

# SYSTEM 100M SERVICE NOTES

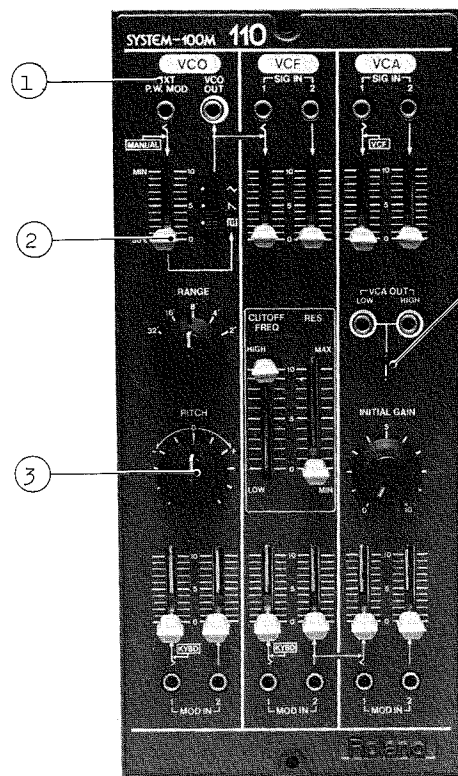
First Edition

Parts are designated in New numbering (8-10 digits) and/or Old (6 digits).

"N" heading abbreviated new number stands for NEW.

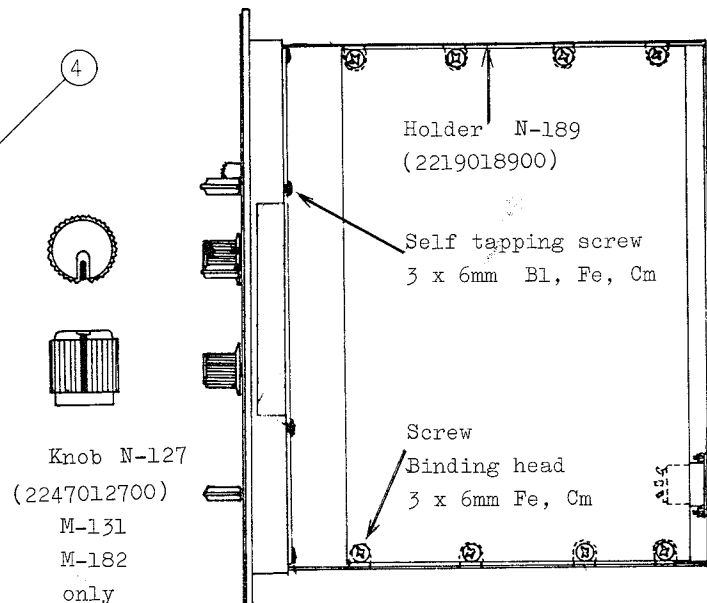
When ordering replacement, use "No." for only old one.

Each figure, 0-13, at lower line in ② - ④ indicates part per module.



Pictures on this page represent parts common to modules and similarities.

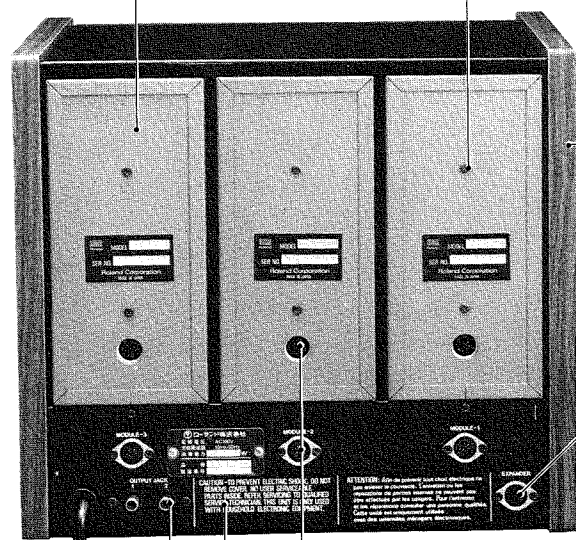
For ①-④, see list at the right.



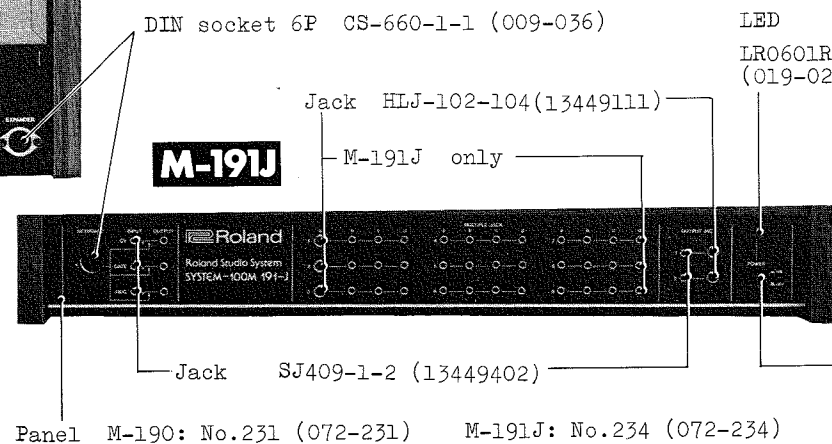
Knob N-127 (2247012700)  
M-131  
M-182  
only

x : Binding 3 x 25mm Br  
△ : Binding 3 x 8mm Br

Cover N-122 (2201012200) Binding head 3 x 6mm Fe



Twin pin jack P-254P-4 (009-016)  
Chassis M-190: No. 222 (061-222)  
M-191J: No. 221 (061-221)  
DIN socket 8P CS0690-1-1 (13429603)

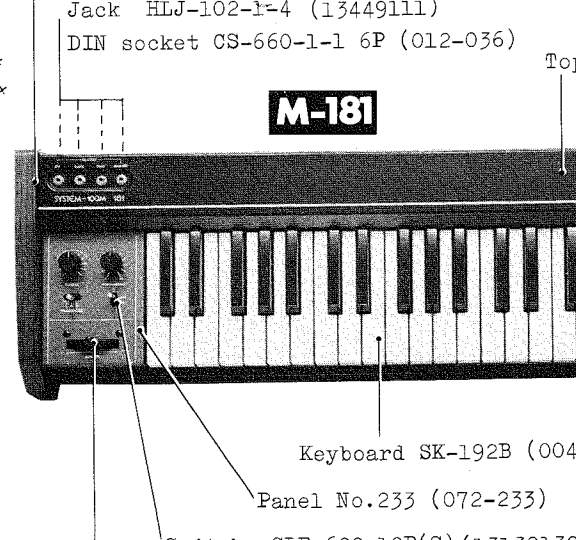


DIN socket 6P CS-660-1-1 (009-036)  
LED LRO601R (019-020)  
Jack HLJ-102-104 (13449111)  
M-191J only  
Panel M-190: No. 231 (072-231) M-191J: No. 234 (072-234)  
Jack SJ409-1-2 (13449402)

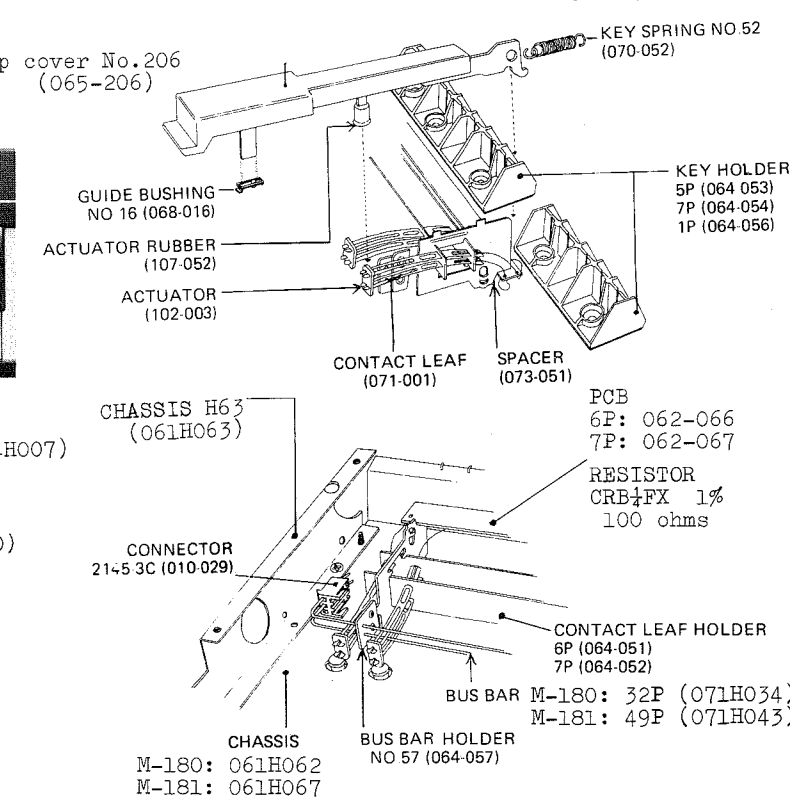
	M-110	M-112	M-121	M-130	M-131	M-132	M-140	M-150	M-172	M-182
①	N-193 22210-19300	N-195 22210-19500	N-197 22210-19700	N-198 22210-19800	N-199 22210-19900	N-200 22210-20000	N-201 22210-20100	N-203 22210-20300	N-204 22210-20400	N-205 22210-20500
②	Knob 13	Knob 10	Knob 16	Knob 12	Knob 4	Knob 10	Knob 10	Knob 4	Knob 0	Knob 0
③	Knob 3	Knob 4	Knob 0	Knob 2	Knob 1	Knob 0	Knob 1	Knob 1	Knob 10	Knob 1
④	GL-3AR-1 (red) 1	GL-3AR-1 (red) 0	GL-3AR-1 (red) 2	GL-3AR-1 (red) 2	GL-3AR-1 (red) 3	GL-3AR-1 (red) 2	GL-3AR-1 (red) 1	GL-3AR-1 (red) 1	GL-3AR-2 (red) 019-020	GL-3AR-2 (red) 15029109
	1	0	2	2	0	0	0	0	2	8



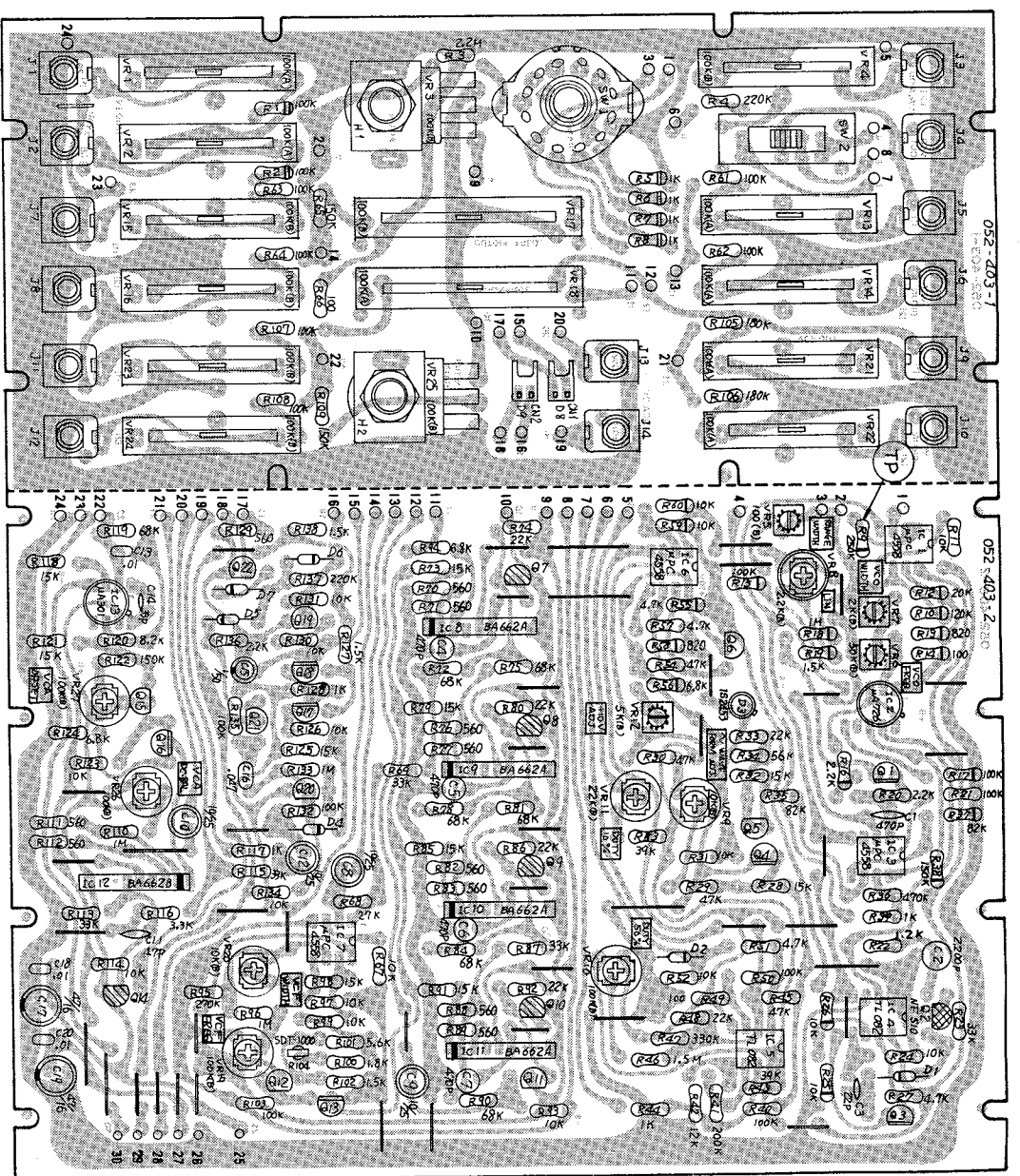
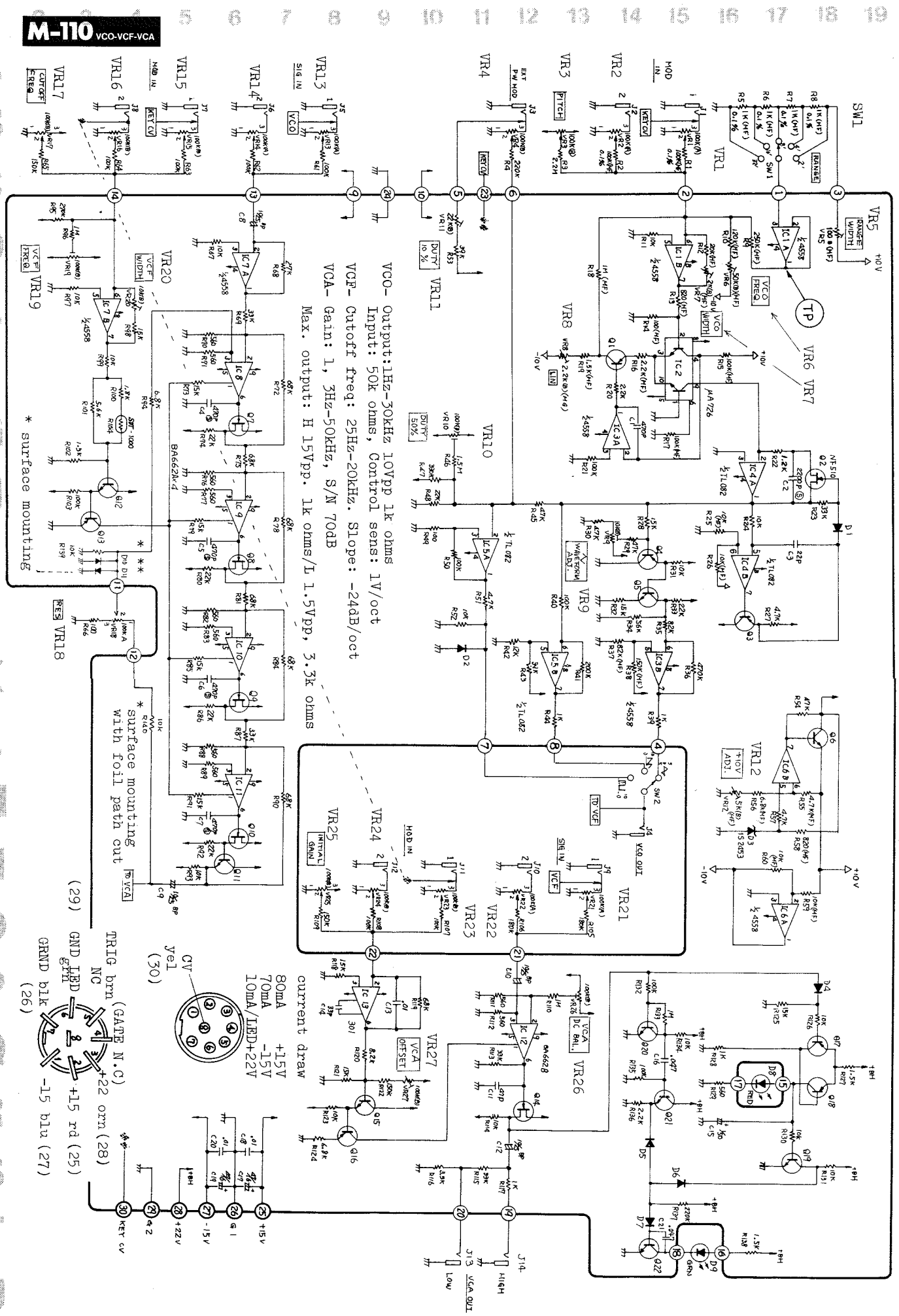
Jack SG-8050#4 (009-007)  
Removal screws Top cover: 3.1 x 10mm wood, RH, Br  
Cabinet (side): 3 x 25mm binding, Br  
Cabinet (bottom): 4 x 15mm truss, Br  
Top cover No. 205 (065-205)  
Cabinet No. 122 (081-122)  
Endblock No. 242 (072-242)  
Keyboard SK-132E (004H006)  
KEY ASSEMBLY  
F (IVORY) (106-015)  
G (IVORY) (106-016)  
A (IVORY) (106-017)  
B (IVORY) (106-018)  
C (IVORY) (106-019)  
D (IVORY) (106-020)  
E (IVORY) (106-021)  
F (IVORY) (106-022)  
SHARP (BLACK) (106-023)  
Knob No. 44 (016-044)  
Pot. VM10RK15B15(L) (028-727)  
Switch SLE-623-12P(S) (13139131)  
Pot. VM10RK15A26(L) (028-756)  
Cabinet No. 155 (081-155)  
Panel No. 241 (072-241)  
Base No. 20 (foot) (111-020)  
KEY SPRING NO 52 (070-052)



Jack HLJ-102-1-4 (13449111)  
DIN socket CS-660-1-1 6P (012-036)  
Top cover No. 206 (065-206)  
Keyboard SK-192B (004H007)  
Panel No. 233 (072-233)  
Switch SLE-622-12P(S) (13139130)  
PB-4 (029-022)  
Power switch SDG5P-001-1 (13129101) 100V  
SDG5P-001-2 (13129102) 117V  
SDG5P-502 (13129103) 220/240V



GUIDE BUSHING NO 16 (068-016)  
ACTUATOR RUBBER (107-052)  
ACTUATOR (102-003)  
CONTACT LEAF (071-001)  
SPACER (073-051)  
KEY HOLDER 5P (064-053)  
7P (064-054)  
1P (064-056)  
CHASSIS H63 (061H063)  
PCB 6P: 062-066  
7P: 062-067  
RESISTOR CRB1/4FX 1% 100 ohms  
CONNECTOR 21-5 3C (010-029)  
CONTACT LEAF HOLDER 6P (064-051)  
7P (064-052)  
BUS BAR M-180: 32P (071H034)  
M-181: 49P (071H043)  
BUS BAR HOLDER NO 57 (064-057)  
CHASSIS M-180: 061H062  
M-181: 061H067



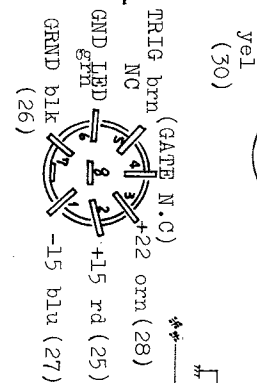
OP9101-030 (P/N 7910103000)  
(pcb 052-403-1)

**M-110**

OP9101-040 (Part number 7910104000)  
(pcb 052-403-2)

NOMENCLATURE	PART NO.	MANUFACTURE NAME
J- 1-16	13449402	SI-409-1-2
SW- 1	13119401	SRM1025172
SW- 2	13159304	SSB02335
VR- 1,2,13,14,21,22	13339301	EVA-H04015A15
VR- 3, 25	13219220	VM10RB100C K20 100KB
VR- 4,15,16,23,24	13339304	EVA-H04015B15
VR- 5	13299501	PM822H101H
VR- 6	13299508	PM822H503H
VR- 7	13299504	PM822H 202H
VR- 8	13299542	CR19R 2.2KB
VR- 9, 20	13299114	SR19R 10KB
VR- 10,19,26,27	13299117	SR19R 100KB
VR- 11	13299115	SR19R 22KB
VR- 12	13299507	PM822H502H
VR- 17	13339402	EVA-T0A015B15
VR- 18	13339401	EVA-T0A015A15
H- 1, 2	2219510600	Holder N-106
ON- 1, 2	13439502	3024-02C
IC- 1, 3, 6, 7	15189105	uPC4458C
IC- 2	15219101	uA726HC
IC- 4, 5	15189118	TL082CP
IC- 8, 9, 10, 11	15229802	BA662-A
IC- 12	15229803	BA662-B
IC- 13	15189109	uA301HC
Q- 1,3,4,13,16,17,18	15119112	2SA1015-Y
Q- 2	15139110	NF510
Q- 5,6,11,12,15,19	15129115	2SC1815-Y
Q- 7,8, 9, 10,14	15139103	2SK30ATM-GR
D- 1,2,4,5,6,7	15019103	1S2473
D- 3	15019625	1S2453 zener
C- 2	13569117T0	C00951H220G-V
C- 4, 5, 6, 7	13569121T0	C00951H471G-V
R- 104 thermistor	15229908	SDP-1000

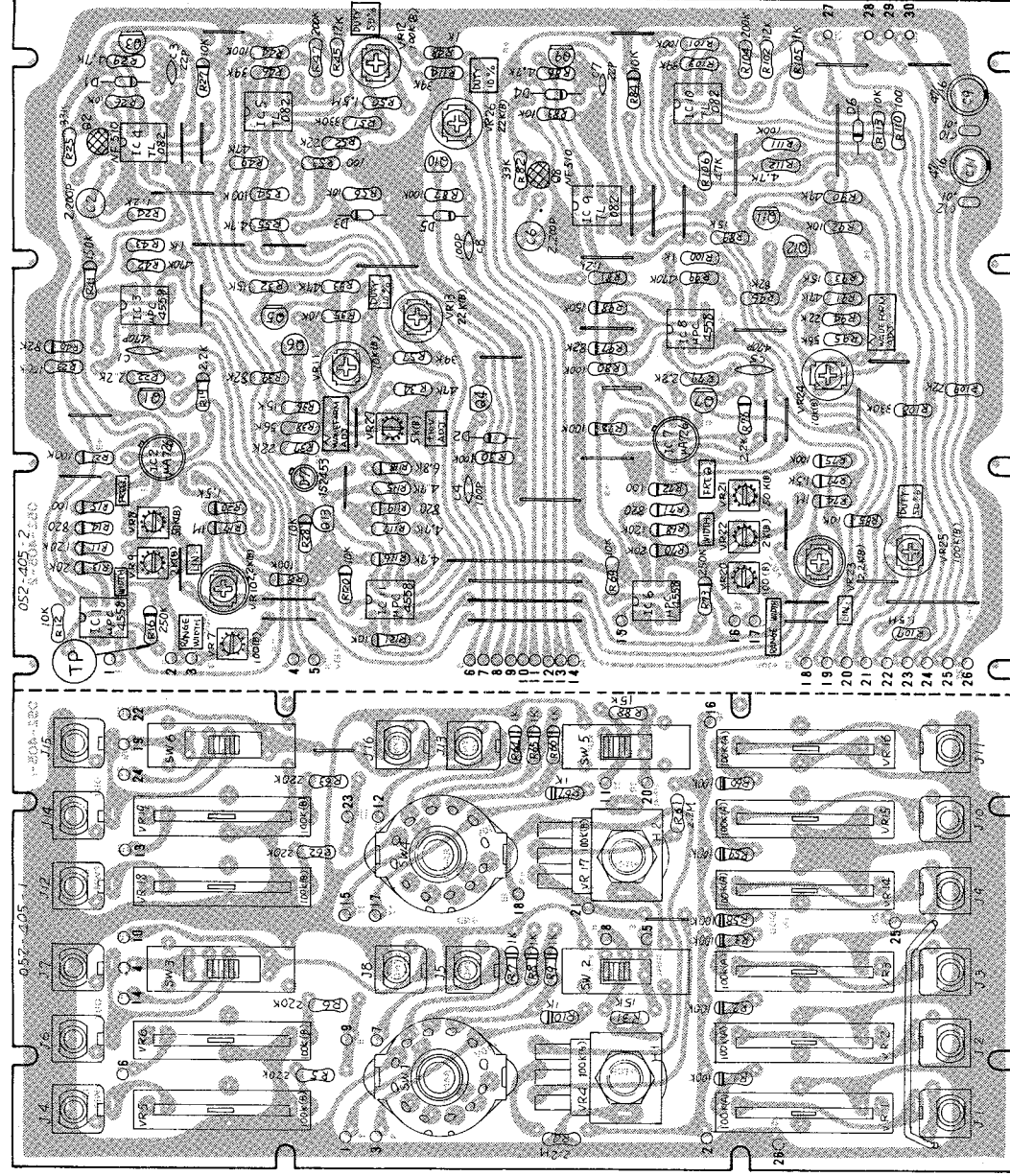
- GRB 1/4 FX 1%
- CRB 1/4 FX 0.1%
- polystyrene
- bi-polar
- tantalum



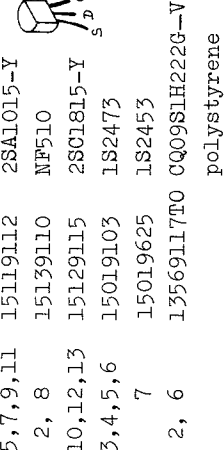
**OP9102-030 (P/N 7910203000) M-112**  
**OP9102-040 (Part number 7910204000)**  
**(pcb 052-405-1) (pcb 052-405-2)**

VCO output: lk, 10V p-p  
 Input: 50k

Freq.: 1Hz-30kHz  
 Control Sens: 1V/oct

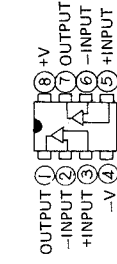


NOMENCLATURE	PART NO.	PART NAME
J- 1-16	13449402	SJ-409-1-2 /PC
SW- 1, 4	13119401	SRM-1025172
SW- 2, 5	13159103	SSB-02242
SW- 3, 6	13159304	SSB-02335
VR- 1-3, 14-16	13339301	EVA-H04C15A15
VR- 4, 17	13219220	VM1OR10C 100KB
VR- 5, 6, 18, 19	13339304	EVA-H04C15B15
VR- 7, 20	13299501	FN82-2H101H
VR- 8, 21	13299508	FN82-2H503H
VR- 9, 22	13299504	FN82-2H202H
VR- 10, 23	13299542	CF19R 2.2KB
VR- 11, 24	13299114	SR19R 10KB
VR- 12, 25	13299117	SR19R 100KB
VR- 13, 26	13299115	SR19R 22KB
VR- 27	13299507	FN82-2H502H
H- 1, 2	2219510600	Holder N-106
IC- 1, 3, 6, 8, 11	15189105	uPC4558C
IC- 2, 7	15219101	uA726HC
IC- 4, 5, 9, 10	15189118	TL082
Q- 1, 3, 5, 7, 9, 11	15119112	2SA1015-Y
Q- 2, 8	15139110	NF510
Q- 4, 6, 10, 12, 13	15129115	2SC1815-Y
D- 1, 2, 3, 4, 5, 6	15019103	1S2473
D- 7	15019625	1S2453
C- 2, 6	13569117T0	CO99SLH222G-V

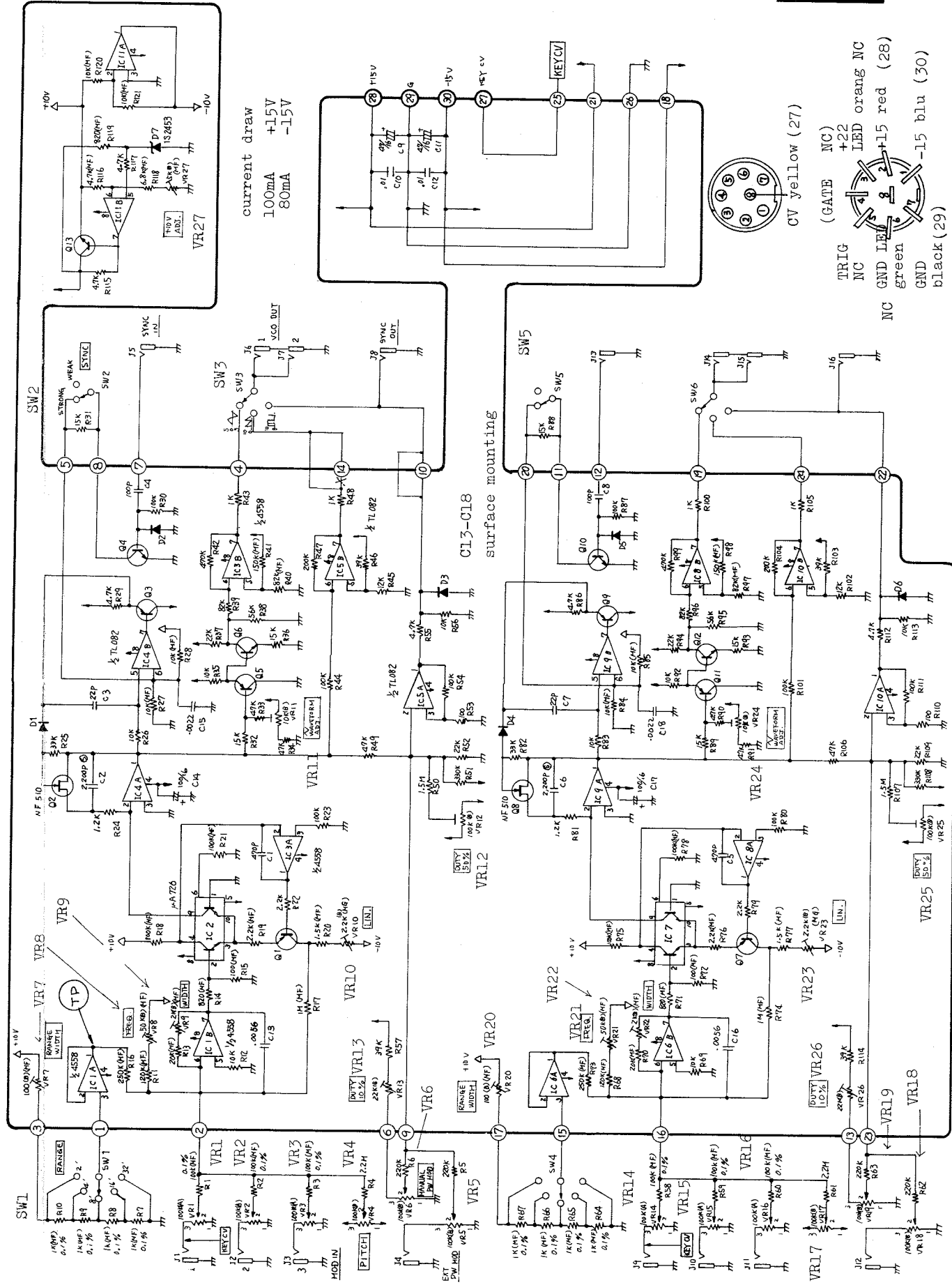


metal film  
 CRB 1/4FX 0.1% 28C-  
 metal film  
 CRB 1/4FX 1% 28A-  
 polystyrene

TOP VIEW



**uPC4558C** BP-INPUT  
**NJM4558** JFET-INPUT  
**TLO82CP**



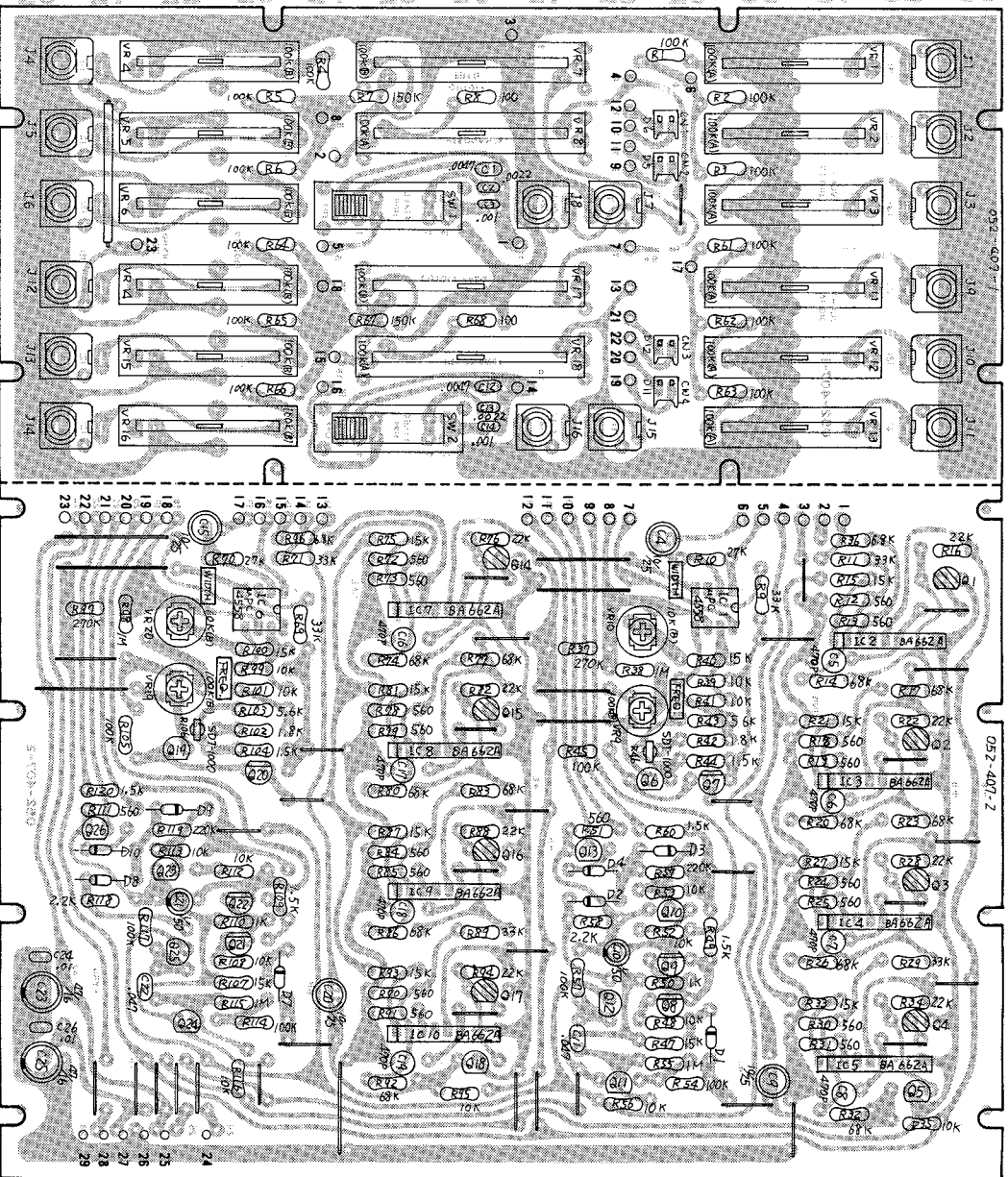
**M-112** 2VCO



OP9103-030 (P/N 7910303000)  
(pcb 052-407-1)

**M-121**

OP9103-040 (Part number 791030400)  
(pcb 052-407-2)



**UA726** M-110 M-112

The transistor pair is held at a constant temperature by active temperature regulator circuitry.

**ABSOLUTE MAXIMUM RATINGS**

Operating Temperature Range  
°C to +85°C

Supply Voltage . . . . . ±18V

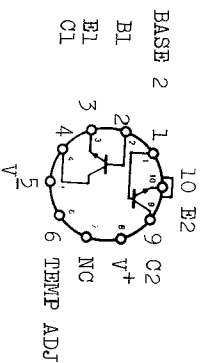
Internal Dissipation . . . . . 500mW

Collector to Emitter Voltage . . . . . 30V

Collector to Base Voltage . . . . . 40V

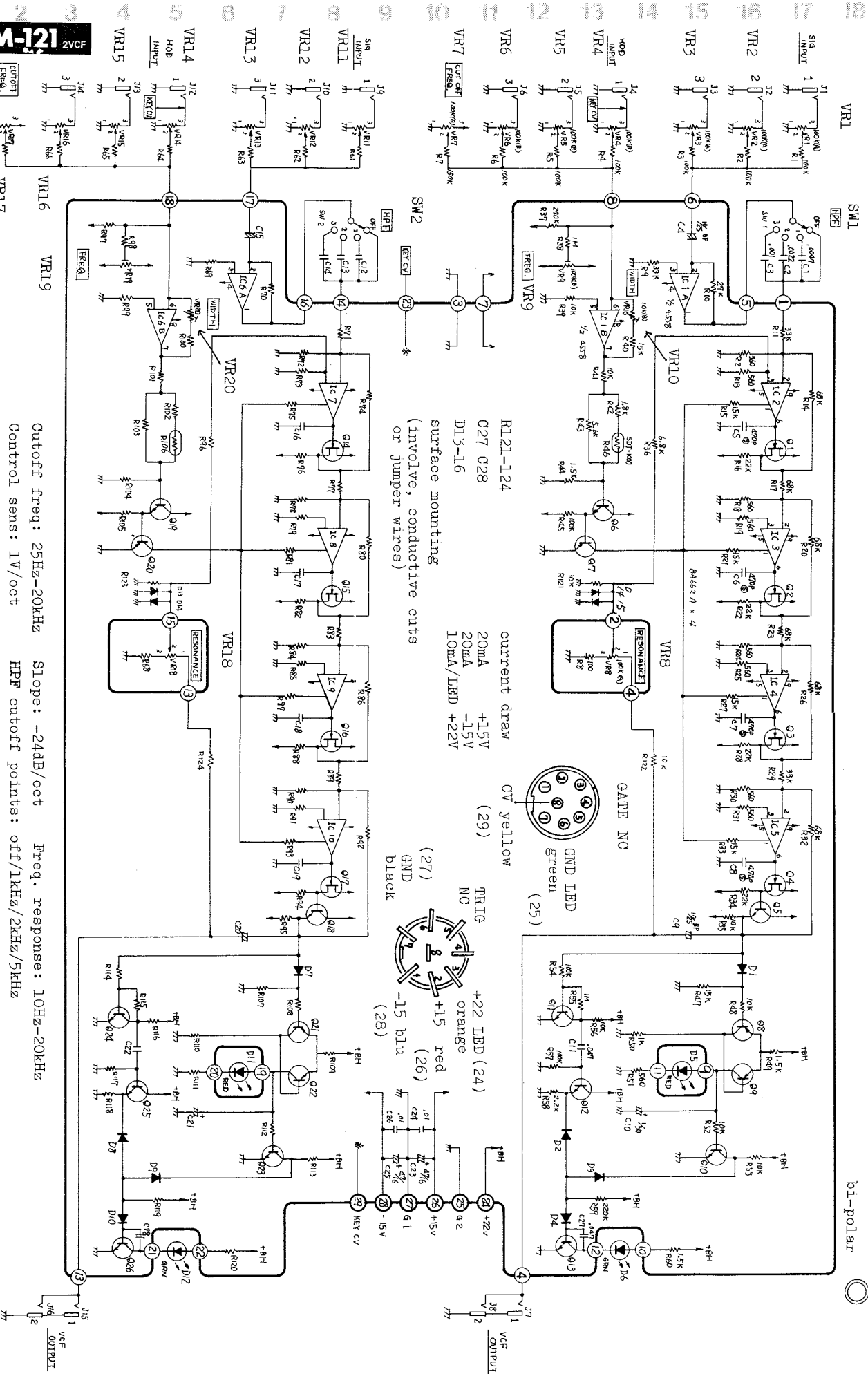
Emitter to Base Voltage . . . . . 5V

Collector Current . . . . . 5mA



NOMENCLATURE	PART NO.	PART NAME
J- 1-16	13449402	SI-409-1-2
SW- 1, 2	13159503	SQPR24-12P
VR- 1-3, 11-13	13339301	EVA-H04-G15A15
VR- 4-6, 14-16	13339304	EVA-H04-G15B15
VR- 7, 17	13339402	EVA-T04-G15B15
VR- 8, 18	13339401	EVA-T04-G15A15
VR- 9, 19	13299117	SR-19R 100KB
VR- 10, 20	13299114	SR-19R 10KB
CN- 1, 2, 3, 4,	13439502	3024-02C
IC- 1, 6	15189105	uPC4558C
IC- 2, 3, 4, 5, 7-10	15229802	BA662-A
Q- 1-4, 14-17	15139103	28K30ATM-GR
Q- 5-6, 10-13	15129115	28C1815-Y
Q- 18, 19	20-22	15119112
Q- 7-9, 20-22	15119112	28A1015-Y
D- 1-4, 7-10	15019103	1S2473
C- 5-8, 16-19	13569121T0	CQ09S1H47G-V
R- 46, 106	15229908	SDM-1000
C- 4, 9, 15, 20	13639932	BOE-A25N10

bi-polar



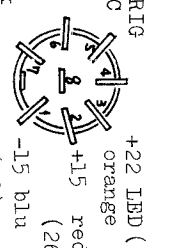
R1,21-1,24  
C27 C28  
D13-16  
surface mounting  
(involve, conductive cuts  
or jumper wires)

current draw  
20mA +15V  
20mA -15V  
10mA/LED +22V

CV yellow  
GND LED  
GREEN (25)

TRIG  
NC  
orange  
+22 LED (24)

-15 bin  
black  
GND (27)



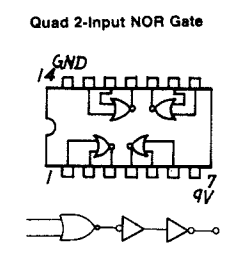
Cutoff freq: 25Hz-20KHz Slope: -24dB/oct Freq. response: 10Hz-20KHz  
Control sens: 1V/oct HPF cutoff points: off/1kHz/2kHz/5kHz

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41

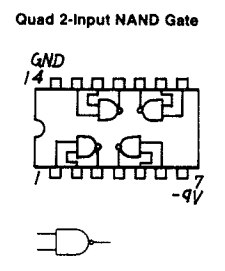
M-130 2VCA

NOMENCLATURE	PART NO.	PART NAME
J- 1-16	13449402	SJ-409-1-2
SW- 1, 2	13159103	SSB-022-42
VR- 1-3, 11-13	13339301	EVA-H04-C15A15 100KA
VR- 4-6, 14-16	13339304	EVA-H04-C15B15 100KB
VR- 7, 17	13219220	VM1ORB10CK20 100KB
VR- 8, 10, 18, 20	13299117	SR19R 100KB trimmer
VR- 9, 19	13299115	SR19R 22KB
CN- 1-4	13439502	3024-02C
IC- 1, 2	15229803	BA662-B
IC- 3	15189105	uPC4558C
Q- 1, 12	15139103	2SK30ATM-GR FET
Q- 2, 4, 8-11	15129115	2SC1815-Y
Q- 3, 5-7	15119112	2SA1015-Y
D- 1-4, 7-10	15019103	1S2473
C- 10mfd/25V	13639932	Bi-polar ECE-A25N (C9)

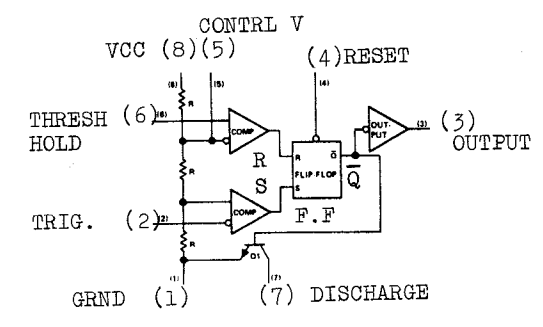
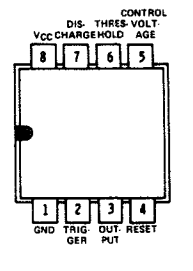
**TC4001BP**



**TC4011UBP**

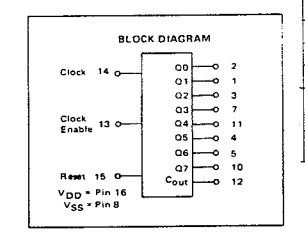


**NE555 TIMER**



**MC14022B OCTAL COUNTER/DIVIDER**

Four stage Johnson octal counter with built-in code converter.

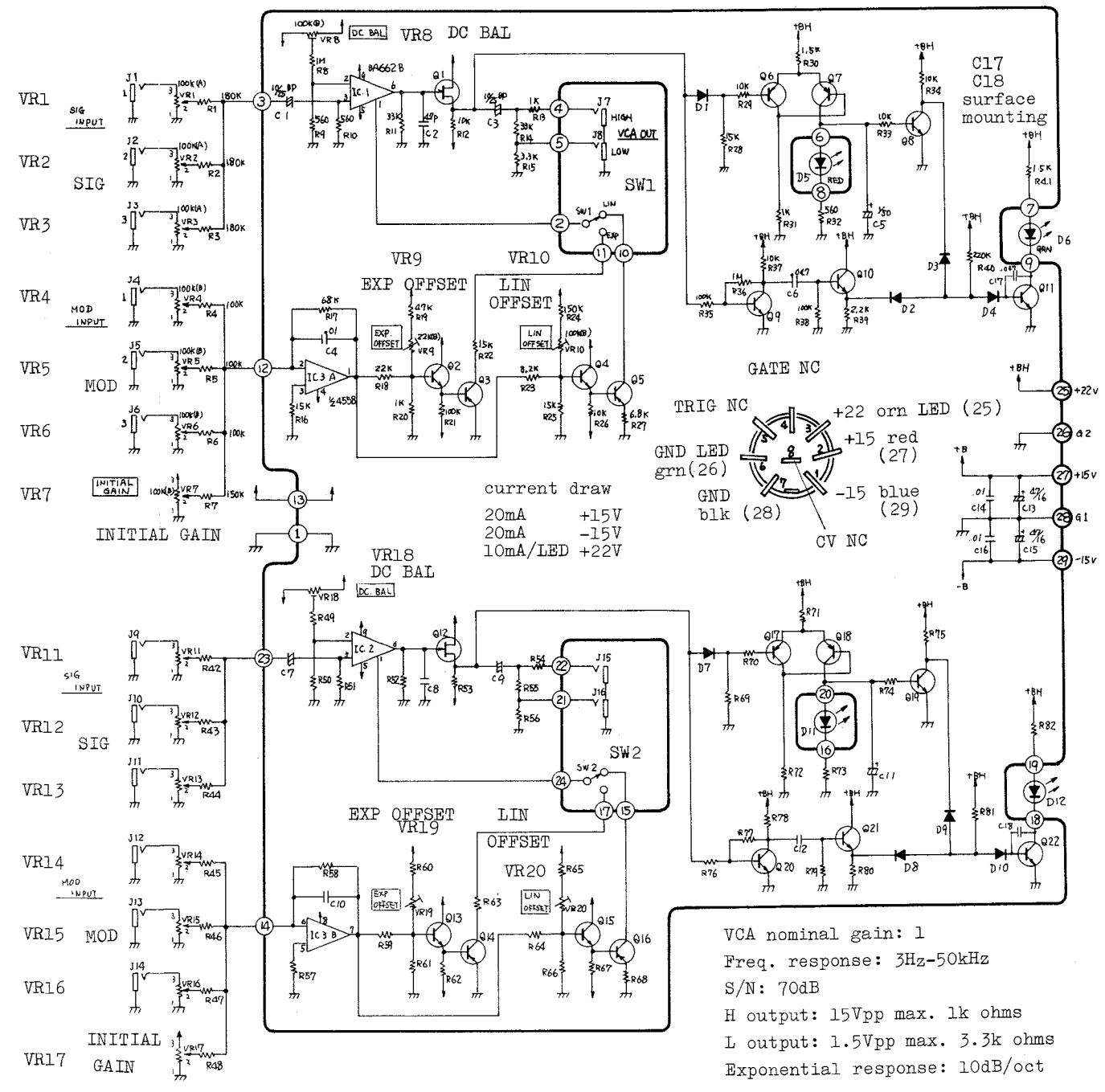
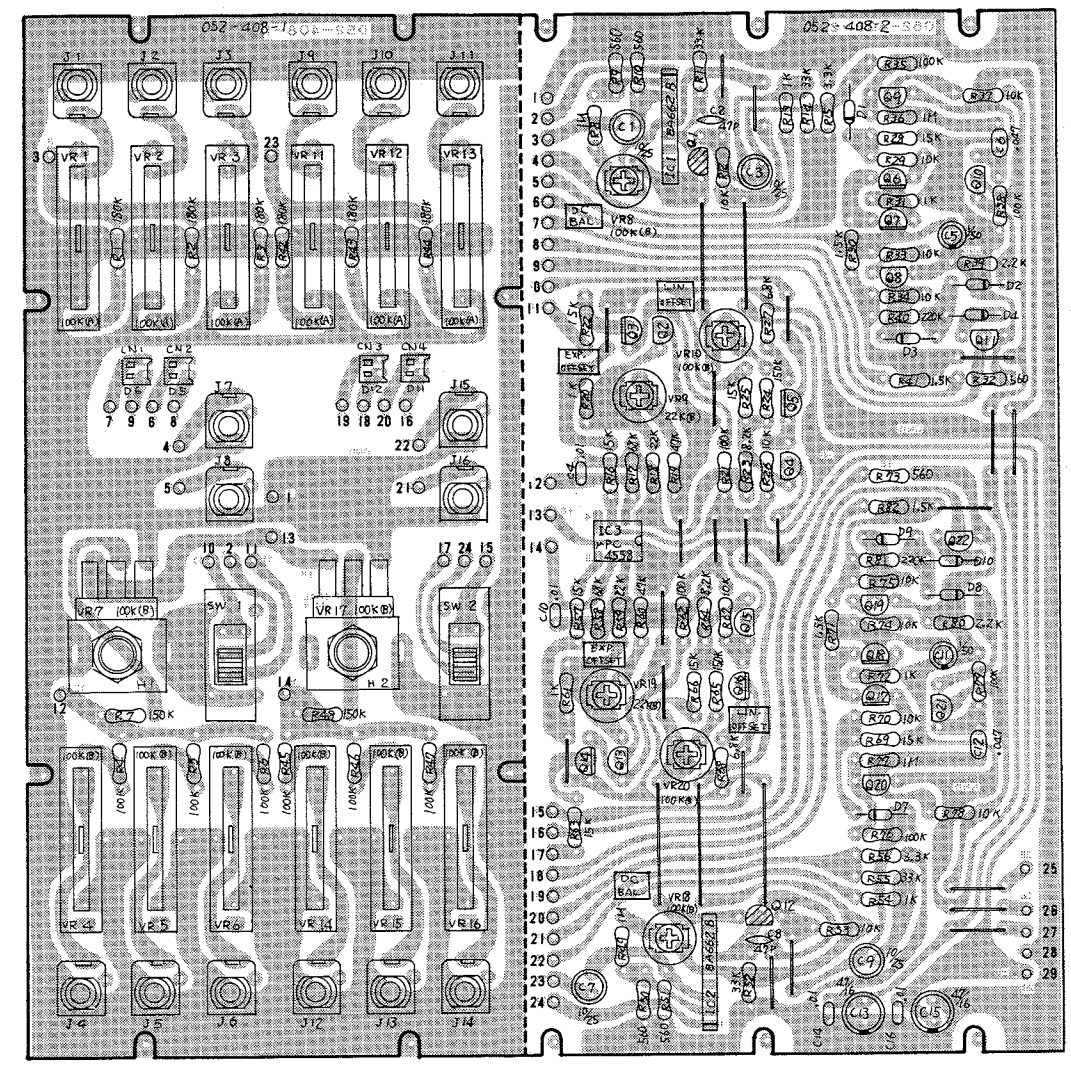


**TRUTH TABLE**

CLK	ENABLE	RESET	OUTPUT n
0	X	0	n
X	1	0	n
1	X	0	n+1
1	0	0	n
X	0	0	n
X	X	1	Q0

X Don't Care  
If n < 4 Carry=1  
Otherwise = 0

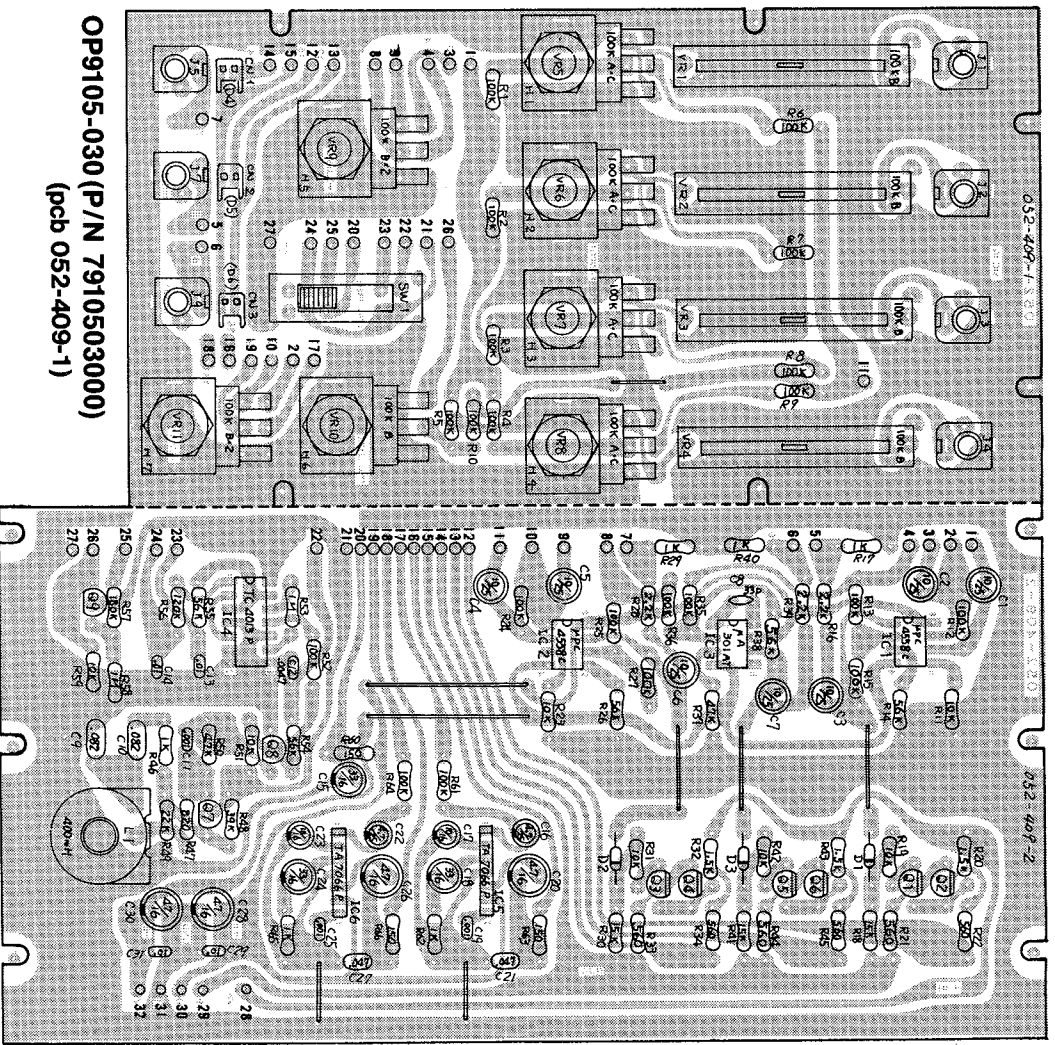
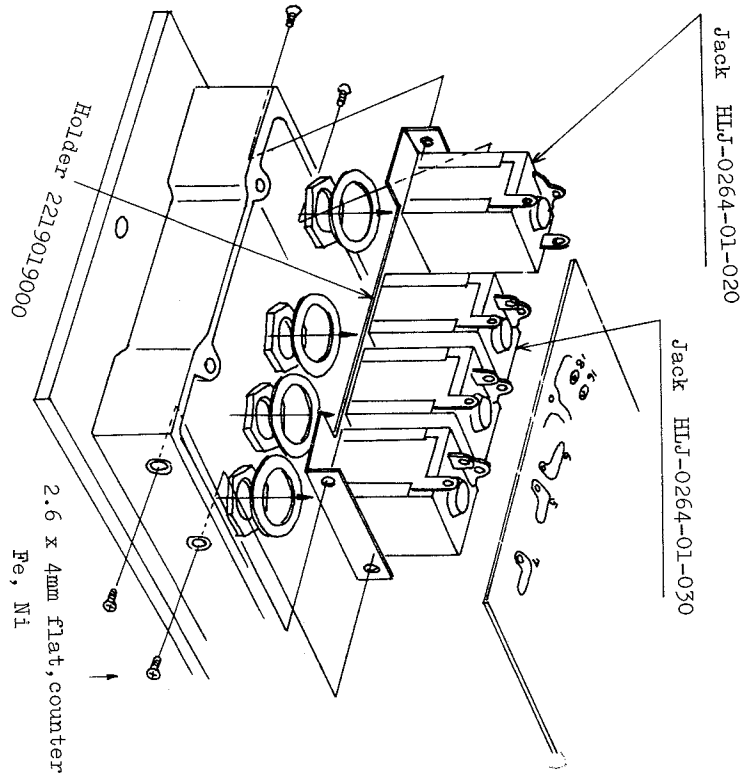
**OP9104-030 (P/N 7910403000) M-130 OP9104-040 (P/N 7910404000)**  
(pcb 052-408-1) (pcb 052-408-2)



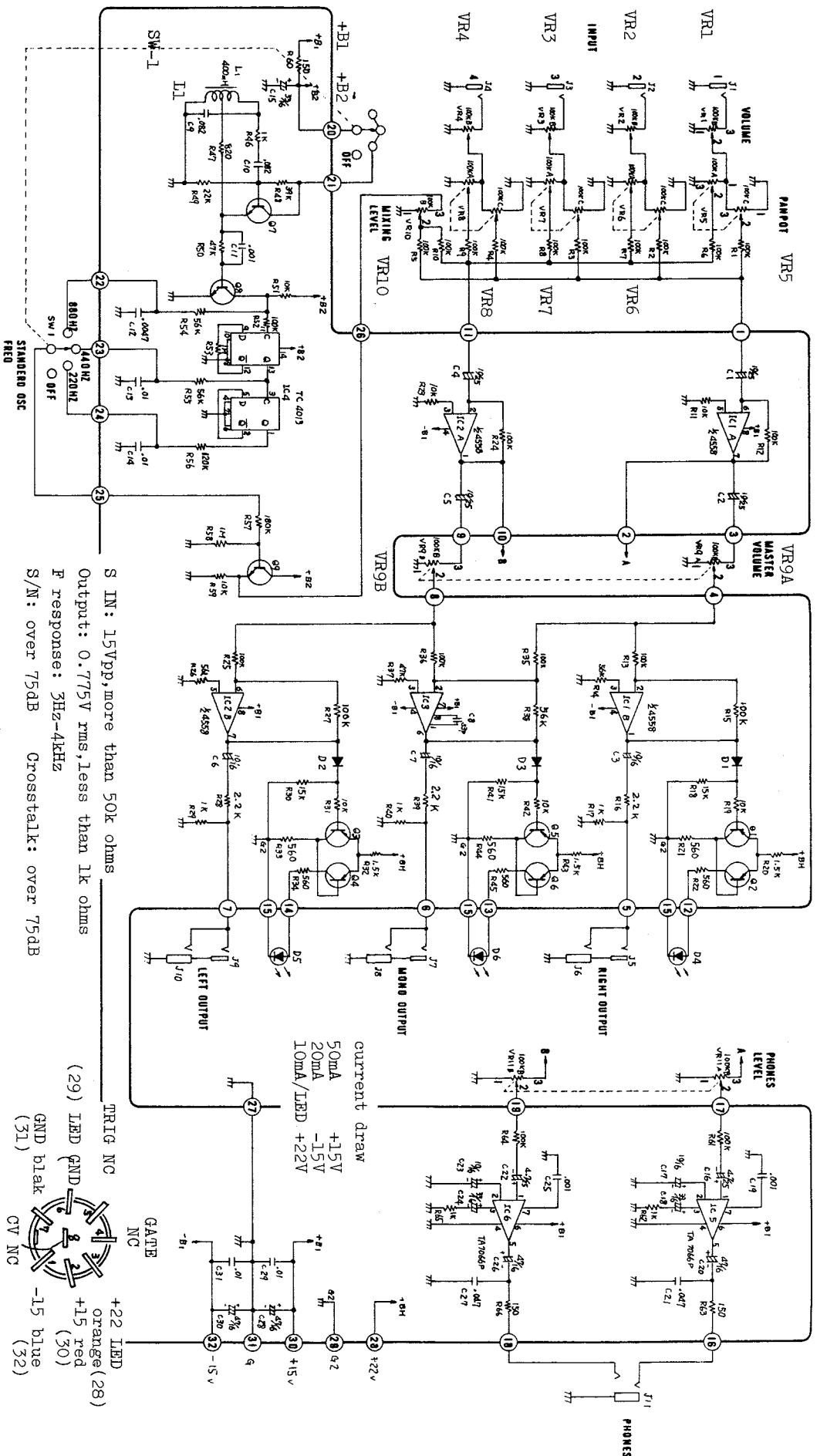
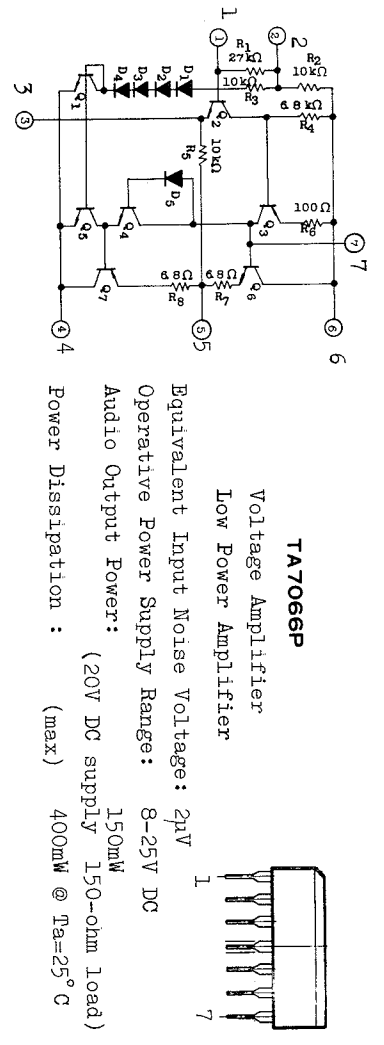
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40

**M-131** OUTPUT MIXER

NOMENCLATURE	PART NO.	PART NAME
J- 1-5, 7-9	13449402	SJ-409-1-2
J- 6, 8, 10	13449115	HLJ-0264-01-030
J- 11	13449114	HLJ-0264-01-020
SW- 1	13159503	SQPR24-12P
VR- 1-4	13339402	EVA-TOA-C15B15
VR- 5-8	13219806	GM7OR910E K20 100KB A/C
VR- 9, 11	13219807	GM7OR910E K20 100KB x 2
VR- 10	13219220	VMIORB10C K20 100KB
H- 8	2219019000	Holder N-190
D- 4-6	15029110	GL-3AR-1
IC- 1, 2	15189105	UPC4558C
IC- 3	15189109	UA301HC
IC- 4	15159105F0	TC4013BP
IC- 5, 6	15199502	TA7066AP
Q- 1-6	15119112	2SA1015-Y
Q- 7-9	15129115	2SC1815-Y
D- 1-3	15019103	1S2473
L- 1	2244021200	Coil MC4RV 400mH
C- bi-polar	13639932F0	ECBA25N10 10mfcd/25V



**M-131** OP9105-040 (P/N 7910504000) (pcb 052-409-2)



S IN: 15Vpp, more than 50k ohms  
Output: 0.775V rms, less than 1k ohms  
F response: 3Hz-4kHz  
S/N: over 75dB  
Crosstalk: over 75dB

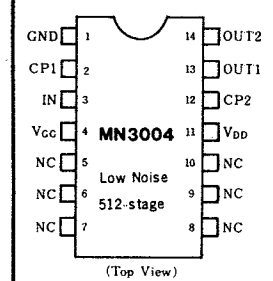


1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41

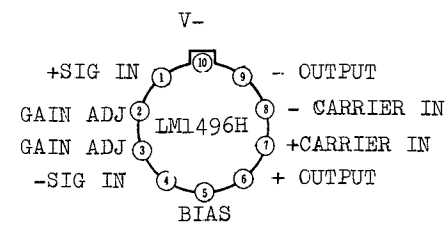
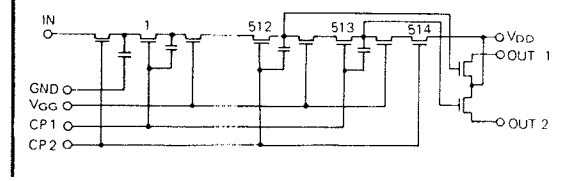
A  
B  
C  
D  
E  
F  
G  
H  
I  
J  
K  
L  
M  
N  
O  
P  
Q  
R  
S  
T  
U  
V

**M-132** DUAL CV/AUDIO MIXER & VOLTAGE PROCESSOR

NOMENCLATURE	PART NO.	PART NAME
J-	1-18	13449402 SJ-409-1-2
VR-	1-8	13339304 EVA-HO4C15B15
VR-	9, 10	13339402 EVA-TOAC15B15
VR-	11,12	13299544 CR19R 22KB
IC-	1-4	15189105 uPC4558C
Q-	1-4	15119112 2SA1015-Y
D-	1-4	15019103 1S2473
C-		13639149J0 BCE-A16V47 47/16V

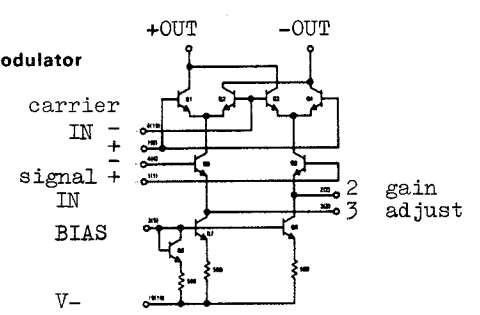


**BBD**  
Signal Delay Time  
2.56ms-25.6ms  
S/N 85dB typ  
VDD -15V  
VGG -14V  
THD 0.4%



Output voltage is proportional to the product of an input (signal) voltage and a switching (carrier) signal.  
Carrier Suppression: 65dB typ. @ 0.5MHz  
50dB typ. @ 10MHz

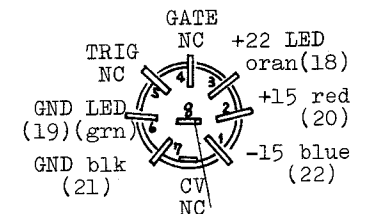
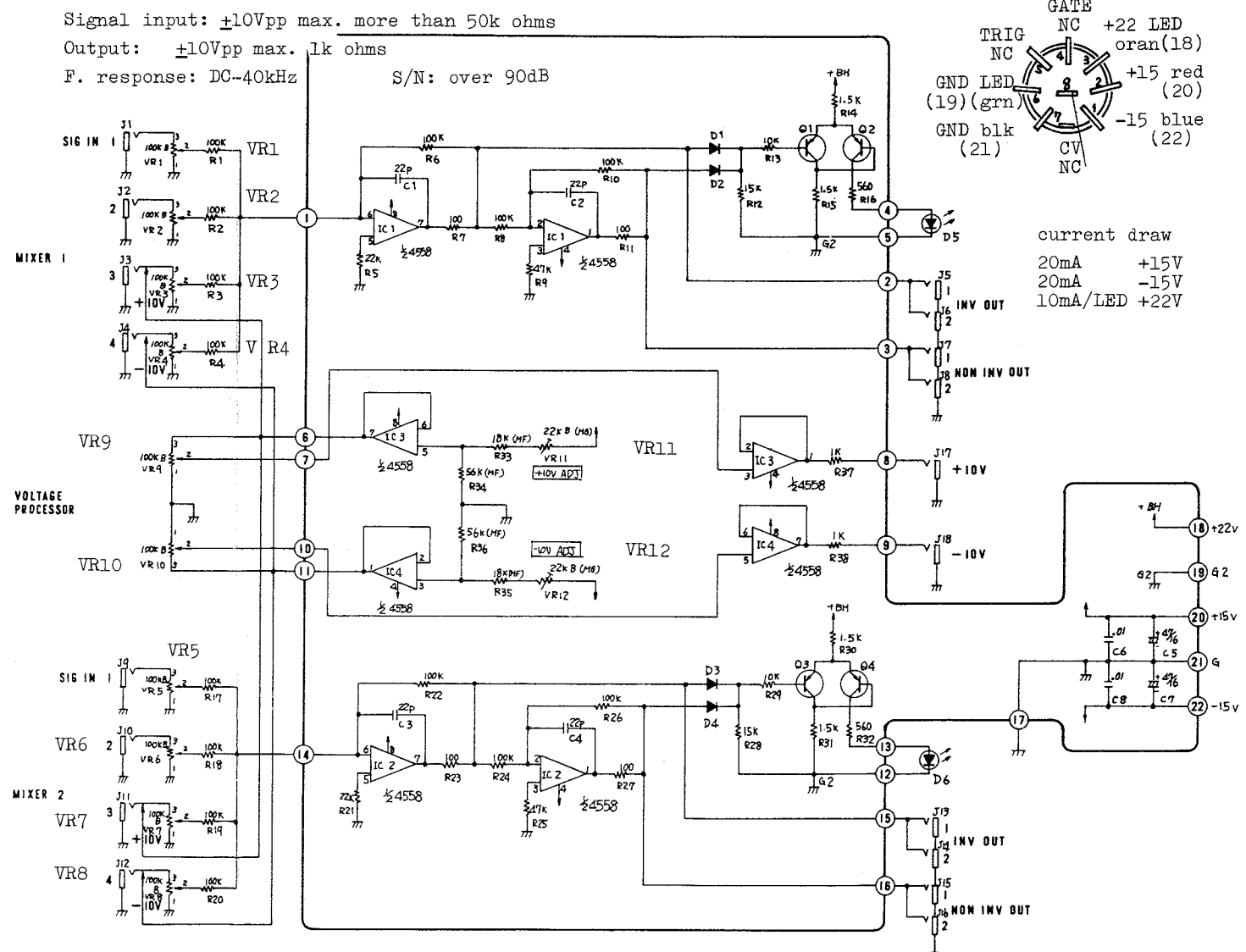
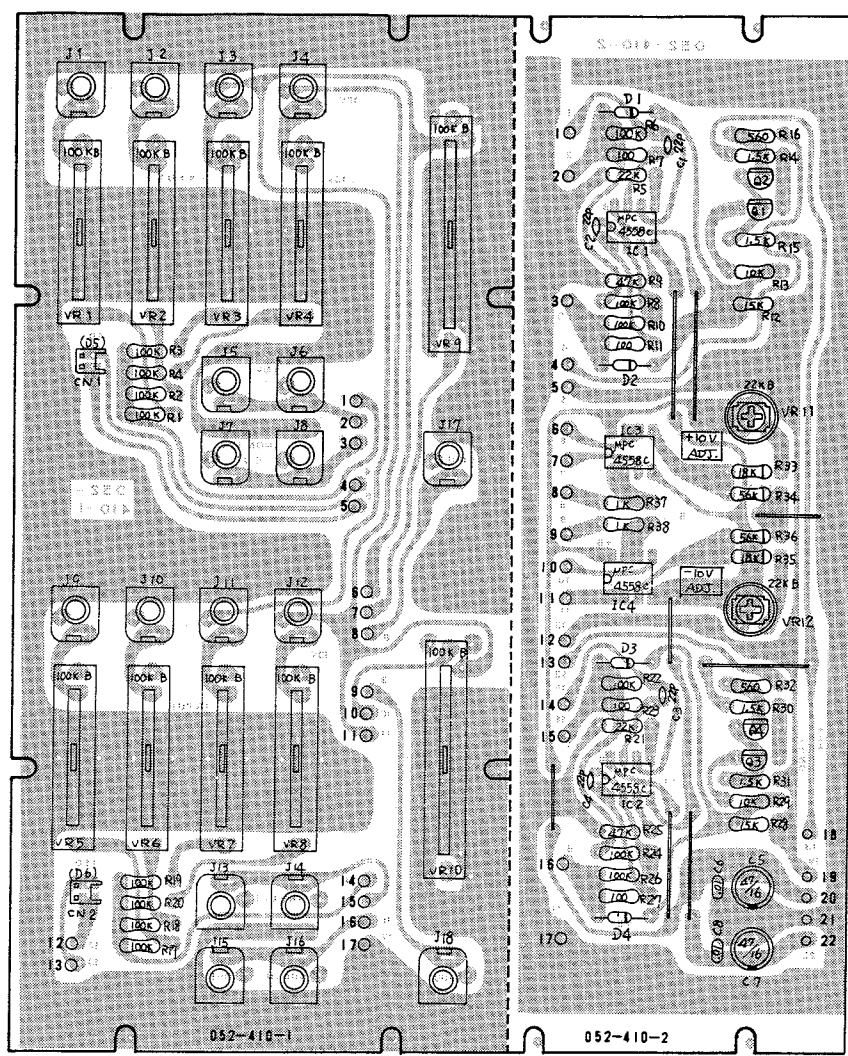
**LM1496**  
balanced modulator-demodulator



OP9106-030 (P/N 7910603000)  
(pcb 052-410-1)

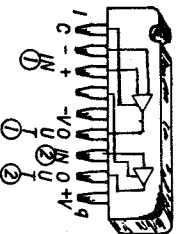
**M-132**

OP9106-040  
(Part Number 7910604000)  
(pcb 052-410-2)



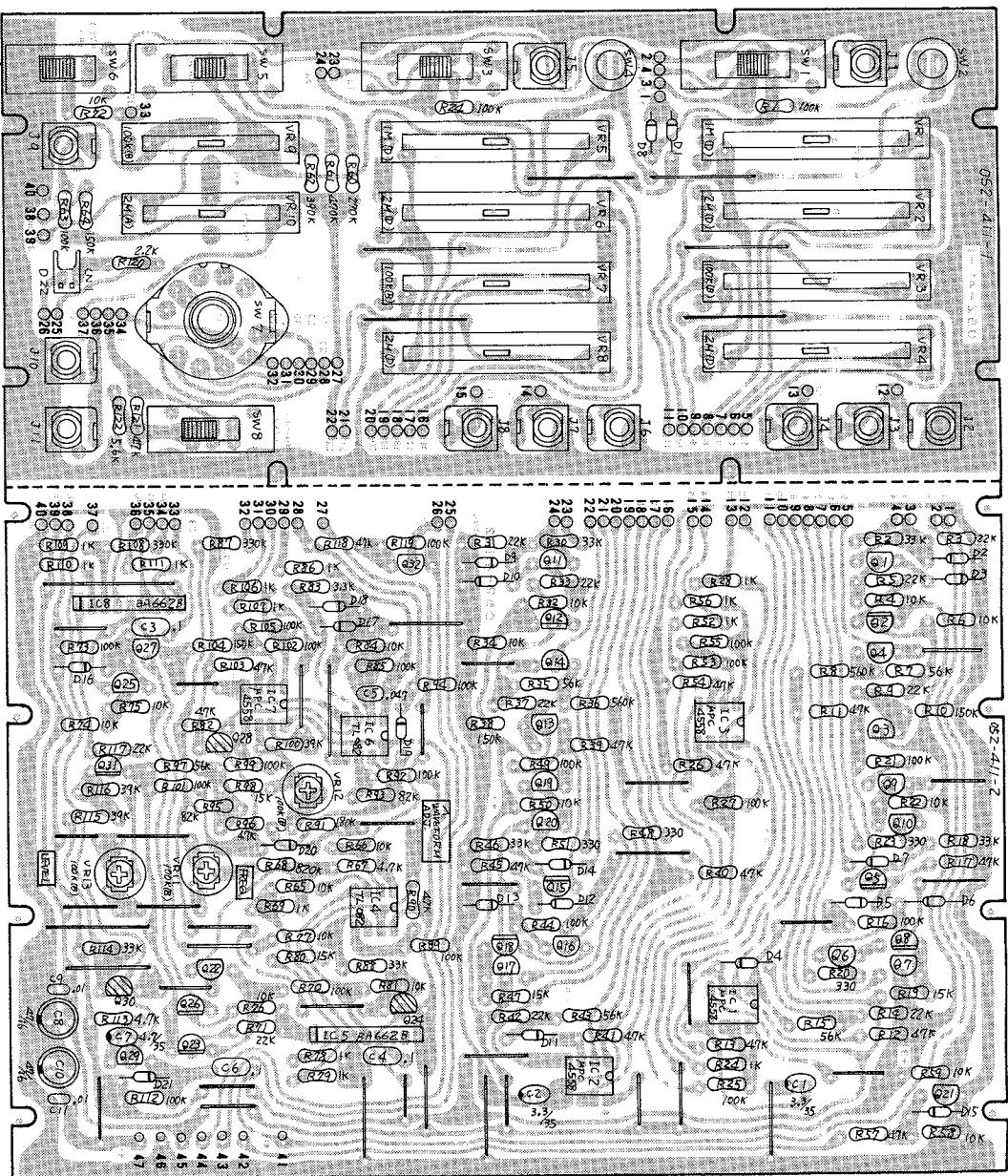
current draw  
20mA +15V  
20mA -15V  
10mA/LED +22V

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40



**BA662 A**  
**BA662 B**

Roland Custom-made DC Controlled Variable Transconductance (gm) Amp.  
 \* Device with an "A" suffix features lower offset coefficients.  
 \* For some particular applications, BA662's are further classified based on "gm" and are painted in a group color. Both BA662 "A" and "B" in the same color are characterized by a "gm" in the range.  
 Since suffix "A" indicates superior performance, the BA662 "A" is a good alternative for the existing BA662's in the 100M modules.



BA662 "B" can replace only where designation is "B" or "A" or "B" in circuit diagram or on accompanying list. Device without the suffix will be found on several occasions. Labelling them with suffix is preferable for future reference especially when storing as spare. Also, there might be colored ones, inevitable dependency on IC availability, having no significant meaning in terms of modules' performances, but restoration of more accurate characteristics would be expected if replacement is in the same color.  
**COLOR HAS GREAT IMPORTANCE** in circuits of some MODELS.

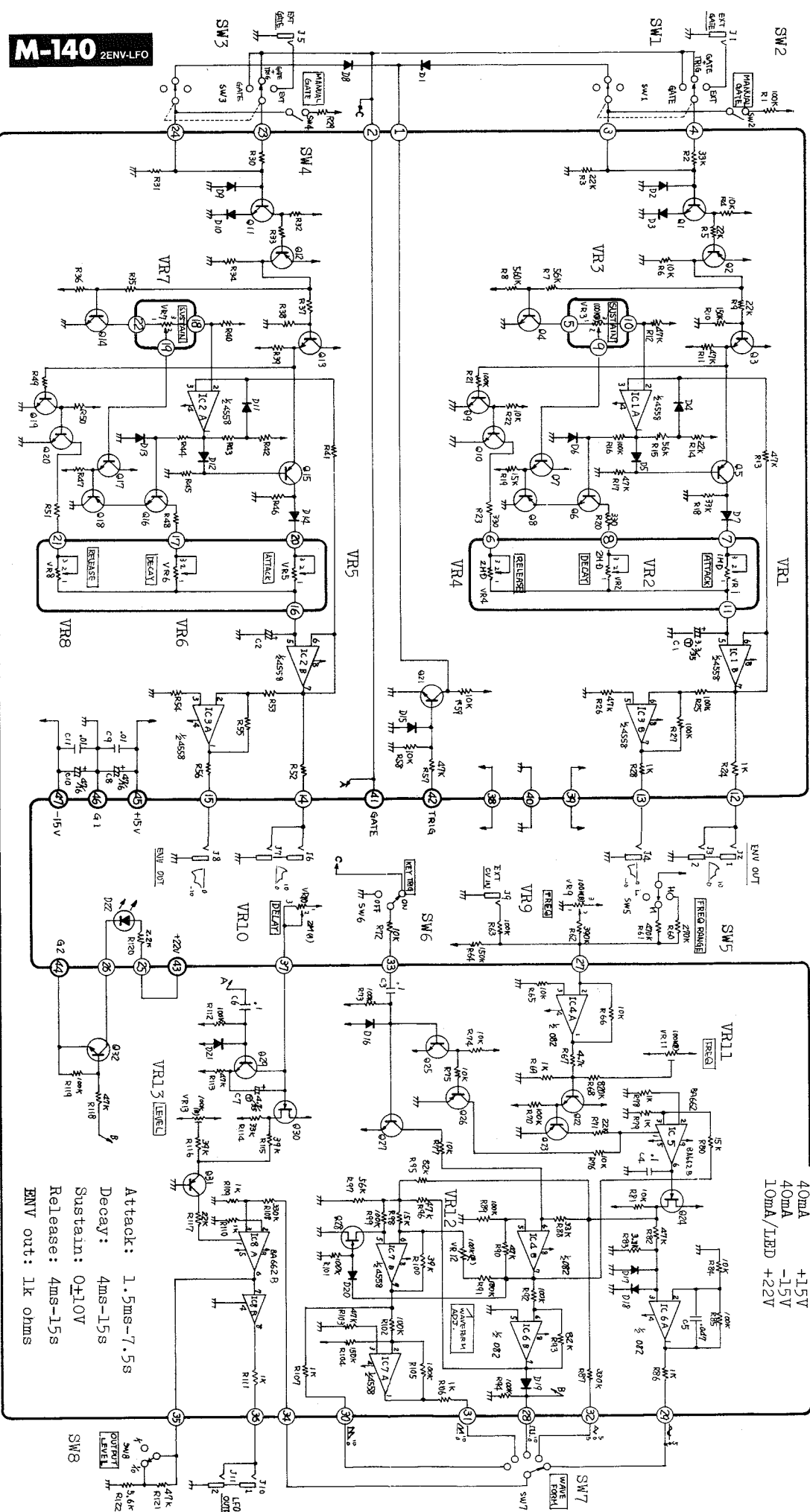
NOMENCLATURE	PART NO.	PART NAME
J- 1-11	13449402	SJ-409-1-2
SW- 1, 3, 5	13159304	SSB-02335
SW- 2, 4	13129901	DS-102 red
SW- 6, 8	13159103	SSB-022-42
SW- 7	13119401	SRM-1025172
VR- 1, 5	13359403	EVA-T0A015D16
VR- 2, 4, 6, 8	13359404	EVA-T0A015D26
VR- 3, 7	13359304	EVA-H04-C15B15
VR- 9	13329917	EVA-H04-C15A26
VR- 11, 12, 13	13299117	SR19R 100KB
IC- 1, 2, 3, 7	15189105	uPC4558C
IC- 4, 6	15189118	TL082CP
IC- 5, 8	15229803	BA662-B
Q- 1, 3, 4, 6, 7, 9-11, 13, 14, 16, 17, 19-22, 25, 27, 29, 32	15129115	2SC1815-Y
Q- 2, 5, 8, 12, 15, 18, 23, 26, 31	15119112	2SA1015-Y
Q- 24, 28, 30	15139103	2SK30ATM-GR
D- 1-21	15019103	1S2473
C- 1, 2	13619710N0	3.3mfcd/35V tantalum
C- 7	13619711N0	4.7mfcd/35V tantalum

**OP9107-030 (P/N 7910703000)**  
**M-140** (pcb 052-411-1)

**OP9107-040 (Part number 7910704000)**  
**M-140** (pcb 052-411-2)

Gate/Trig in: 50k ohms, 3V min.  
 LFO: 0.05Hz-30Hz  
 Control sens: 1V/oct

Output: 10Vpp, 1k ohms  
 Delay time: 0-7s



GATE white (41)  
 TRIG brn (42)  
 +22 LED orn (43)  
 Gnd LED grn (44)  
 +15 LED red (45)  
 Gnd blk (46)  
 -15 blk (47)  
 current draw  
 40mA  
 40mA  
 -15V  
 10mA/LED +22V

Attack: 1.5ms-7.5s  
 Decay: 4ms-15s  
 Sustain: 0-10V  
 Release: 4ms-15s  
 ENV out: 1k ohms

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z



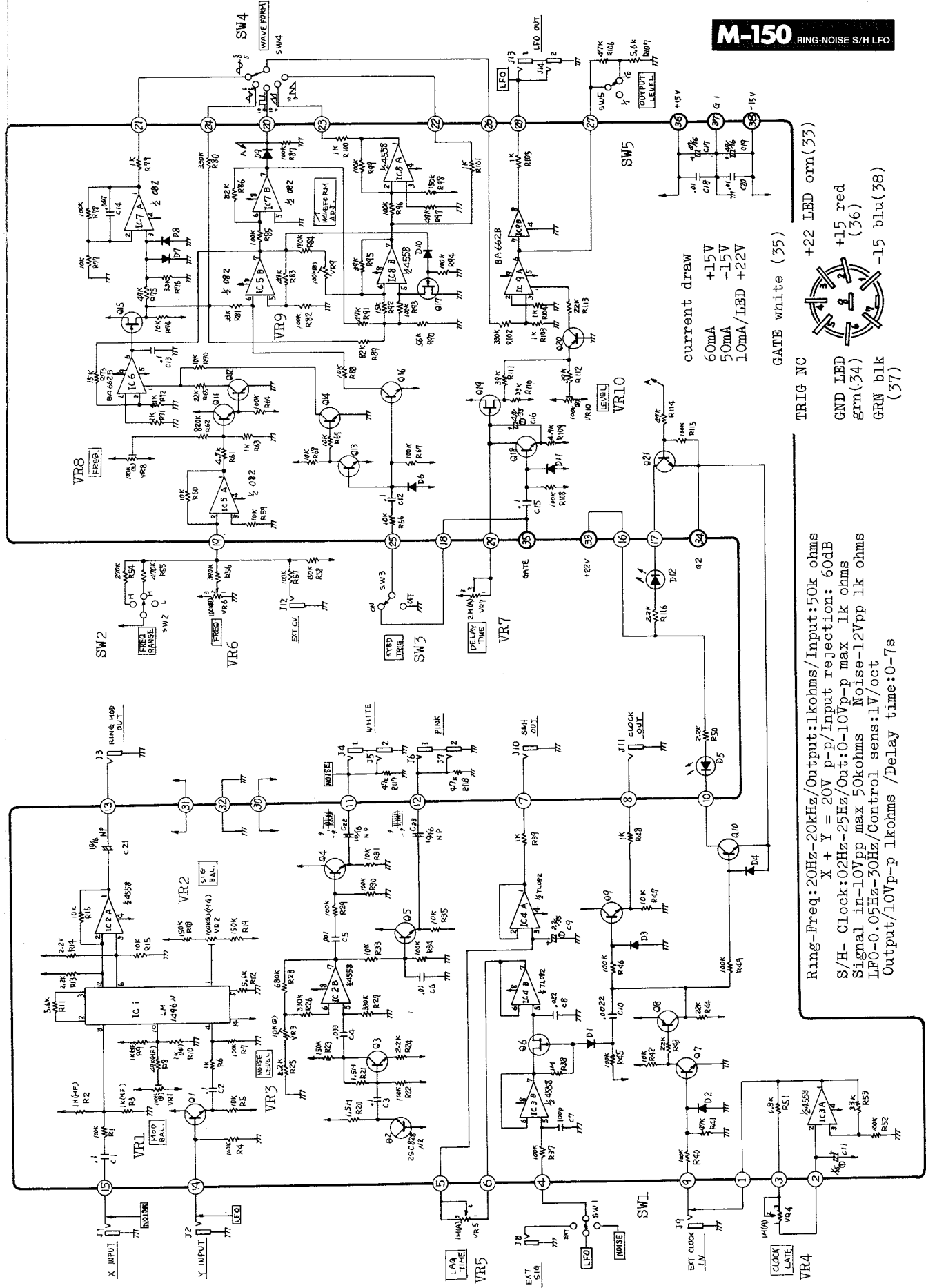
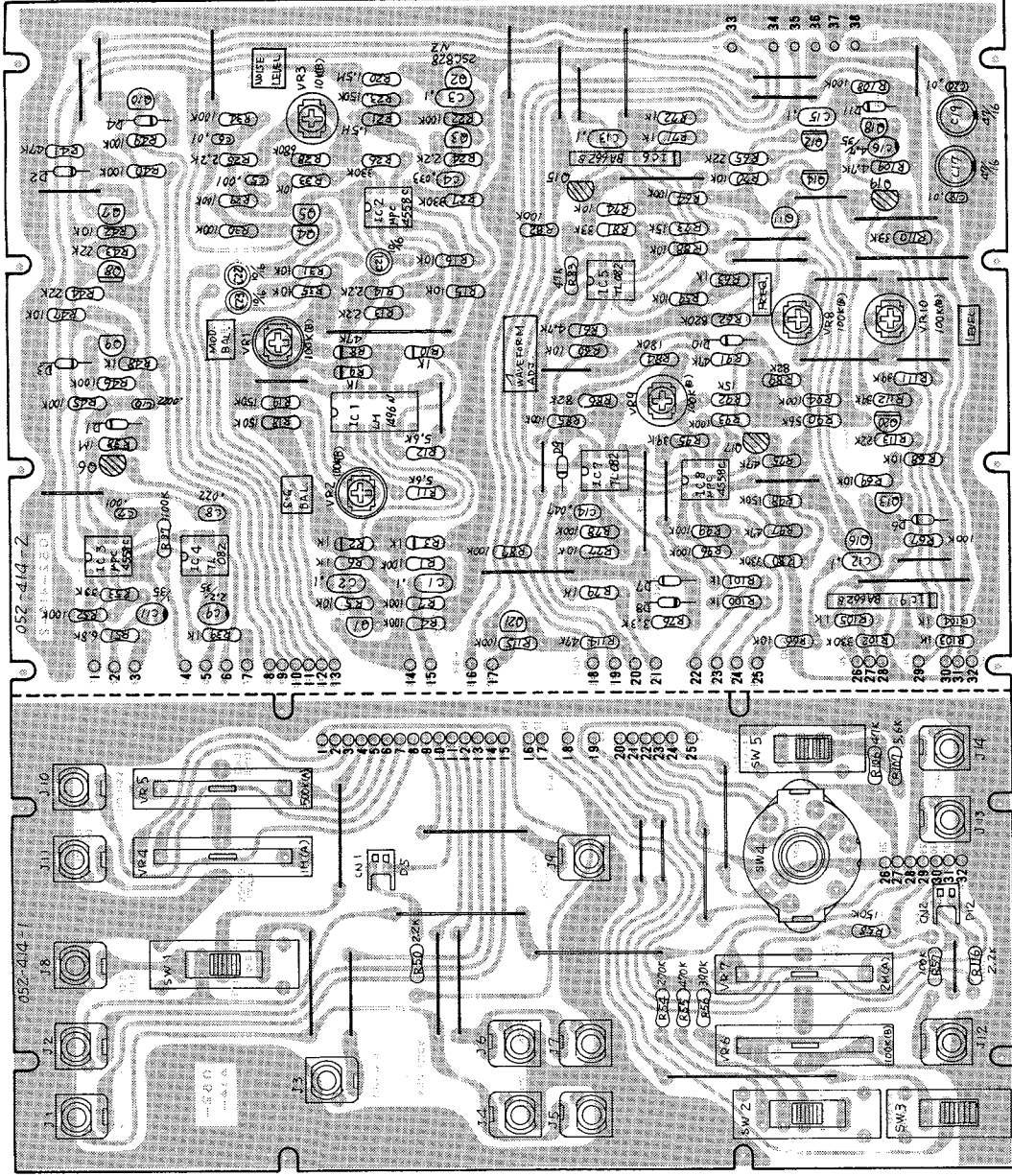
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41

OP9108-030 (P/N 7910803000)  
(pcb 052-414-1)

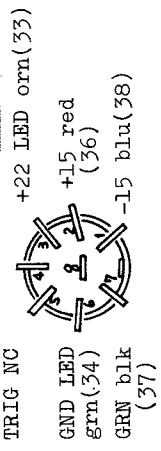
OP9108-040 (Part number 7910804000)  
(pcb 052-414-2)

**M-150**

NOMENCLATURE	PART NO.	PART NAME
J- 1-14	13449402	SJ-409-1-1-2
SW- 1, 2	13159304	SSB-02335
SW- 3, 5	13159103	SSB-02242
SW- 4	13119401	SRM1025172
VR- 1, 2	13299546	OR19R 100KB
VR- 3	13299114	SR19R 10KB
VR- 4	13339302	EVA-H04C15A16
VR- 5	13339305	EVA-H04C15A55
VR- 6	13339304	EVA-H04C15B15
VR- 7	13339303	EVA-H04C15A26
VR- 8, 9, 10	13299117	SR19R 100KB
CN- 1, 2	13439502	3024-02C
IC- 1	15219106	IM1496N
IC- 2, 3, 8	15189105	uPC4558C
IC- 4, 5, 7	15189118	TL0820P
IC- 6, 9	15229803	BA662-B
Q- 1, 3-5, 7	15129115	2SC1815-Y
Q- 9-11, 13, 16, 18, 21	15129105A	2SC828R selected for noise generator
Q- 6, 15, 17	15139103	2SK30ATM-GR
Q- 19	15119112	2SA1015-Y
Q- 8, 12, 14	15019103	1S2473
D- 1-4, 6-11	13619709N0	2.2mfd/35V
C- 9	13619707N0	1mfd/35V
C- 11	13619711N0	4.7mfd/35V
C- 16		tantalum
C-	13639149J0	ECEAL6V47 47mfd/16V
C-	13639922J0	BOEAL6N10 b1-polar



**M-150** RING-NOISE S/H LFO

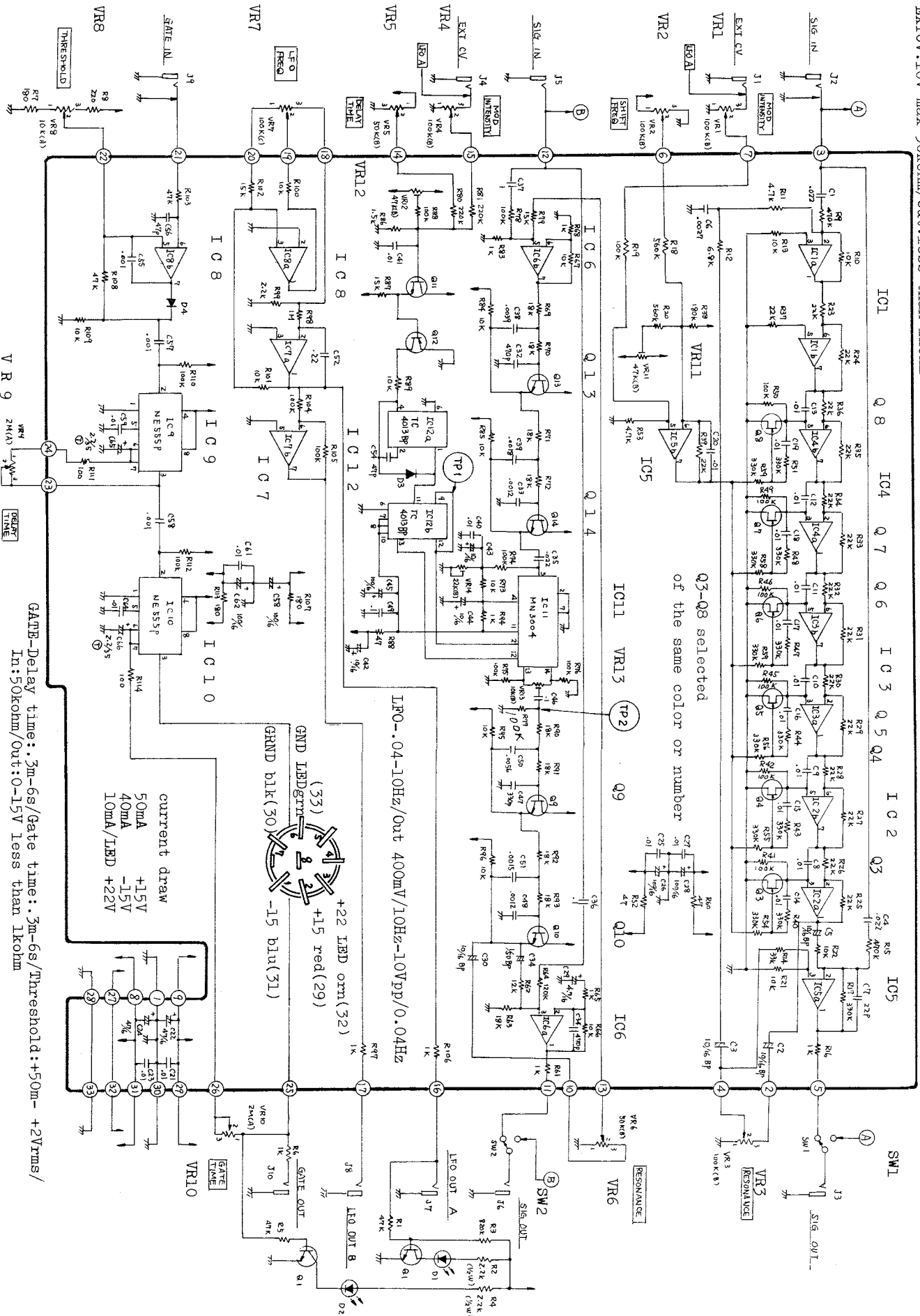


Ring-Freq: 20Hz-20kHz/Output: 1kohms/ Input: 50k ohms  
 X + Y = 20V p-p/ Input rejection: 60dB  
 S/H- Clock: 0.2Hz-25Hz/ Out: 0-10V p-p max 1k ohms  
 Signal in- 10Vpp max 50kohms Noise- 12Vpp 1k ohms  
 LFO- 0.05Hz- 30Hz/ Control sens: 1V/oct  
 Output/ 10V p-p 1kohms / Delay time: 0-7s

current draw  
 60mA +15V  
 50mA -15V  
 10mA/LED +22V

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40

M-172 PHASE SHIFTER/AUDIO DELAY/GATE DELAY



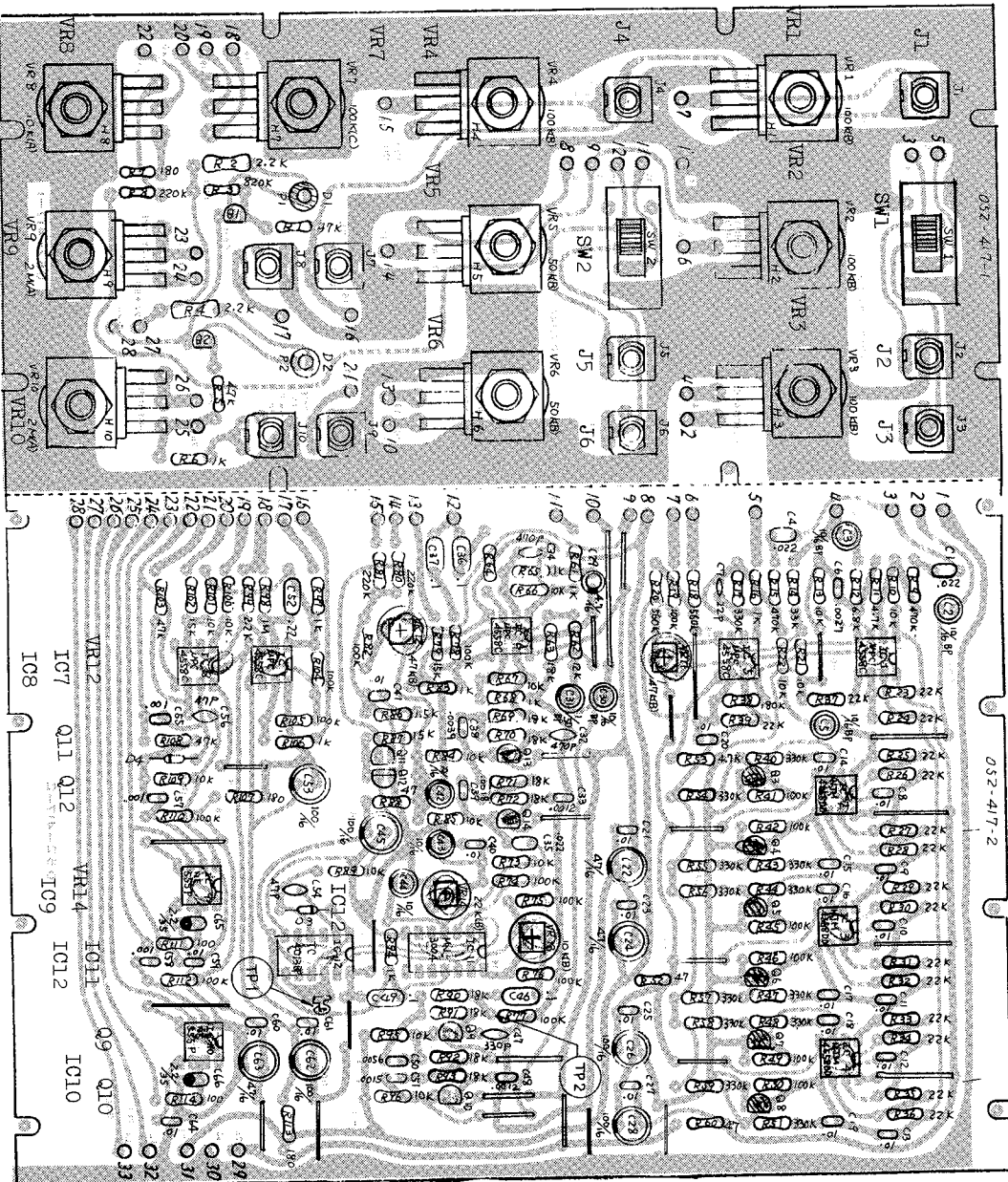
PH. SHIFR-200Hz-8kHz/1080° F resp: 20Hz-20KHz  
 S/N: 60dB/In: 10V/50kohm/Out: less 1kohm  
 EXT CV: 10V max 50kohm/Out: less than 1kohm

OP9109-030 (7910903000)  
 (pcb 052-417-1)

M-172

OP9109-040 (Part number 7910904000)  
 (pcb 052-417-2)

A. DELAY-.0m-7ms/30Hz-20KHz/ S/N: 60dB/In: 10V  
 50K/Out: less 1k/EXT CV: 10Vmax 50kohm



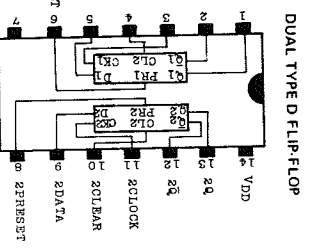
TRUTH TABLE

INPUTS		OUTPUTS	
Q1	PR D	Qn+1	Qn+1
L	H	*	H
L	L	*	L
H	L	*	H
H	H	*	L
L	L	*	H
L	H	*	L
L	L	*	H
L	L	*	H

\*: Don't Care  
 .: No Change

4013B

DUAL TYPE D FLIP-FLOP

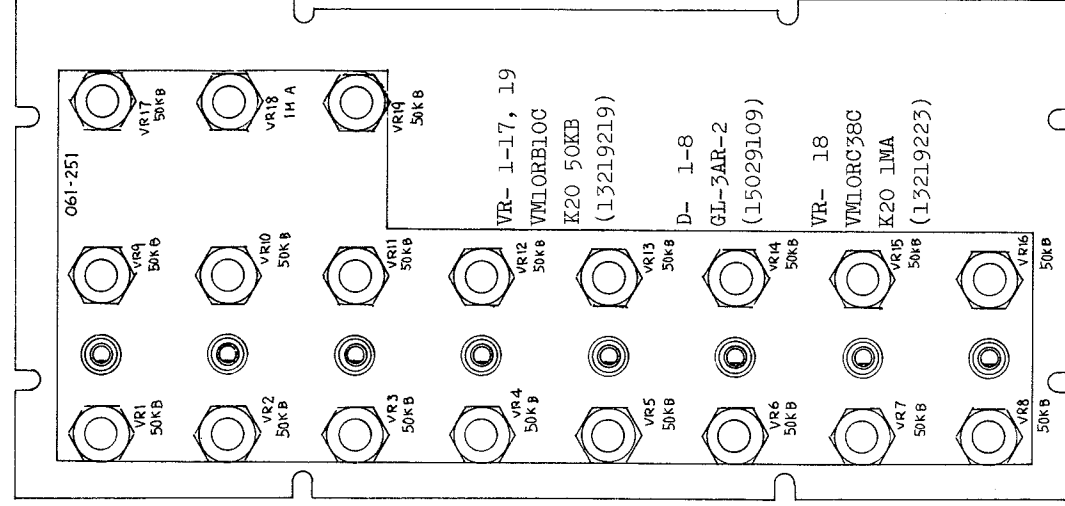
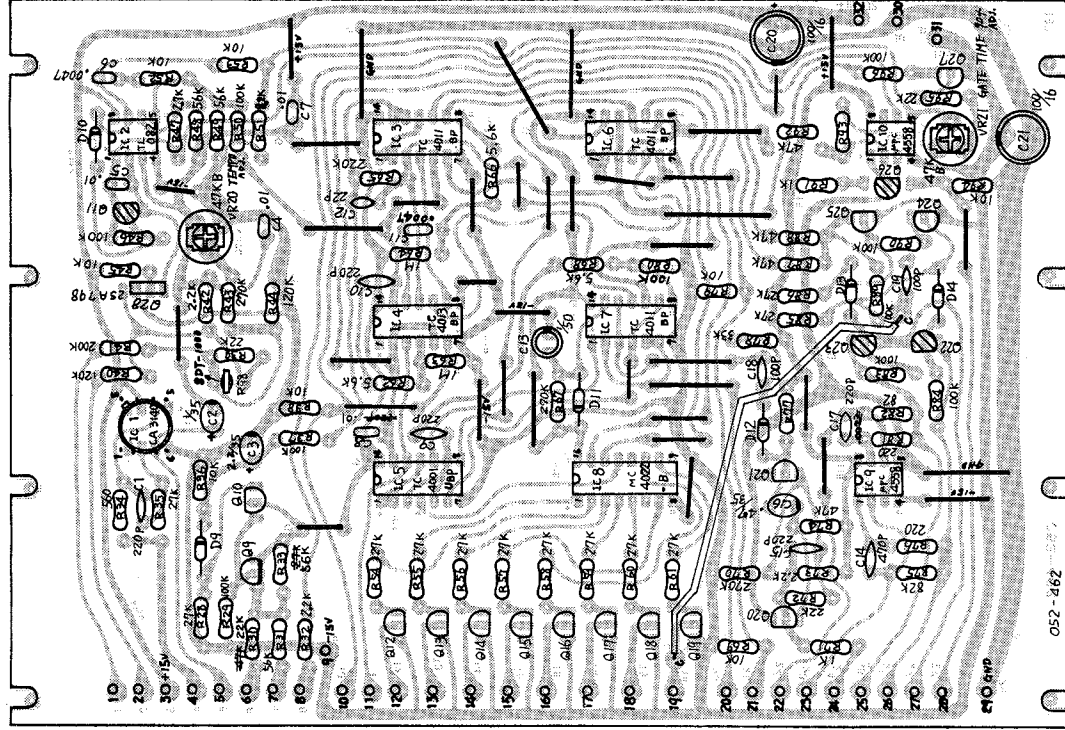
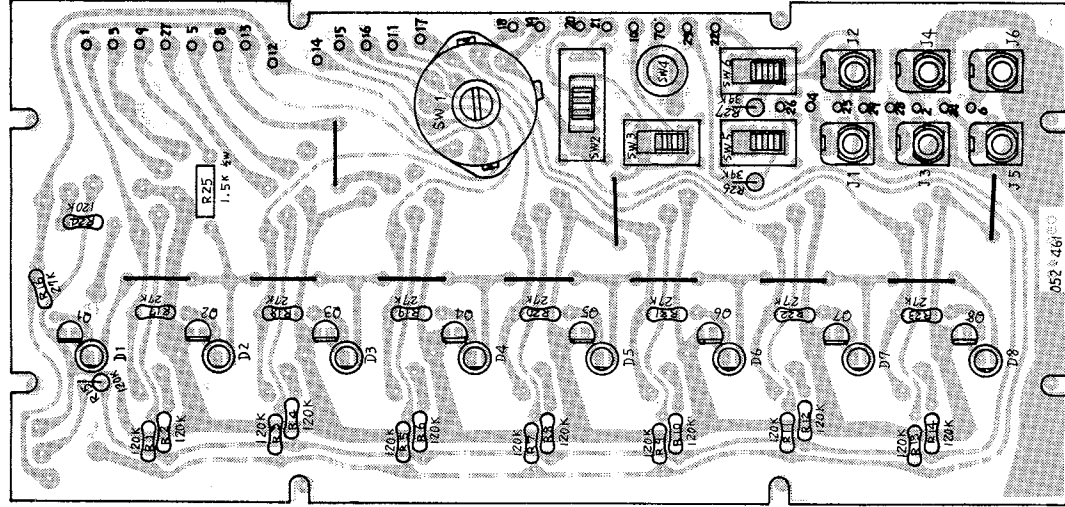


NOMENCLATURE	PART NO.	PART NAME
J- 1-10	13449402	SJ-409-1-2
SW- 1, 2	13159103	SSB02242
VR- 1, 2, 4	13219220	VM1ORB10C K20 100KB
VR- 3	13219225	VM1ORC38C K20 10KB
VR- 5, 6	13219219	VM1ORB10C K20 50KB
VR- 7	13219226	VM1ORC38C K20 100KC
VR- 8	13219222	VM1ORC38C K20 10KA
VR- 9, 10	13219221	VM1ORC38C K20 2MA
IC- 1, 5, 6, 7, 8	15189105	uPC4558G
IC- 2, 3, 4	15189102	NJW4558DD BP MONO Dual
IC- 9, 10	15219109	NB555P
IC- 11	15219203	MM3004 BBD
IC- 12	15159105TC	TC4013BP
Q- 1, 2, 9-11, 13, 14	15129107	2S0945-Q
Q- 3-8	151391030A	2SK30A1M-GR selected
Q- 12	15119106	2SA733-Q
D- 3, 4	15019103	1S2473
C- 65, 66	13619709N0	tantalum 2.2/35V
VR- 11, 12	13299116	SR19R 47KB
VR- 13	13299114	SR19R 10KB
VR- 14	13299115	SR19R 22KB

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41

- J- 1-6 13449402 SJ-409-1-2 SW- 4 13129901 DS-102 red IC- 4 15159105TO TC4013BP Q- 1-8 15119106 2SA733-Q
- SW- 1 13119702 SRW10181L2 IC- 1 15189121 CA3140T IC- 5 15159102TO TC4001UBP Q- 9 15119108 2SA798-G
- SW- 2 13159302 S8A04301 IC- 2 15189118 TL082CP IC- 8 15159107ZO MC14022B Q- 10,12-21, 24,25,27 15129107 280945-Q
- SW- 3,5,6 13159102 SSA04202 IC- 3,6,7 15159104TO TC4011BP IC- 9,10 15189105 uPC4558C

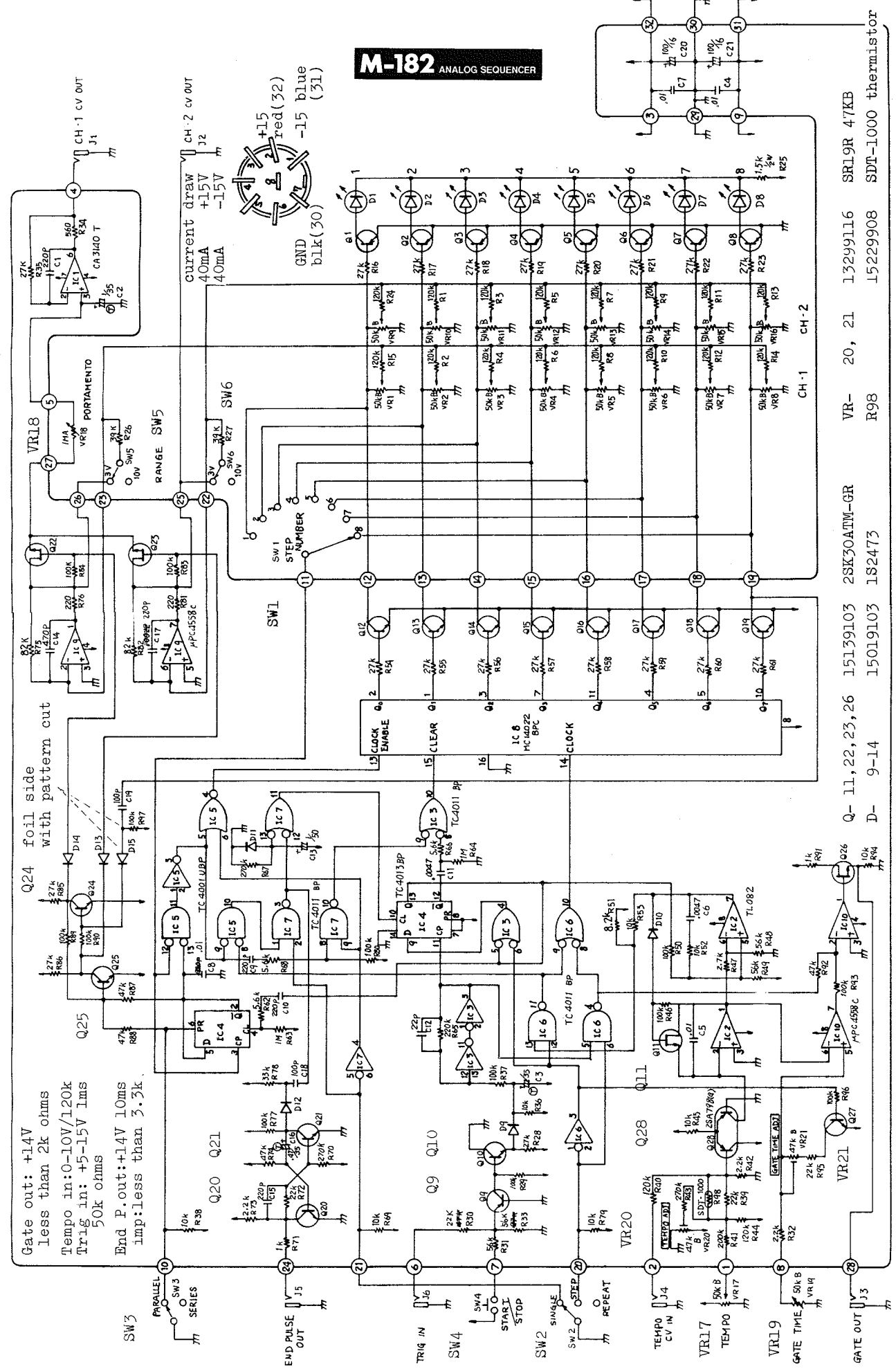
See bottom for remainders.



OP110-030 (P/N 7911003000) (pcb 052-461)

OP11-040 (Part number 7911004000) (pcb 052-462)

Tempo: 7s-5ms (0.14Hz-33Hz) PORTAMENTO: 0-10s Gate time: 10-90% CV out: 0.3-10V





**ADJUSTMENT**

For M-180 and M-181, see pp. 16-17.

**M-110** VCO-VCF-VCA

**M-112** 2VCO

The following precautions should be kept in mind before starting adjustment on M-180 and M-181.

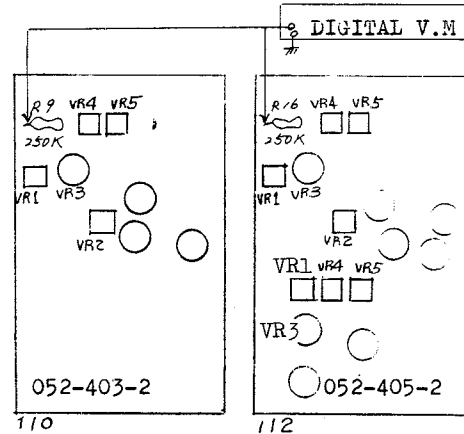
Leave the test and testing equipments turned on for 20-30 minutes as a warmup period.

Keep room at a normal and constant operating temperature.

Check keyboard KCV or reference voltage for 1V/oct ( $\pm 1mV$ ).

**VCO**

(1) - RANGE - coarse



Trimpot designations are independent of those on circuit diagrams.

Connect digital voltmeter to R9 or R16 lead.

1. Set VR1 around its midpoint.
2. Adjust VR2 for 10V reading.

(2) - WIDTH. FREQUENCY -

Set VR3 and VR4 around the midpoint.

1. While pressing 1V key (M-180 C2 key with TRANSPOSE set in L; M-181 C1 key), adjust VR4 for 1:1 Lissajous (WIDTH).
2. With 2V key holding down, adjust VR5 for motionless waveform.
3. Repeat steps 1 and 2 until waveforms stand still. Tolerance at 2V key: cycle/5s (0.2Hz).
4. Pressing 5V key, lock Lissajous with VR3. (LINEARITY) (M-180: C4, TRANSPOSE H)

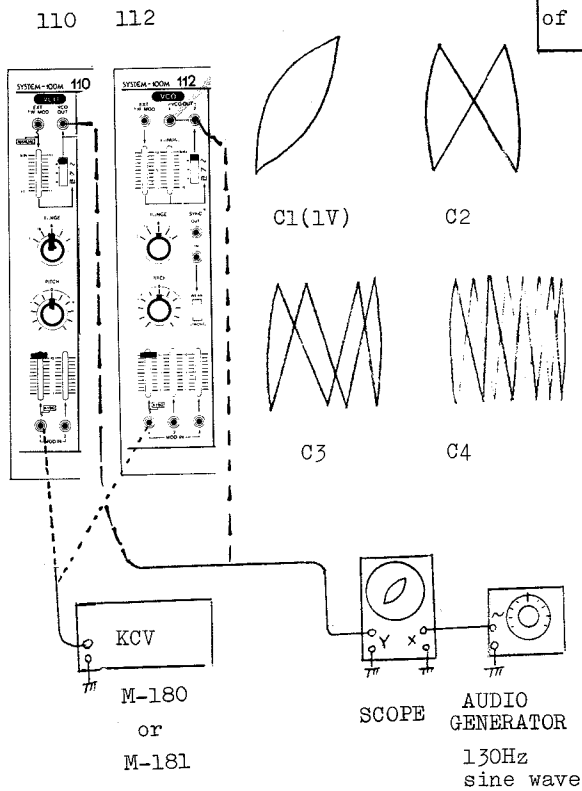
Turning VR3 will affect previous adjustments in this section. Repeat from step 1.

Tolerance: 1Hz at 4V key.

(3) - RANGE - fine

Keep 1V key pressed down.

While continuously rotating RANGE knob across full travel range, adjust VR1 for the least detune at every RANGE setting.

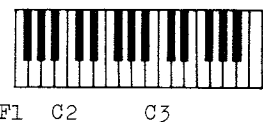


KEY DESIGNATION

M-181

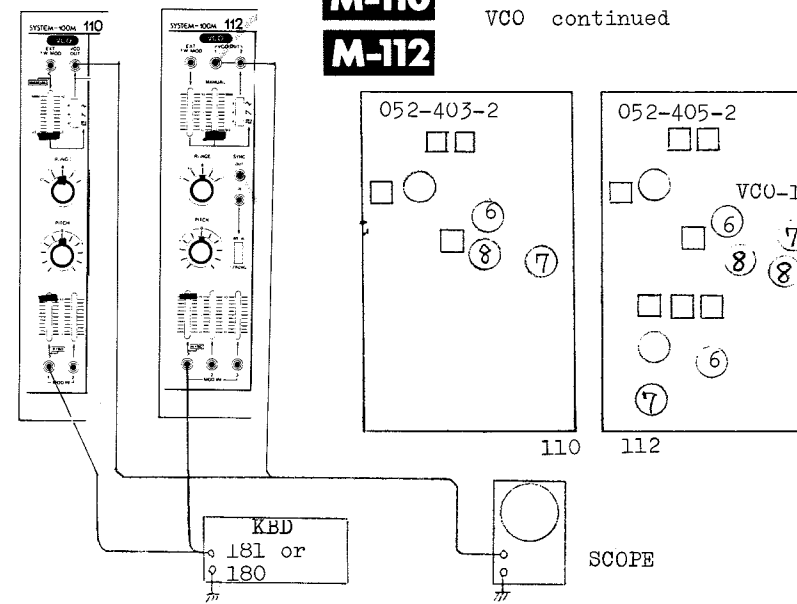


M-180



**M-110**  
**M-112**

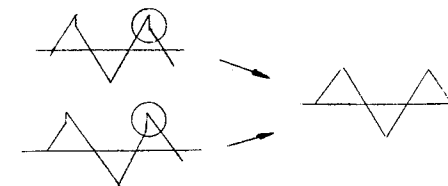
VCO continued



(4) - TRIANGULAR -

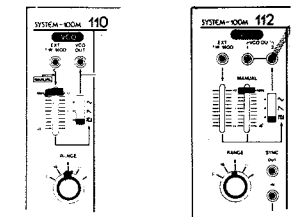
VCO OUT switch:  $\sphericalangle$

With 2V key holding down, adjust VR6 for straightness.



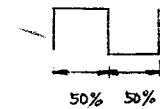
(5) - RECTANGULAR -

Set OUT switch to  $\square$ .



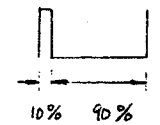
Set MANUAL to 50% (0).

While pressing 2V key, adjust VR7 for 50% duty ratio.



Set MANUAL to MIN (10).

While pressing 2V key, adjust VR8 for 10% duty ratio.

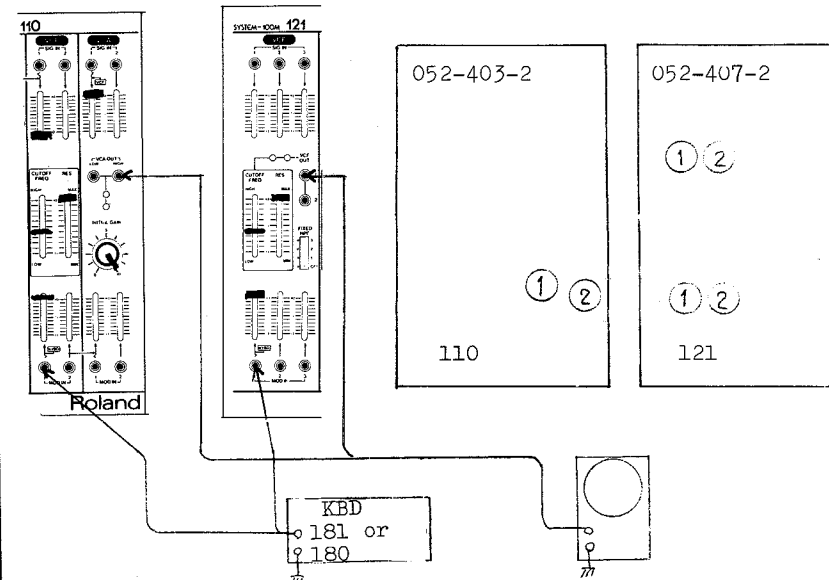


**M-110** VCO-VCF-VCA

**M-121** 2VCF

**VCF**

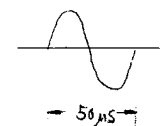
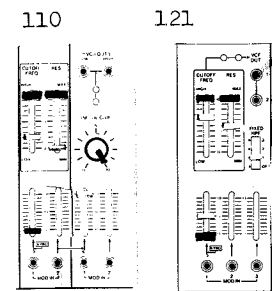
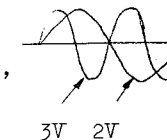
(2) - FREQUENCY -



(1) - WIDTH -

Make sure that VCF oscillates when RES knob is set around 7-8th line.

While quickly playing 2V and 3V keys alternately, adjust VR1 for waveforms 1:2 in frequency.



Adjust VR2 for 20kHz (50us).

**M-110** VCO-VCF-VCA **M-130** 2VCA

**VCA**

110 130

052-403-2 052-408-2

10V 0V 20Hz

or

LFO OUT from M-150

(1) - DC BALANCE -

(2) - OFFSET -

(3) - VCA GAIN - M-130 only

1. Adjust VR1 for minimum amplitude. Increase scope's Vertical gain as the output reduces.
1. Adjust VR2 for 0dBm reading
2. Check signal for leakage with INITIAL GAIN set at FCCW (0).

millivoltmeter

**M-140** 2ENW-LFO **M-150** RING-NOISE S/H LFO

**LFO**

140 052-411-2

150 052-414-2

(1) - FREQUENCY -

Adjust VR1 for 30Hz (33ms).

(2) - AMPLITUDE -

Adjust VR2 for 10V p-p.

Change WAVEFORM to SAWTOOTH.

(3) - SAWTOOTH -

Adjust VR3 for straightness.

**PEAK INDICATOR** **M-131** OUTPUT MIXER **STANDARD OSC**

PANPOT midpoint

PAN-POT

MASTER VOLUME

FREQ MIXING LEVEL

052-409

L1

sine wave 440Hz

1. Set FREQ in 440Hz.
2. Set MASTER VOL and MIX LEVEL for proper level.
3. Turn L1 with nonferrous metal tool for 1:1 Lissajous.

**M-150** RING-NOISE S/H LFO **NOISE**

18Vp-p

Adjust VR1 for 18V p-p. (early M-150: 12-14V)

052-414-2

**RING MODULATOR**

(1) - SIGNAL BALANCE -

Insert short circuit plug into EXT SIG X jack to place a ground to the jack circuit.

Adjust VR2 for minimum RING OUT.

**M-132** DUAL CV/AUDIO MIXER & VOLTAGE PROCESSOR **VOLTAGE PROCESSOR** **MIXER-1.2**

+10V -10V

OVERLOAD INDICATOR

DIGITAL V.M.

-10V -10V +10V

052-410

VR11

VR12

(1) - +10V -

1. Set +OUT slider at +10.
2. Adjust VR11 for 10.5±10mV.

(2) - -10V -

1. Set -OUT slider at -10.
2. Adjust VR12 for -10±10mV.

MIXER-1

MIXER-1	
SIG IN slider	
NO.4	NO.3
0	9-10
9-10	0

MIXER-2

MIXER-2	
SIG IN slider	
NO.4	NO.3
0	9-10
9-10	0

**M-150** RING-NOISE S/H LFO

(2) - MODULATION BALANCE -

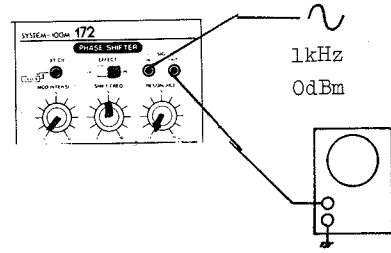
Connect EXT SIG X to LFO OUT.

Adjust VR3 for distortion free output. Modulated waveform doubles the input in frequency.

**M-172** PHASE SHIFTER/AUDIO DELAY/GATE DELAY

**PHASE SHIFTER**

- SHIFT FREQUENCY -

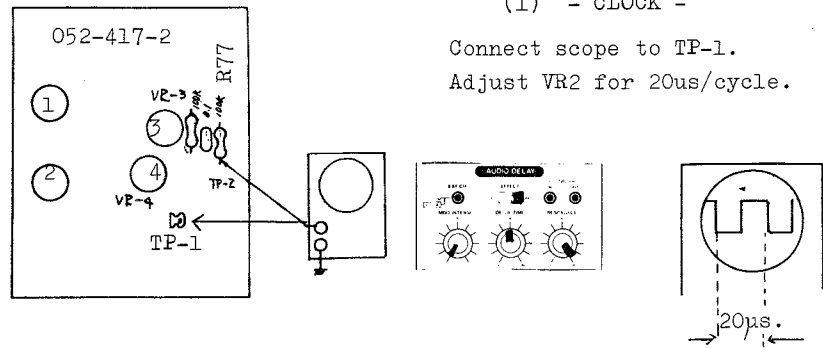


1. Rotate VR1 FCW to/from FCCW; level of PHASE SHIFTER output will decrease to minimum three times per full rotation.
2. Stop the rotation at the 2nd, and fine-tune VR1 for the minimum waveform level.

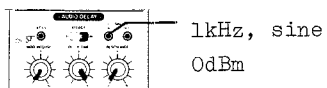
**AUDIO DELAY**

(1) - CLOCK -

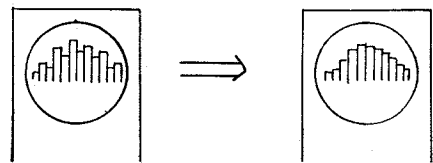
Connect scope to TP-1.  
Adjust VR2 for 20us/cycle.



(2) - BBD OUTPUT BALANCE -



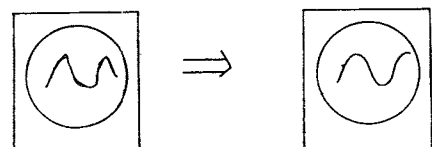
Connect scope to TP-2.  
Adjust VR3 for smooth envelope.



(3) - BBD BIAS -

Connect scope to AUDIO DELAY SIG OUT.  
Advance audio generator level control until some distortion occurs.

Free waveform from distortion by turning VR4.



**LFO**

Check LFO OUTs (A,B) for the following:

Frequency shifts 0.04Hz-10Hz as FREQUENCY advances.

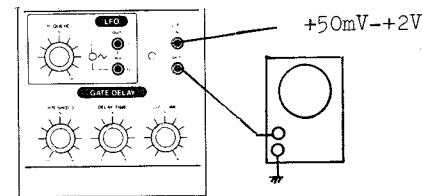
Amplitude varies with frequency.

10V p-p at 0.04Hz

400mV p-p at 10Hz

Waveforms from OUT A and B are 180° out of phase with each other.

**GATE DELAY**



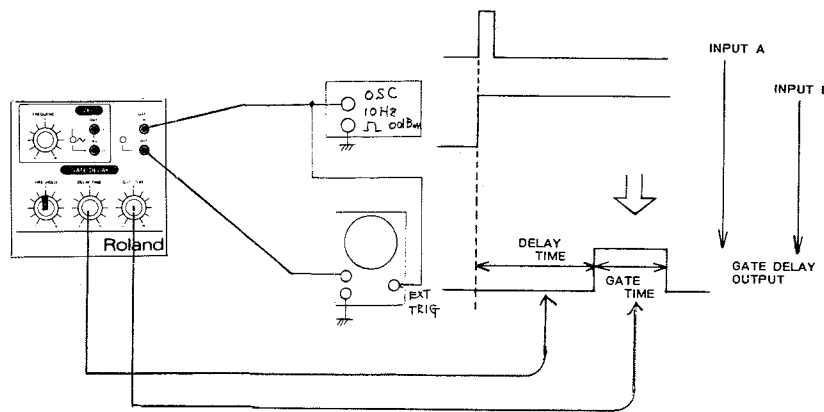
(1) - THRESHOLD -

Check that GATE OUT provides +15V in the following input levels and settings:

input +50mV±10% . . . THRESHOLD FCCW

input +2V±20% . . . THRESHOLD FCW

(2) - DELAY TIME & GATE TIME -



Lengths of DELAY TIME and GATE TIME are as follows:

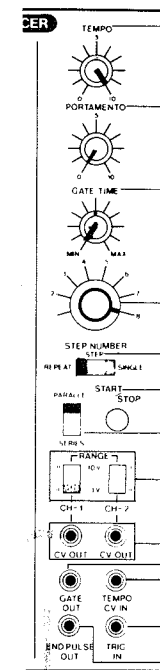
DELAY TIME	delay time	GATE TIME	gate time
FCCW (0)	0.3ms	FCCW (0)	0.3ms
FCW (10)	6s	FCW (10)	6s

**M-182** ANALOG SEQUENCER

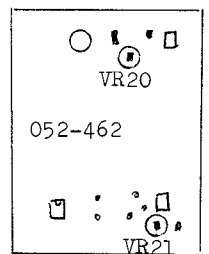
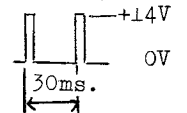
**GATE**

(1) - TEMPO -

Set controls as illustrated at left.



Adjust VR20 for:



(2) - LED ON/OFF TIMING -

With TEMPO at "0", a LED stays on for 7 seconds before the next LED lights.

With TEMPO at "5", LED lighting duration is approximately 0.5 seconds.

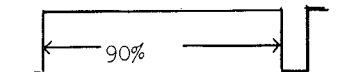
(3) - DUTY CYCLE -

Keep initial settings shown above.  
Turn GATE TIME FCW.

Adjust VR21 for 90±2% duty ratio.

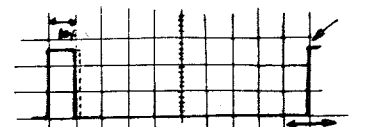
Reverse GATE TIME (FCCW).

1. Adjust TEMPO to display one cycle of waveform across ten divisions on graticule.
2. Check that duty ratio is 8-12%.



Set GATE TIME at "4".

Check that duty ratio is 50%.  
(±7%)





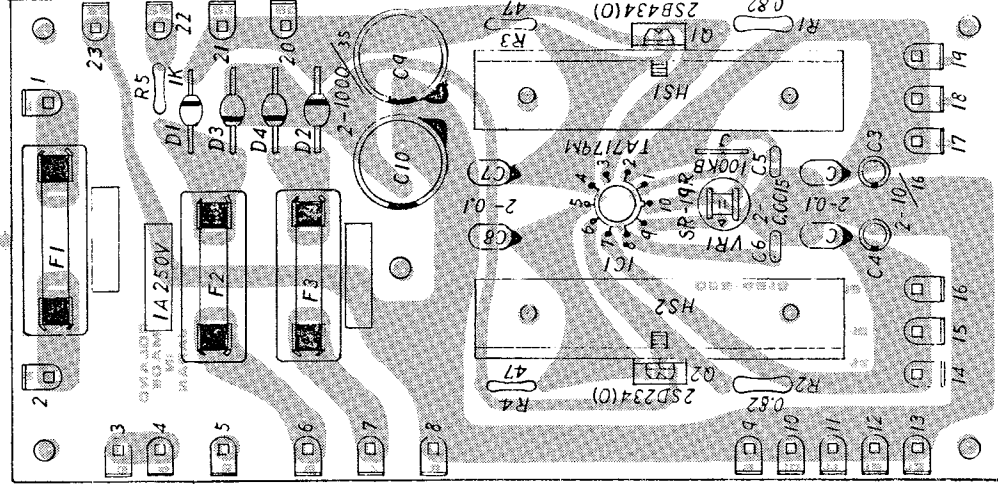
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

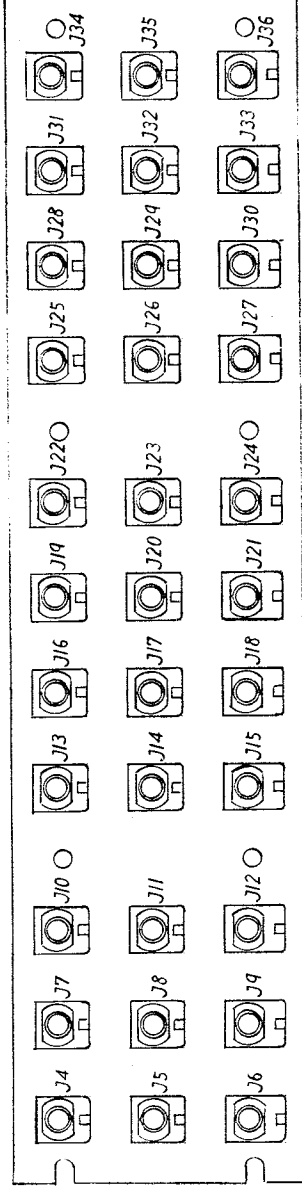
**M-190 M-191J**

- PS-46B (146-046B) 100V
- PS-47B (146-047B) 117V
- PS-48B (146-048B) 220/240V

(pcb 052-421B)



JACKS HSJ0409-01-020



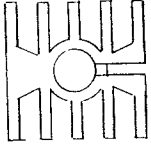
- |        |            |                          |
|--------|------------|--------------------------|
| IC- 1  | 15119110T0 | TA7179M                  |
| Q- 1   | 15119800   | 2SB434-0                 |
| Q- 2   | 15129801   | 2SD234-0                 |
| D- 1-4 | 15019210   | 1R5BZ61 or 1M4003        |
| D- 5   | 019-020    | LED                      |
| VR- 1  | 13299117   | SR19R 100KB              |
| R- 1,2 | 044-589    | BRG-01ANJ 0.82 ohms 1/2W |
| F.P.T. | 022H025J   | 100V                     |
|        | 022H025C   | 117V                     |
|        | 022H025D   | 220/240V                 |

- 100/117V
- 220/240V



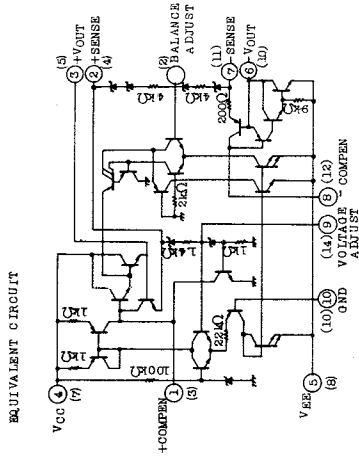
- |             |          |               |
|-------------|----------|---------------|
| Fuse holder | 012H022  | F-3265        |
| F- 1-3      | 12559114 | MGC 1.0A 100V |
|             | 12559301 | MGC0001 117V  |
| F- 1        | 12559511 | CEE T500mA    |
| F- 2, 3     | 12559513 | CEE T1A       |

- HS- 1, 2 048-052 Heat sink no.52



**TA7179M**

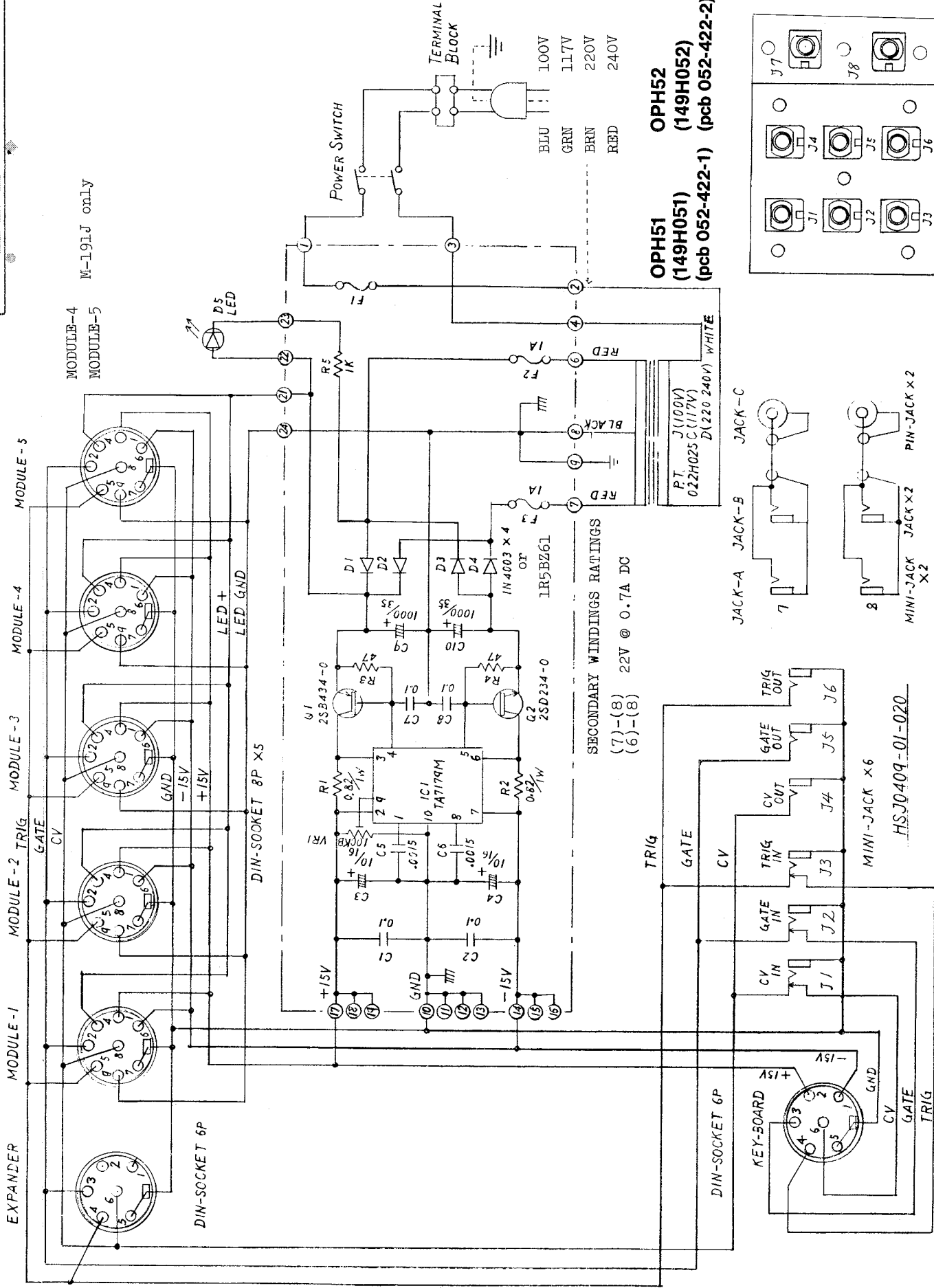
Pin numbers in parentheses are for the plastics type TA7179P only.



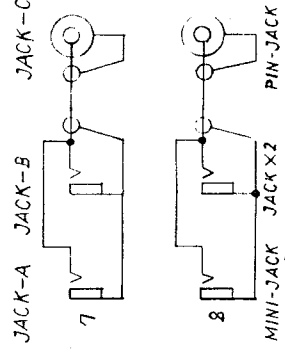
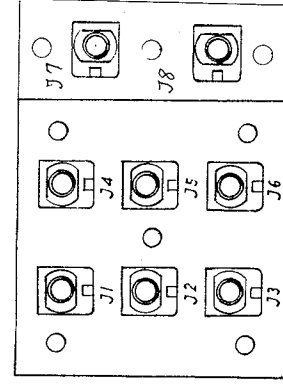
- ABSOLUTE MAXIMUM RATINGS (T=25°C)
- Input voltage (+) (-) 30V
- Output current (+) (-) 100mA
- Power dissipation 500mW
- Operating temperature -30°-+75° C

**M-190** 3 MODULE SYSTEM RACK

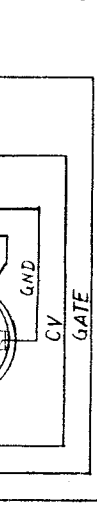
**M-191J** 5 MODULE SYSTEM RACK



**OPH51 (149H051)**  
**OPH52 (149H052)**  
(pcb 052-422-1) (pcb 052-422-2)



MINI-JACK X2  
HSJ0409-01-020



SECONDARY WINDINGS RATINGS  
(7)-(8) 22V @ 0.7A DC  
(6)-(8)

**M-180** 32-KEY KEYBOARD CONTROLLER

NOMENCLATURE	PART NO.	PARTS NAME
SW-	1	13139131 SLE-623-12P(S)
VR-	1	028-720 VM10RK15(L)A26 2MA
VR-	2	028-727 VM10RK15(L)B15 100KB
VR-	3	13299504 PN82-2H202H 2KB
VR-	4	13299506 PN82-2H501H 500 ohms
IC-	1	15189131 LF13741H
IC-	2	15189121 CA3140T
IC-	3	15189109 uA301HC
IC-	4-6	15189105 uPC4558C
Q-	1-5	15129115 2SC1815-Y
Q-	6, 7	15119112 2SA1015-Y
Q-	8	15139103 2SK30ATM-GR
D-	1	15019627 1S2454 zener
D-	2-7	15019103 1S2473
C-	4	polypropylene ECQF-2334MZ
C-	5	tantalum lmf 35V
R-	23,24	CRB $\frac{1}{4}$ FX 0.1% selected
R-		CRB $\frac{1}{4}$ FX 1%

**ADJUSTMENT**

PB-4 (M-181 only)

When PB-4 is replaced with a factory assembled one, step 1 is negligible.

Connect a voltmeter (preferably, digital type for precise measurements) into BENDER OUT jack.

- With PB-4 lever left at neutral, position VR-5 wiper for 0.1mV reading.
- With the lever held at leftmost position, set VR-7 on OP-98 for -5V reading.
- With the lever held at rightmost, set VR-6 for +5V reading.

**TUNING**

Connect voltmeter into CV OUT.

- WIDTH**
  - While pressing C2 (M-180) C3 (M-181) key, note the reading. Call this Vx.
  - While pressing C3 (M-180) C4 (M-181) key, adjust VR-3 for Vx + 1V.
  - Check that adjacent C keys are in 1V/oct relation.
- SHIFT**

While pressing C2 (M-180) key, set C3 (M-181) VR-4 for 2V reading.

**3. TUNABLE RANGE**

CV should lower by 0.5V when TUNING VR-2 is turned from 0 point to FCCW, and should rise by 0.5V when VR-2 turned 0 to FCW.

**4. TRANSPOSE**

CV should vary by 1V when TRANSPOSE is set from M position to L or H.

**5. PORTAMENTO**

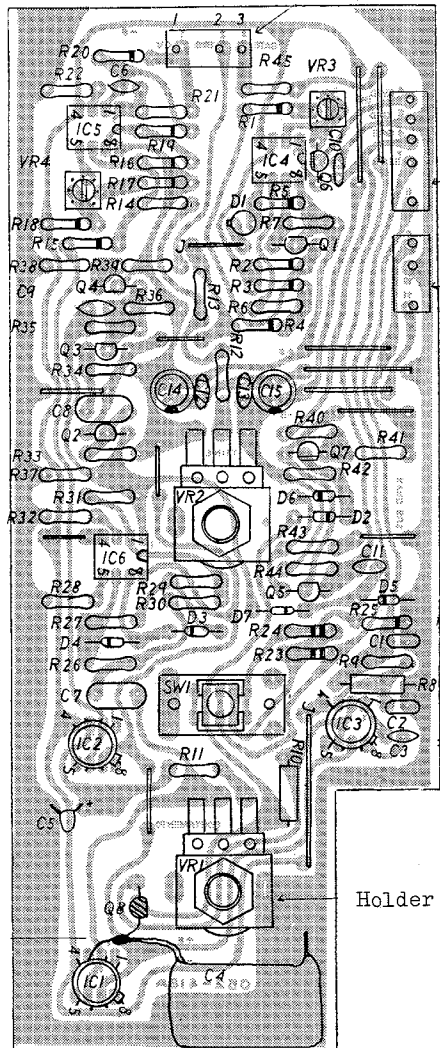
(M-181 - SW-2 on -)

Turn PORTAMENTO fully clockwise.

- Press the lowest key, then, the upmost key. The time required for CV to reach the voltage specified by latter key is 23s.
- Reverse the above key pressing order. The time is also 23s.

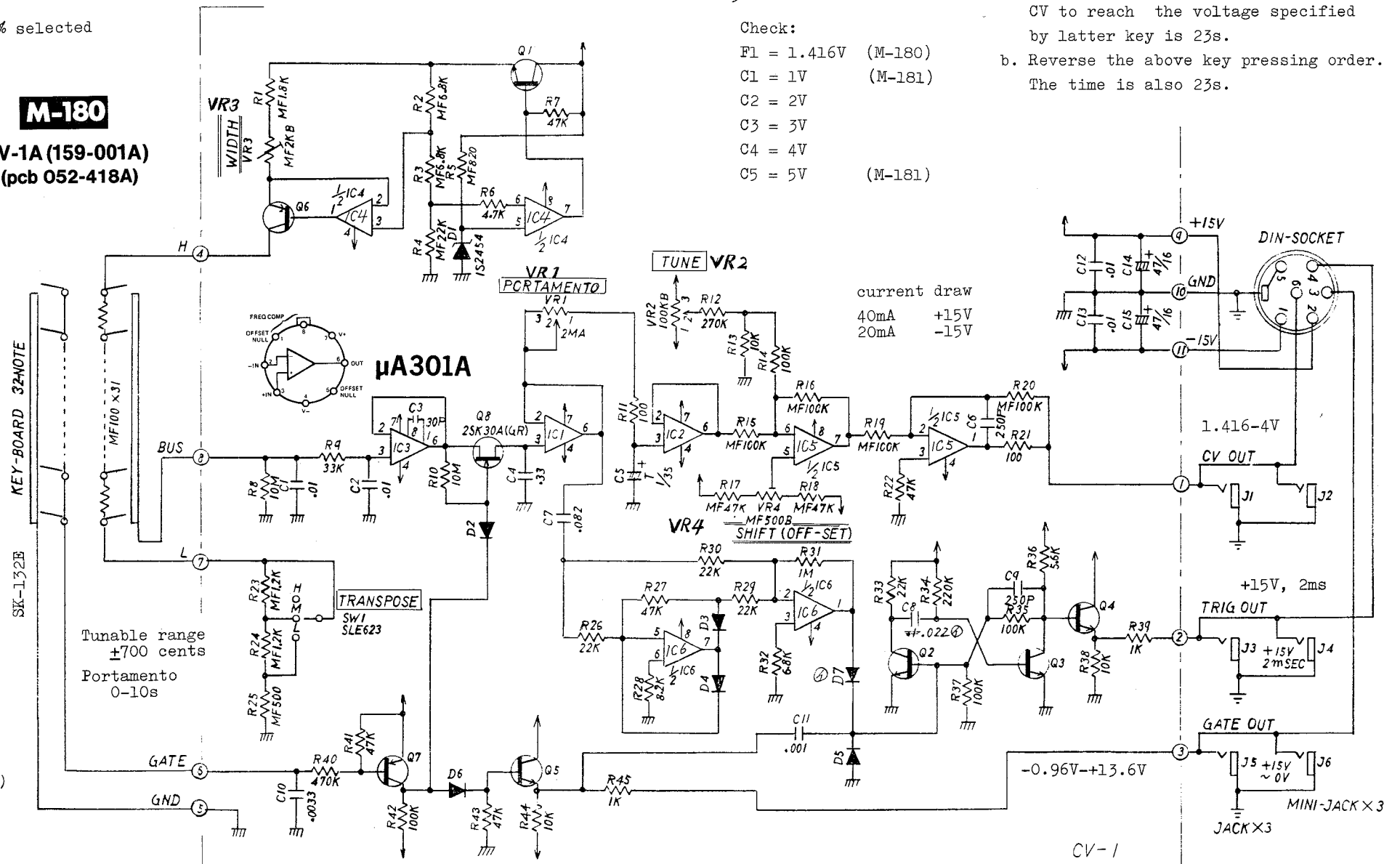
**Check:**

- F1 = 1.416V (M-180)
- C1 = 1V (M-181)
- C2 = 2V
- C3 = 3V
- C4 = 4V
- C5 = 5V (M-181)



**M-180**  
CV-1A (159-001A)  
(pcb 052-418A)

Holder N-106 (H55A)



current draw  
40mA +15V  
20mA -15V

Tunable range  $\pm 700$  cents  
Portamento 0-10s

CV-1

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41

A  
B  
C  
D  
E  
F  
G  
H  
I  
J  
K  
L  
M  
N  
O  
P  
Q  
R  
S  
T  
U  
V

6. TRIG OUT

While depressing a key, tap the lower key. This keyings should cause TRIG OUT to send out pulses each time the contact closes and opens.

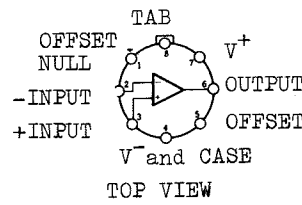
CA3140

MOS/FET Input Bipolar Output

DC Supply Voltage . . . 36V  
(Between V<sup>+</sup> and V<sup>-</sup> terminals)

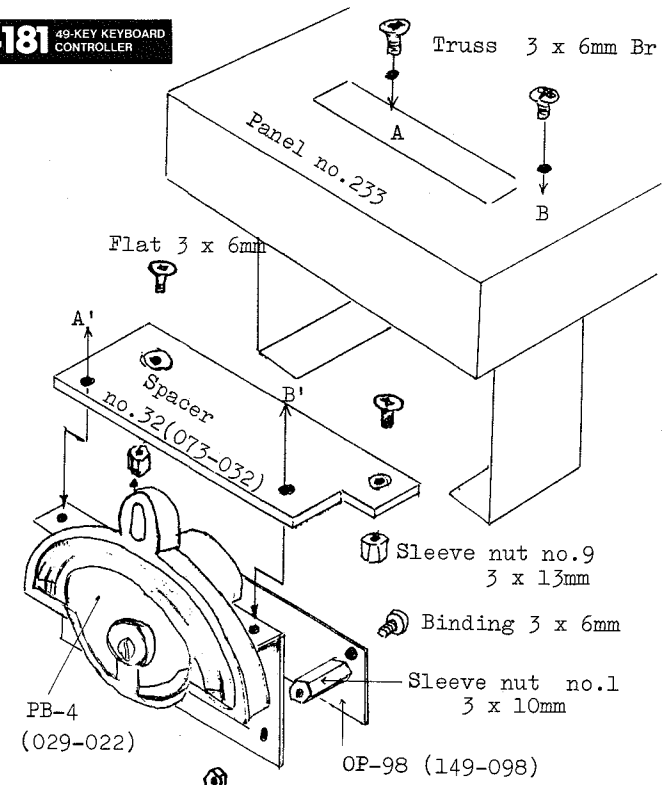
Differential-mode Input Voltage . . . ±8V

Input Terminal Current . . . 1mA

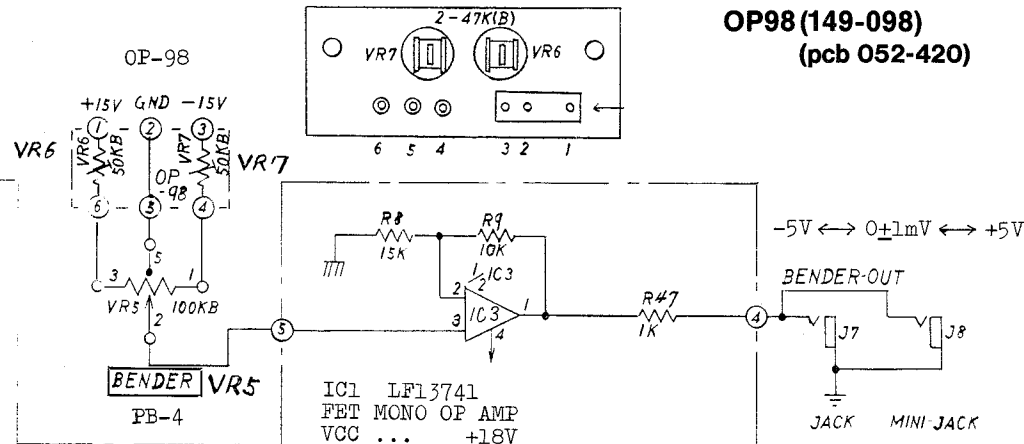


NOMENCLATURE	PART NO.	PARTS NAME	Q-	1-5	15129115	2SC1815-Y
SW-	1	SLE-623-12P(S)	Q-	6, 7	15119112	2SA1015-Y
SW-	2	SLE-622-12P(S)	Q-	8	15139103	2SK30ATM-GR
VR-	1	VM10RK15A26 2MA	D-	1	15019627	1S2454 zener
VR-	2	VM10RK15B15 100KB	D-	2-7	15019103	1S2473
VR-	3	PN82-2H202H 2KB	R-	25,26		CRB½FX 0.1% selected
VR-	4	PN82-2H501H 500	R-			CRB½FX metal film
VR-	5	PB-4 assy	C-	3	polypropylene	BCQF-2334MZ 0.33mfd
VR-	6, 7	SR19R 47KB	C-	4	tantalum	1mfd 35V
IC-	1	LF13741H OP amp				
IC-	2	CA3140T				
IC-	3-6	uPC4558C				

M-181 49-KEY KEYBOARD CONTROLLER



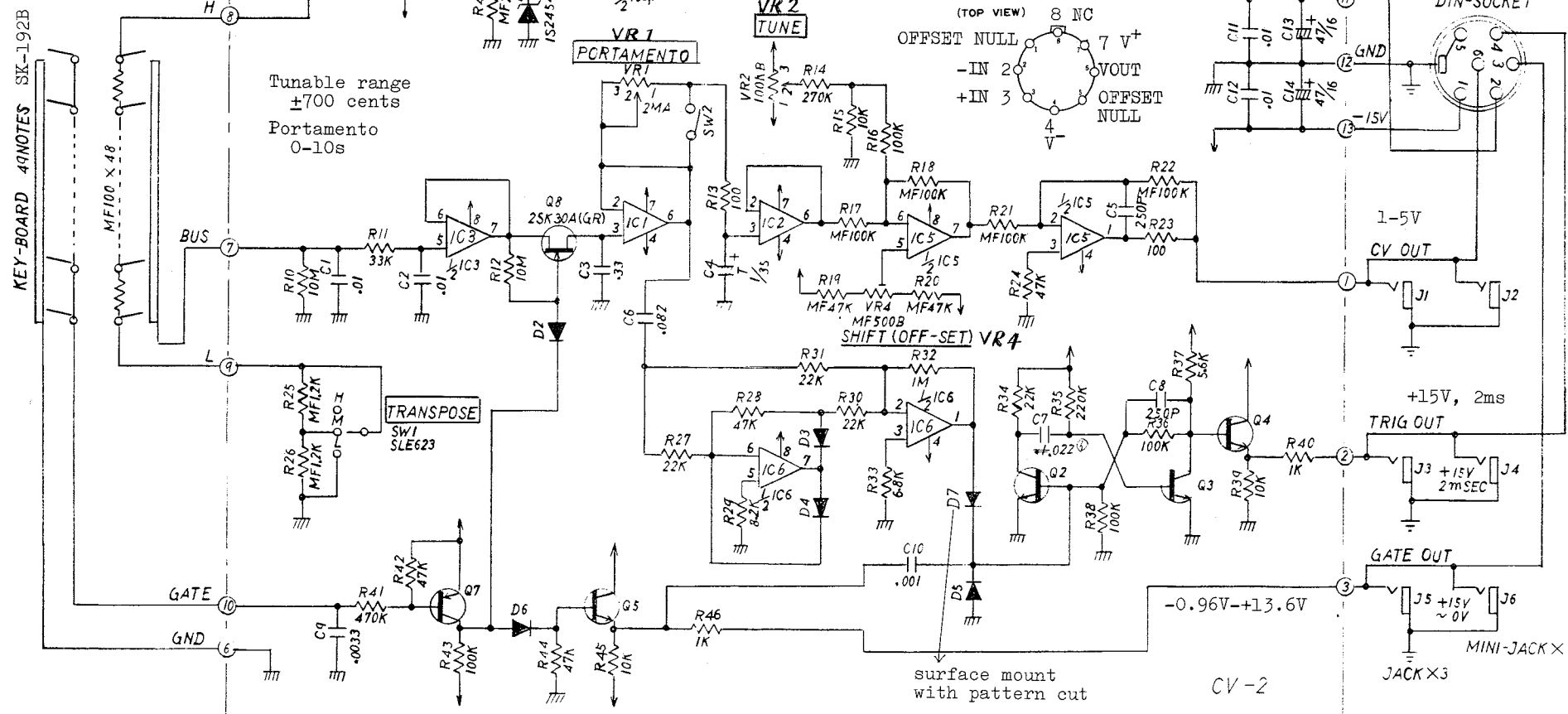
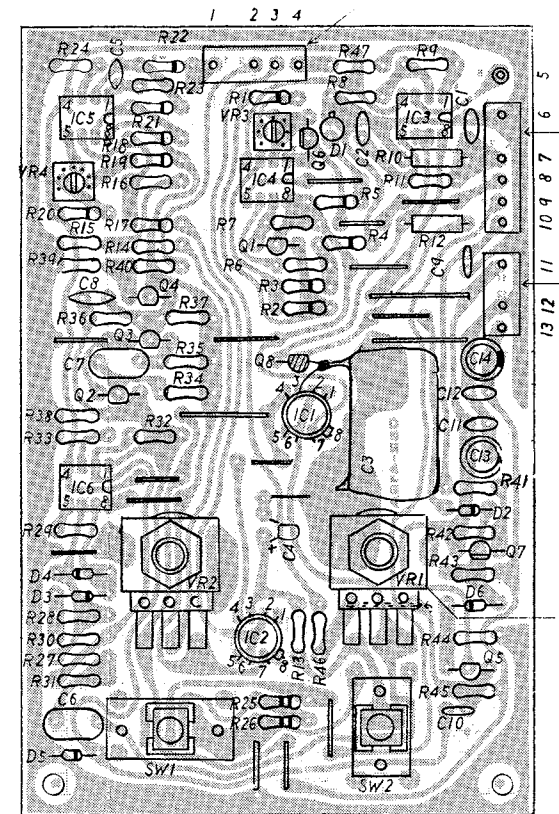
OP98 (149-098)  
(pcb 052-420)



M-181

CV2A (159-002A)  
(pcb 052-419A)

current draw  
40mA +15V  
20mA -15V





**GENERAL PARTS LIST & CROSS-REFERENCE**

**Old number to New number**

This list confines itself to components finding applications not only in modules but also in some other models.

For the rest parts, refer to illustration on the front cover or individual sections.

Some type names consist of abbreviated numbers following N- which stands for NEW.

Module names list by last two digits.

Use of new number on ordering sheet encourages the factory for dispatch.

**KNOB**

OLD	NEW	NAME	MODULE
016-044	. . .	Knob no.44 rotary	80/81
016-077	2247012700	Knob N-127 rotary	31/82
016-078	2247012800	Knob N-128 rotary	10/12/30/31/40/50/72/82
016-079	2247012900	Knob N-129 slide	10/12/21/30/31/32/40/50

**JACK. SOCKET**

009-039	13449402	SJ-409-1-2	10/12/21/30/31/32/40/50/72/82/90/91
009-015	13449111	HLJ-102-1-4	80/81/90/91
009-030	13449115	HLJ-0264-01-030	31
009-007	. . .	SG-8050#4	80/81
009-040	13449114	HLJ-0264-01-020	31
009-016	. . .	P-254P-4 2-pin	90/91
012-037	13429603	DIN 8P CS0690-1-1	all but 90/91
009-036	. . .	DIN 6P CS-660-1-1	80/81/90/91

\*Jacks are often called out by abbreviation. So are switches.  
exp. HLJ-0264-01-030 --- LJ-264-1-3

**SWITCH**

. . .	13139131	SLE-623-12P(S) lever single throw	80/81
. . .	13139130	SLE-622-12P(S) lever U/D throw	81
001-214	13119401	SRM-1025172 rotary	10/12/40/50
001-272	13119702	SRM-1018112 rotary	82
001-183	13159304	SSB-02335 slide	10/12/40/50
001-182	13159103	SSB02242 slide	12/30/40/50/72
001-228	13159503	SQPR240120P slide	21/31 (abbr. SQPR24-12P)
001-177	13159302	SSA04301 slide	82
001-176	13159102	SSA04202 slide	82
001-049	13129901	DS-102 red push	40/82
001-215	13129101	SDG5P001-1 power	90/91 100V
001-216	13129102	SDG-5P001-2	90/91 117V
001-217	13129103	SDG5P502	90/91 220/240V

OLD NO.	NEW NO.	PART NAME	MODULE
<b>POTENTIOMETER</b>			
<b>Slider</b>			
029-519	13339301	EVA-HO4C15A15 100KA	10/12/21/30
029-521	13339305	EVA-HO4C15A55 500KA	50
029-522	13339302	EVA-HO4C15A16 1MA	50
029-531	13339304	EVA-HO4C15B15 100KB	10/12/21/30/32/40/50
029-523	13339303	EVA-HO4C15A26 2MA	40/50
029-543	13339401	EVA-TOAC15A15 100KA	10/21
029-555	13339402	EVA-TOAC15B15 100KB	10/21/31/32/40
029-570	13339403	EVA-TOAC15D16 1MD	40
029-571	13339404	EVA-TOAC15D26 2MD	40
029-022	. . .	PB-4 assy	81
		EVA-H 20mm stroke	
		EVA-T 30mm storke	

<b>Rotary</b>			
028-720	. . .	VM10RK15A26(L) 2MA	80/81
028-727	. . .	VM10RK15B15(L)100KB	80/81
028-763	13219220	VM10RB10CB15 100KB	10/12/30/31/72
028-762	13219219	VM10RP10CB54 50KB	72/82
028-760	13219225	VM10RC38CB14 10KB	72
028-774	13219226	VM10RC38CC15 100KC	72
028-749	13219222	VM10RC38CA14 10KA	72
028-756	13219221	VM10RC38CA26 2MA	72
028-755	13219223	VM10RC38CA16 1MA	82
		*VM10RC38C/10RB10C shaft: K-20 (20mm length w/serrations)	
		GM70R910E terminal: L shaped pc type	
028-664	13219806	GM70R910E 100KA/100KC	31
028-665	13219807	GM70R910E 100KB x 2	31

**Trimmer**

Carbon solid formerly named as "SR19R"			
030-465	13299114	H1051A013 10KB	10/12/21/50/72
030-467	13229115	H1051A015 22KB	10/12/30/72
030-469	13299116	H1051A016 47KB	72/81/82
030-471	13299117	H1051A019 100KB	10/12/21/30/40/50/90/91

Metal glaze formerly named as "CR19R"

030-491	13299542	H1021A009 2.2KB	10/12
030-497	13299544	H1021A015 22KB	32
030-501	13299546	H1021A019 100KB	50

Tantalum thin film

030-625	13299501	PN822H101H 100B	10/12
030-630	13299504	PN822H202H 2KB	10/12/80/81
030-631	13299506	PN822H501H 500B	80/81
030-632	13299507	PN822H502H 5KB	10/12
030-636	13299508	PN822H503H 50KB	10/12

Zener diodes 1S2453, 1S2454

Application is thermal drift compensation. Although indicates identical electrical characteristics, 1S2454 is provided with low temperature coefficient and can be a good replacement for 1S2453.

OLD NO.	NEW NO.	PART NAME	MODULE
<b>SEMICONDUCTOR</b>			
<b>Transistor</b>			
017-010	15129801	2SD234-0	90/91
017-012	15119106	2SA733-Q	72/82
017-013	15129107	2SC945-Q	72/82
017-016	15139103	2SK30ATM-GR FET	10/21/30/40/50/80/81/82
017-016S	15139103A	"SK30ATM-GR selected on gm base	72
017-022	15119800	2SB434-0	90/91
017-039	15139110	NF510	10/12
017-046	151291050A	2SC828R NZ selected	50
017-105	15119112	2SA1015-Y	10/12/21/30/31/32/40/50/80/81
017-110	15129115	2SC1815-Y	10/12/21/30/31/40/50/80/81
017-124	15119108	2SA798-G	82
<b>Diode</b>			
018-014	15019103	1S2473	except 90/91
018-015	15229908	SDT-1000 thermistor	10/21/82
018-061	15019210	1R5BZ61 100V 1.5A	90/91
018-078	15019625	1S2453 zener 6-7V 250mW @ 10mA	10/12
018-079	15019627	1S2454 see below center	80/81
<b>LED</b>			
019-020	15029109	GL-3AR-2 red	72/82
		LR0601R red	90/91
		* LR -- longer leads	
019-022	15029110	GL-3AR-1 red	10/12/21/30/31/32/40/50
019-023	15029111	GL-3PG-1 green	10/21/30
<b>IC</b>			
020-001	15199502	TA-7066AP	31
020-024	15189109	uA301HC	10/31/80
020-032	15219101	uA726HC	10/12
020-040	15159104T0	TC4011BP	82
020-041	15159105T0	TC4013BP	31/72/82
020-063	15219203	MN3004 BBD	72
020-026	15219106	LM1496N	50 1000
020-096	15229803	BA662B	10/30/40/50
020-160	15229802	BA662A	10/21
		*BA662A can replace BA662B	
020-097	15189105	uPC4558C	all except 90/91
020-100	15189118	TL082CP	10/12/40/50/82
020-105	15189121	CA3140T	82/80/81
020-152	15189102	NJM4558DD	72
020-165	15219109	NE-555P	72
020-167	15159107Z0	MC14022B	82
020-194	15159102T0	TC4001UBP	82
020-228	15199110T0	TA7179M	90/91
. . .	15189131	LF1374H	80/81