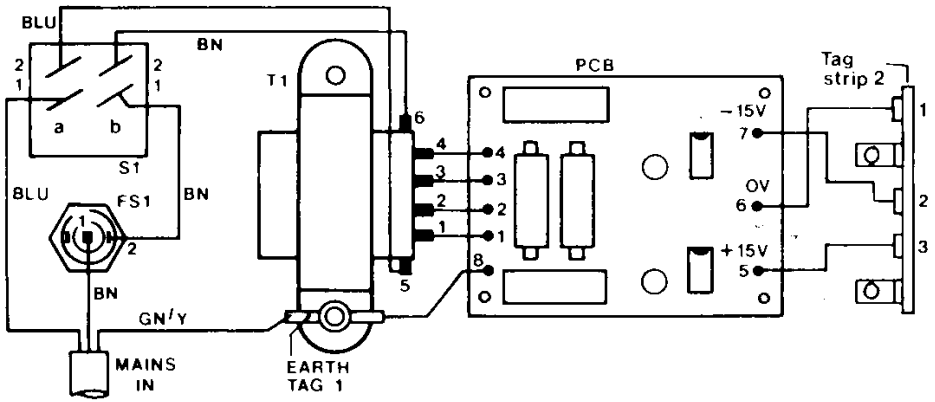
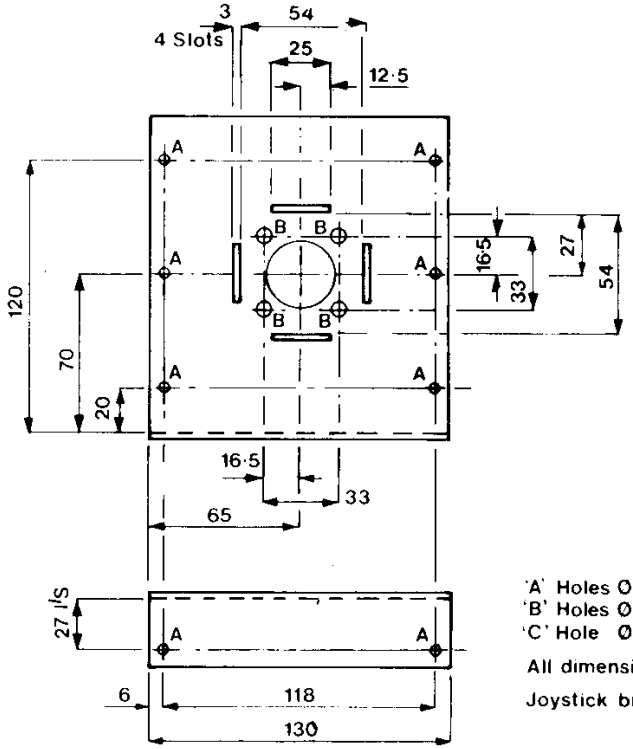


Figure 26. Metalwork details.



Inner side panel (2 required)
Plywood 13mm thick.
Dimensions in millimetres.
Scale (drawn) 1:2

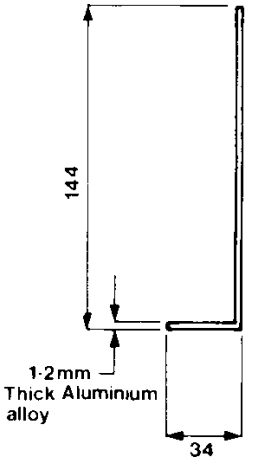




'A' Holes Ø 4mm
'B' Holes Ø 5mm
'C' Hole Ø 37mm

All dimensions in millimetres

Joystick bracket. Scale (drawn) 1:2



WIRING DETAILS

From	To	Remarks
PLA/L	FS 1/1	
PLA/N	S1a/1	
PLA/E	Earth tag 1	
FS1/	S1b/1	
S1a/2	T1/5	
S1b/2	T1/6	
T1/1	PSU/1	
T1/2	PSU/2	
T1/3	PSU/3	
T1/4	PSU/4	
PSU/5	Tag strip 2/3	
PSU/6	Tag strip 2/1	
PSU/7	Tag strip 2/2	
PSU/8	Earth tag 1	
Controller/1	Not used	
Controller/2	Not used	
Controller/3	JK1/1	
Controller/4	S15a/3	
Controller/5	S15a/2	Link to S15a/4
Controller/6	Not used	
Controller/7	JK3/1	
Controller/8	Tag strip/2	
Controller/9	Tag strip/1	
Controller/10	Tag strip/3	
Controller/11	Not used	
Controller/12	RV4/ccw	
Controller/13	VCO/98	
Controller/14	RV4/cw	Link to RV4/w
Controller/15	Keyboard contact/3	
Controller/16	Keyboard contact/4	
Controller/17	Keyboard contact/2	
Controller/18	Keyboard contact/1	
LFO/19	S5/1	
LFO/20	S5/3	
LFO/21	RV7/w	
LFO/22	RV7/1	Link to S5/2
LFO/23	S2b/C	
LFO/24	S2a/A	
LFO/25	S2a/6	
LFO/26	S2b/11	
LFO/27	S2b/12	
LFO/28	S2b/7	
LFO/29	S2b/10	
LFO/30	S2b/8	
LFO/31	S2b/9	
LFO/32	Tag strip 2/1	
LFO/33	Not used	
LFO/34	Tag strip 2/3	
LFO/35	Tag strip 2/2	
LFO/36	RV7/2	Link to D20/K
LFO/37	D20/a	
LFO/38	RV6/ccw	
LFO/39	RV6/w	
LFO/40	RV6/cw	
LFO/41	S15a/6	
VCO/42	JK6/1	
VCO/43	Not used	
VCO/44	Filter/107	
VCO/45	Filter/106	
VCO/46	S10/5	
VCO/47	S10/6	
VCO/48	S10/3	
VCO/49	S10/2	
VCO/50	S10/1	
VCO/51	S9/5	
VCO/52	S9/6	
VCO/53	S9/1	
VCO/54	S9/2	
VCO/55	S9/3	
VCO/56	D28/K	
VCO/57	Not used	
VCO/58	RV25/w	
VCO/59	RV16/w	
VCO/60	S7/1	
VCO/61	S7/3	
VCO/62	S7/4	
VCO/63	S7/5	
VCO/64	RV15/ccw	
VCO/65	Not used	
VCO/66	S3/6	Link to S4/6
VCO/67	S3/5	Link to S4/5
VCO/68	53/4	Link to S4/4
VCO/69	S3/3	Link to S4/3
VCO/70	S3/2	Link to S4/2
VCO/71	S3/1	Link to S4/1
VCO/72	Not used	

VCO/73	S3/A	
VCO/74	S4/A	
VCO/75	Not used	
VCO/76	S6/6	
VCO/77	S6/5	
VCO/78	S6/4	
VCO/79	S6/2	
VCO/80	RV14/ccw	
VCO/81	RV14/cw	Link to JK5/1
VCO/82	RV13/w	
VCO/83	RV26/cw	Link to RV25/ccw
VCO/84	RV26/w	
VCO/85	RV26/ccw	
VCO/86	JK4/1	
VCO/87	S8b/8	Link to S8b/10
VCO/88	S8b/7	
VCO/89	Not used	
VCO/90	S8b/11	Link to S8b/9
VCO/91	S8a/5	Link to S8a/4
VCO/92	S8a/1	Link to S8a/2 & 3
VCO/93	Not used	
VCO/94	RV28/ccw	Screen
VCO/95	RV28/w	Conductor *
VCO/96	Not used	
VCO/97	RV5/w	
VCO/99	RV40/cw	Link to JK2/1
VCO/100	Not used	
VCO/101	Tag strip 2/1	
VCO/102	RV16/cw	
VCO/103	Tag strip 2/3	
VCO/104	RV16/ccw	
VCO/105	Tag strip 2/2	
Filter/108	Not used	
Filter/109	RV31/cw	
Filter/110	RV31/ccw	
Filter/111	RV31/w	
Filter/112	RV32/cw	
Filter/113	RV32/ccw	
Filter/114	RV32/w	
Filter/115	S11a/A	
Filter/116	S11b/C	
Filter/117	S11a/5	
Filter/118	S11a/1,2,3	
Filter/119	JK7/1	
Filter/120	S9 & S10/A	Conductor *
	Not used	Screen
Filter/121	Envelope/178	
Filter/122	S12a/A	Link to S12b/5,6
Filter/123	S12a/1	
Filter/124	S12b/B	
Filter/125	S12c/C	
Filter/126	S12c/9	Link to S12d/10,11
Filter/127	S12b/4	
Filter/128	Not used	
Filter/129	S12c/7,8	
Filter/130	S12d/12	
Filter/131	RV38/w	
Filter/132	RV40/w	
Filter/133	RV39/w	
Filter/134	S6/1	
Filter/135	RV36/w	
Filter/136	RV36/cw	Link to RV39/cw, S15a/1a,5a
Filter/137	Tag strip 2/1	
Filter/138	Tag strip 2/3	
Filter/139	Tag strip 2/2	

Envelope/140	RV53/w	
Envelope/141	RV52/w	
Envelope/142	RV54/w	
Envelope/143	RV51/w	
Envelope/144	RV53/cw	
Envelope/145	RV48/w	
Envelope/146	RV47/w	
Envelope/147	RV49/w	
Envelope/148	RV46/w	
Envelope/149	RV48/cw	
Envelope/150	S15a/A	
Envelope/151	S15b/C	
Envelope/152	S15b/10,11	
Envelope/153	D38/K	
Envelope/154	S13/4	
Envelope/155	S13/5	
Envelope/156	RV46,47,49,51,52,54/cw	
Envelope/157	RV46,47,48,49,51,52,53,54/ccw, D38a	
Envelope/158	RV42/ccw	
Envelope/159	RV42/cw	
Envelope/160	Tag strip 2/1	
Envelope/161	Tag strip 2/2	
Envelope/162	Tag strip 2/3	
Envelope/163	S14a/Wiper	
Envelope/164	S14b/Wiper	
Envelope/165	S14b/5b	Link to RV45a & b/ccw
Envelope/166	S14b/6b	
Envelope/167	S14b/1b,2b,3b,4b	
Envelope/168	JK10/1	Conductor *
Screen not used	JK10/2	Screen
Envelope/169	JK11/1	Conductor *
Envelope/171	JK11/2	Screen
Envelope/170	JK9/1	Conductor *
Screen not used	JK9/2	Screen
Envelope/172	RV45a/w	
Envelope/173	RV45b/w	
Envelope/174	S14c/3c,4c,5c,6c	
Envelope/175	RV45b/cw	
Envelope/176	RV45a/cw	
Envelope/177	JK8/1	
Envelope/179	RV42/W	
JK1-8 incl/2	Tag strip 2/1	
S5/1	S11b/7, S13/1	
S5/2	S11b/8, S13/2, S14a/1a,3a	
S5/3	S11b/5, S13/3, S14a/2a,4a	
RV16/cw	D28a, RV5/ccw, RV13/2	
RV16/ccw	RV5/cw, 58b/c, RV25/cw, RV13/1	
RV14/w	S6/A	
RV15/cw	S5/A	
RV15/w	S7/A	
RV28/cw	S8a/A	
RV25/ccw	To screen of S9 & S10/w only	
RV32/ccw	RV40/ccw, RV39/ccw, RV36/ccw, RV38/ccw	
S12b/4	S12d/D, S11a/4,6, S11b/10	
RV31/ccw	S2a/5, S5/6, S13/6	
RV38/cw	S13/A	
JK9/2	JK10/2, JK11/2	
JK9/1	S14c/1c,2c	Conductor *
JK9/2	Screen not used	Screen
JK10/1	S14c/Wiper	Conductor *
JK10/2	Screen not used	Screen
S13/4	S11b/11, S5/4	
S13/5	S11b/12, S5/5	

* Screened Lead

KEYBOARD PARTS LIST

Resistors			
R8-55	47R 2%	48 off	(X47R)
Miscellaneous			
	49-note C-C keyboard		(XB17T)
	Contact springs	49 off	(QY07H)
	Palladium bars, 1.2mm x 330mm	Set of 4	
	24-contact PCB		(GA09K)
	25-contact PCB		(GA10L)
	6BA 1" bolts		(BF67H)
	6BA ½" spacers		(FW35Q)
	6BA washers		(BF22Y)
	6BA nuts		(BF18U)
	Veropins		(FL24B)

POWER SUPPLY UNIT PARTS LIST

Resistors — 5% ⅓W carbon unless specified.			
R1,2	2R2 ½W	2 off	(S2R2)
R3,4	3k3 1%	2 off	(T3K3)
R5,6	3k0 1%	2 off	(T3K0)
R7	330R		(M330R)
RV1,2	1k cermet preset	2 off	(WR40T)
Capacitors			
C1,2	2200uF 25V axial elect.	2 off	(FB90X)
C3,4,7,8	2u2 63V PC elect.	4 off	(FF02C)
C5,6	100pF polystyrene		(BX28F)
Semiconductors			
IC1,2	uA723 14-pin DIL	2 off	(QL21X)
TR1,2	BD135	2 off	(QF06G)
D1-D10	1N4001	10 off	(QL73Q)

Miscellaneous			
T1	240V prim. 0-15, 0-15 sec. 10VA		(LY03D)
S1	DPST rocker switch with neon		(YR70M)
FS1	20mm 500mA quick blow fuse		(WR02C)
	20mm panel fuseholder		(RX96E)
FS2,3	20mm 1A quick blow fuse	2 off	(WR03D)
	20mm chassis fuseholder	2 off	(RX49D)
	14-pin DIL socket	2 off	(BL18U)
	PCB		(GA03D)
	3A 3-core mains cable 2m		(XR01B)
	13A mains plug		(HL58N)
	6BA 1" bolts		(BF07H)
	6BA ½" spacers		(FW35Q)
	6BA nuts		(BF18U)
	4BA ½" bolts		(BF03D)
	4BA nuts		(BF17T)
	4BA solder tags		(BF28F)
	Cable grommet		(LR48C)
	Veropins		(FL24B)

KEYBOARD CONTROLLER PARTS LIST

Resistors — 5% ⅓W carbon unless specified			
R56	33k		(M33K)
R57	5k6 1% film		(T5K6)
R58,59	470R 1% film	2 off	(T470R)
R60	1M0		(M1M0)
R61,85	4k7	2 off	(M4K7)
R62,75	1k0	2 off	(M1K0)
R63	470k		(M470K)
R64,74	100R	2 off	(M100R)
R65,66,78,79	10k	4 off	(M10K)
R67,70,73,80	100k	4 off	(M100K)
R68,69	3k3	2 off	(M3K3)
R71	10M 10%		(M10M)
R72	220k		(M220K)
R76	47k		(M47K)
R81	330k		(M330K)
R82,84	22k	2 off	(M22K)
R83	2k2		(M2K2)
RV3	5k0 multi-turn cermet preset		(WR48C)
RV4	2M2 log. pot.		(FW29G)

Capacitors — polycarbonate unless specified			
C9	68nF		(WW39N)
C10,12,14	100nF	3 off	(WW41U)
C11,13	470nF	2 off	(WW49D)
C65,66	100uF 25V PC elect.	2 off	(FF11M)

Semiconductors			
IC3,4	1458C	2 off	(QH46A)
IC5	CA3240E		(WQ21X)
IC6	CD4093BE		(QW53H)
TR3	2N3819		(QR36P)
TR4	BC182L		(QB55K)
TR5	BC212L		(QB60Q)
D11-D19 (no D15)	1N4148	8 off	(QL80B)

Miscellaneous			
	8 pin DIL socket	3 off	(BL17T)
	14 pin DIL socket		(BL18U)
JK1,3	3.5mm jack socket	2 off	(HF82D)
	PCB		(GA55K)
	Veropins		(FL24B)

VCO PARTS LIST

Resistors — 5% ⅓W carbon unless specified			
R77,89	27k 1% film	2 off	(T27K)
R86,87,149, 150,176,178	1M0 1% film	6 off	(T1M0)
R88	110k 1% film		(T110K)
R90,143,210,211	10k	4 off	(M10K)
R133	3k9 1% film		(T3K9)
R134,135,136, 137	2k4 1% film	4 off	(T2K4)
R138	3k0 1% film		(T3K0)
R139	56k		(M56K)
R140-142,144, 152-161,174, 180,187,188, 192,198-200, 205-207	100k	25 off	(M100K)
R145	240k 1% film		(T240K)
R146,166,167	220k 1% film	3 off	(T220K)
R147,148	91k 1% film	2 off	(T91K)
R151	2M2 10%		(M2M2)
R162,163	100k 1% film	2 off	(T100K)
R164,165	47k 1% film	2 off	(T47K)
R168,171	24k 1% film	2 off	(T24K)
R169,172	910R ½W	2 off	(S910R)
R170,175	510k 1% film	2 off	(T510K)
R173	560k		(M560K)
R177,179	5k6 1% film	2 off	(T5K6)
R181,184,325, 327	470R	4 off	(M470R)
R182,185	1k8 1% film	2 off	(T1K8)
R183	300k ½W		(S300K)
R186	180k		(M180K)
R189	1k0		(M1K0)
R190	680k		(M680K)
R191	120K		(M120K)
R195,202	330k	2 off	(M330K)
R196,203	240k ½W	2 off	(S240K)
R197,204	150k	2 off	(M150K)
R201,208	47k	2 off	(M47K)
R209	3k3		(M3K3)
R212	68k		(M68K)
R213,214	220k	2 off	(M220K)
R215	6k8		(M6K8)
R324,326	1M0	2 off	(M1M0)
R328	100R		(M100R)
RV9,10,11,12,19	1k0 cermet preset	5 off	(WR40T)
RV14	10k log. pot.		(FW22Y)
RV15	47k log. pot.		(FW24B)
RV16,25	470k lin. pot.	2 off	(FW07H)
RV17,18	100k cermet preset	2 off	(WR44X)
RV20,21,22	50k cermet preset	3 off	(WR43W)
RV23,24	10k multi-turn cermet preset	2 off	(WR49D)
RV26	100k lin. pot.		(FW05F)
RV27	100k min. horiz. preset		(WR61R)
RV5,28	220k lin. pot.	2 off	(FW06G)
RV29,30	2k2 min. horiz. preset	2 off	(WR56L)
RV55,56	22k min. horiz. preset	2 off	(WR59P)

Capacitors — monolithic ceramic unless specified			
C21,24,25,26,27, 28,29,30,33	100nF	9 off	(YY11M)
C22,23	1nF	2 off	(YY24B)
C31,34	1nF 1% polystyrene	2 off	(BX56L)
C32,35,71,72	10nF	4 off	(YY08J)
C36	1uF polycarb.		(WW53H)
C37	270pF ceramic plate		(WX61R)
C38	100pF polystyrene		(BX28F)
C69,70	100uF 25V PC elect.	2 off	(FF11M)

Semiconductors			
IC7,14,19	1458C	3 off	(QH46A)
IC13	LF353 or TL082		(WQ31J)
IC15,16	CEM 3340	2 off	
IC17	CD4093BE		(QW53H)
IC18	CD4013BE		(QX07H)
TR15	BC212L		(QB60Q)
TR16,17	2N3819	2 off	(QR36P)
D28	Red LED		(WL27E)
D29,30	1N4148	2 off	(QL80B)

Miscellaneous			
S3-10	Rotary switch 2-pole 6-way	8 off	(FF74R)
RV7,13	Joystick, 100k lin. pots.		(XB09K)
JK2,4,5,6	3.5mm jack socket	4 off	(HF82D)
	8 pin DIL socket	4 off	(BL17T)
	14 pin DIL socket	2 off	(BL18U)
	16 pin DIL socket	2 off	(BL19V)
	PCB		(GA36P)
	Veropins		(FL24B)

FILTER BOARD PARTS LIST

Resistors — 5% ⅓W carbon unless specified			
R193,229	33k	2 off	(M33K)
R194,242,257	1k0	3 off	(M1K0)
R216,239	15k	2 off	(M15K)
R217	39k		(M39K)
R218	30k ½W		(S30K)
R219,223,226, 231,250,253, 259,261,265, 269,270	100k	11 off	(M100K)
R220,221	300k ½W	2 off	(S300K)
R222	620k ½W		(S620K)
R224,245,246, 247	1M0	4 off	(M1M0)
R225,230,266	470k	3 off	(M470K)
R227	1k8		(M1K8)
R228	680k		(M680K)
R232	220k		(M220K)
R233,234	100R	2 off	(M100R)
R235	18k		(M18K)
R236,238	47k	2 off	(M47K)
R237	22k		(M22K)
R240	4k7		(M4K7)
R241,243	27k	2 off	(M27K)
R244	5k6		(M5K6)

R248,252	120k	2 off	(M120K)
R249,251,256, 260,267	91k ½W	5 off	(S91K)
R254	330k		(M330K)
R255	51k ½W		(S51K)
R258	1k5		(M1K5)
R262,263	240k ½W	2 off	(S240K)
R264,272	56k	2 off	(M56K)
R268	180k		(M180K)
R271	150k		(M150K)
RV31,36,39,40	100k lin. pot.	4 off	(FW05F)
RV32	100k log. pot.		(FW25C)
RV33	100k min. horiz. preset		(WR61R)
RV34,35	10k min. horiz. preset	2 off	(WR58N)
RV37	50k cermet preset		(WR43W)
RV38	47k log. pot.		(FW24B)
Capacitors			
C39	100pF ceramic		(WX56L)
C40	1uF polycarb.		(WW53H)
C41	100nF polycarb.		(WW41U)
C42,47	1u0 100V PC elect.	2 off	(FF01B)
C43-46	100pF polystyrene	4 off	(BX28F)
C48,49	10uF 35V PC elect.	2 off	(FF04E)
Semiconductors			
IC20	1458C		(QH46A)
IC21,23,26	741C	3 off	(QL22Y)
IC22	CA3080E		(YH58N)
IC24	LF353 or TL082		(WQ31J)
IC25	CEM 3320		
TR12,13,14	BC182L	3 off	(QB55K)
D33,34,35	1N4148	3 off	(QL80B)
Miscellaneous			
S11,13	Rotary switch 2-pole 6-way	2 off	(FF74R)
S12	Rotary switch 4-pole 3-way		(FF76H)
JK7	3.5mm jack socket		(HF82D)
	8 pin DIL socket	6 off	(BL17T)
	18 pin DIL socket		(HQ76H)
	PCB		(GA57M)
	Veropins		(FL24B)

LFO PARTS LIST

Resistors — 5% ⅓W carbon unless specified			
R91	220R		(M220R)
R92,100,103, 110,323	33k	5 off	(M33K)
R93,99,104,105, 106,116,117	10k	7 off	(M10K)
R94	56k		(M56K)
R95,118	47k	2 off	(M47K)
R96,108	1k0	2 off	(M1K0)
R97	180R		(M180R)
R98	4M7 10%		(M4M7)
R101,111,320, 321,322	39k	5 off	(M39K)
R108	1k8		(M1K8)
R107	10M 10%		(M10M)
R109	150k		(M150K)
R112	13k ½W		(S13K)
R113	270k		(M270K)
R114	390k		(M390K)
R115	75k ½W		(S75K)
R119	240k ½W		(S240K)
R120	120k		(M120K)
R121	24k ½W		(S24K)
R122,123	100k	2 off	(M100K)
R124	5k1 ½W		(S5K1)
R125	27k		(M27K)
R126	18k		(M18K)
R127	30k ½W		(S30K)
R128	6k8		(M6K8)
R129	2k7		(M2K7)
R130	180K		(M180K)
R131	22k		(M22K)
R132	82k		(M82K)
RV6	220k log. pot.		(FW26D)
RV8	470k min. horiz. preset		(WR63T)
Capacitors — polycarbonate unless specified			
C15	330nF		(WW47B)
C16	220nF		(WW45Y)
C17,18	10nF	2 off	(WW29G)
C19	6n8		(WW27E)
C20	100nF		(WW41V)
C67,68	100uF 25V PC elect.	2 off	(FF11M)
Semiconductors			
IC8	LF351 or TL081		(WQ30H)
IC9,10,12	1458	3 off	(QH46A)
IC11	CA3140 (see text)		(QH29G)
TR6,8,17	BC212L	3 off	(QB60Q)
TR7	2N2646		(QR14Q)
TR9,11,16	BC182L	3 off	(QB55K)
TR10	2N3819		(QR36P)
D20	Red LED		(WL27E)
D21-27,D15	1N4148	8 off	(QL80B)
Miscellaneous			
	PCB		(GA53H)
	Veropins		(FL24B)
S2	Rotary switch 2-pole 6-way		(FF74R)

ENVELOPE SHAPER BOARD PARTS LIST

Resistors — 5% ⅓W carbon unless specified			
R273	62k ½W		(S62K)
R274,288	56k	2 off	(M56K)
R275,279,286, 289,290	150k	5 off	(M150K)
R276,277,313, 314	10k	4 off	(M10K)
R278	20k ½W		(S20K)
R280,291,303, 304,329	100R	5 off	(M100R)
R281	680R		(M680R)
R282	6k8		(M6K8)
R283,284,285, 287,292,294, 298,299,307	100k	9 off	(M100K)
R293,295,296, 301,318,319	47k	6 off	(M47K)
R297,300,302	1M	3 off	(M1M0)
R305	22k		(M22K)
R306	1k8		(M1K8)
R308	2k2		(M2K2)
R309,311	24k ½W	2 off	(S24K)
R310,312	750R ½W	2 off	(S750R)
R315	220k		(M220K)
R316	12k		(M12K)
R317	82k		(M82K)
R330	560R		(M560R)
RV41,43,44	100k min. horiz. preset	3 off	(WR61R)
RV42	4k7 lin. pot.		(FW01B)
RV45	4k7 log. dual gang pot.		(FX08J)
RV46,47,49,51, 52,54	10k lin. pot.	6 off	(FW02C)
RV48,53	100k lin. pot.	2 off	(FW05F)
RV50	47k min. horiz. preset		(WR60Q)
Capacitors — polycarbonate unless specified			
C50,53	1nF ceramic plate	2 off	(WX68Y)
C51,55	4n7	2 off	(WW26D)
C52	100pF ceramic plate		(WX56L)
C54	1u0 100V PC elect.		(FF01B)
C56,73	12pF ceramic plate	2 off	(WX46A)
C57	6n8		(WW27E)
C58,60	22nF	2 off	(WW33L)
C59,61	39nF	2 off	(WW36P)
C62	100nF		(WW41U)
C63,64	100uF 25V PC elect.	2 off	(FF11M)
C74,75,76	1u0	3 off	(WW53H)
C77	10u 35V PC elect.		(FF04E)
Semiconductors			
IC27,33	1458C	2 off	(QH46A)
IC28	CEM 3330		
IC29	LF347		(WQ29G)
IC30	741C		(QL22Y)
IC31,32	CEM 3310	2 off	
TR15	BC212L		(QB60Q)
D36,37,39,40	1N4148	4 off	(QL80B)
D38	Red LED		(WL27E)
D41	10V 400mW zener		(QH14Q)
Miscellaneous			
S14	Shaft assembly		(FH46A)
	and 2-pole 6-way wafer	2 off	(FH48C)
S15	Rotary switch 2-pole 6-way		(FF74R)
JK8	3.5mm jack socket		(HF82D)
JK9,10,11	Standard mono jack socket	3 off	(BW78K)
	8 pin DIL socket	3 off	(BL17T)
	14 pin DIL socket		(BL18U)
	16 pin DIL socket	2 off	(BL19V)
	18 pin DIL socket		(HQ76H)
	PCB		(GA59P)