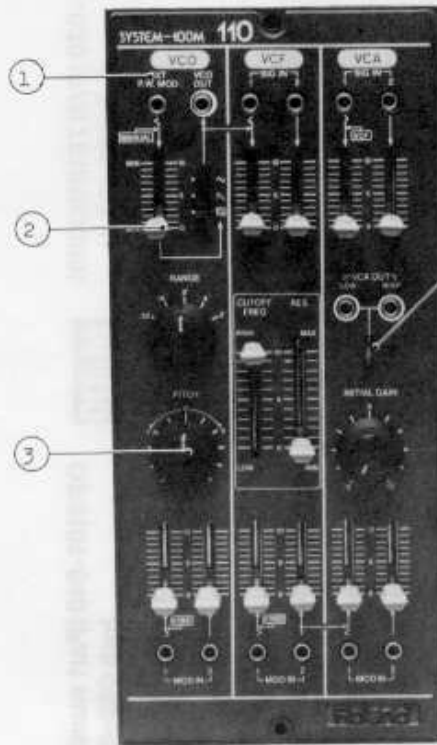


SYSTEM 100M SERVICE NOTES

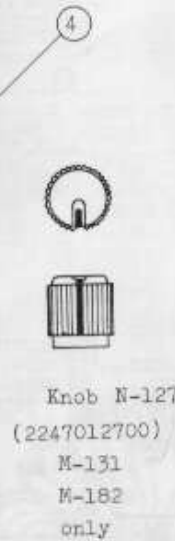
First Edition

M-T	
①	N-19 22210 19300
②	K 13
③	K 3
	G
④	1 G L - 1

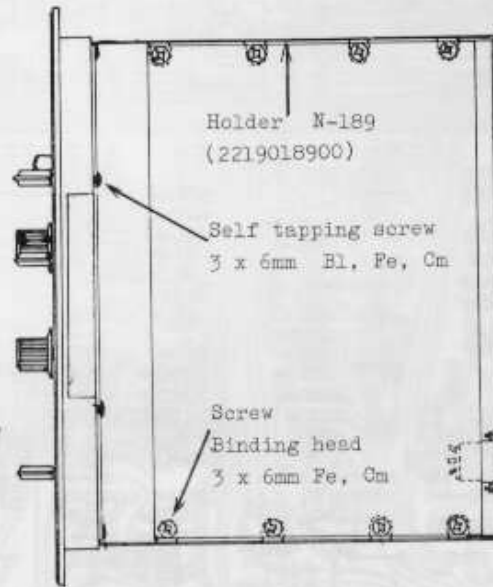


Pictures on this page represent parts common to modules and similarities.

For ①-④, see list at the right.

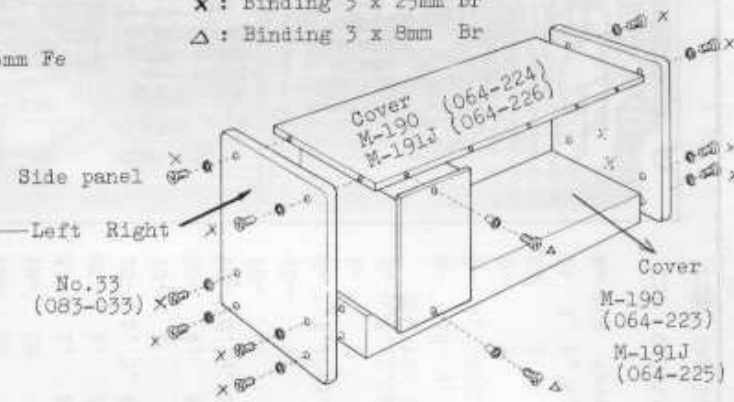


Knob N-127
(2247012700)
M-131
M-182
only



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)

DIN socket 8P
CS0690-1-1
(13429603)

M-190

Chassis
M-190: No.222 (061-222)
M-191J: No.221 (061-221)

M-191J



Jack HLJ-102-104 (13449111)
M-191J only
LED LRO601R (019-020)
Jack SJ409-1-2 (13449402)
Panel M-190: No.231 (072-231) M-191J: No.234 (072-234)

Jack SC
(009-016)

Knob No.
Pot.
VM10RKL
(028-75)

Switch
SLB-623
(131391)

Pot.
VM10RKL
(028-75)

Cabinet

Jack
DIN



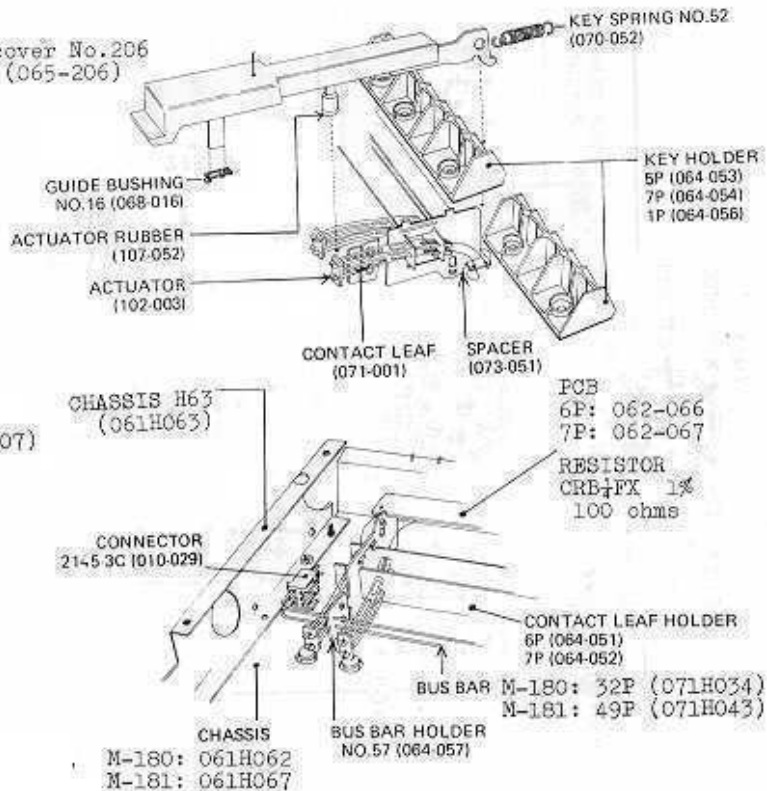
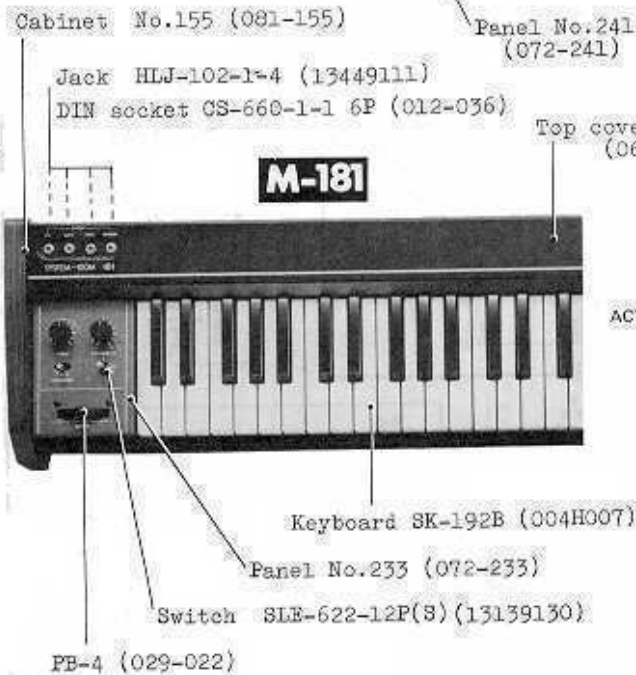
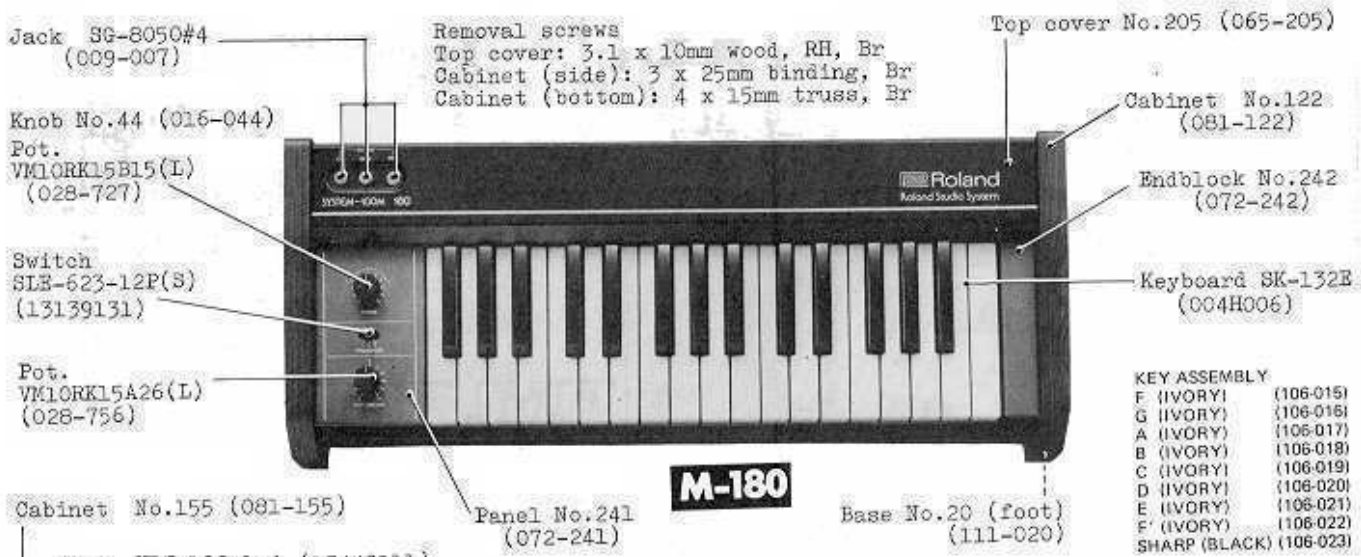
LED
LRO601R
(019-020)

PB-4

Power
SDG5E
SDG5E
SDG5E

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.

	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	K n o b		N o . 7 9		0 1 6 - 0 7 9		2 2 4 7 0 1 2 9 0 0		N - 1 2 9	
	13	10	16	12	4	10	10	4	0	0
③	K n o b		N o . 7 8		0 1 6 - 0 7 8		2 2 4 7 0 1 2 8 0 0		N - 1 2 8	
	3	4	0	2	1	0	1	1	10	1
④	G L - 3 A R - 1 (red)			(0 1 9 - 0 2 2)			1 5 0 2 9 1 1 0		G L - 3 A R - 2 (red)	
	1	0	2	2	3	2	1	1	0 1 9 - 0 2 0	
	G L - 3 P G - 1 (green) (019-023)			15029111)					1 5 0 2 9 1 0 9	
	1	0	2	2	0	0	0	0	2	8

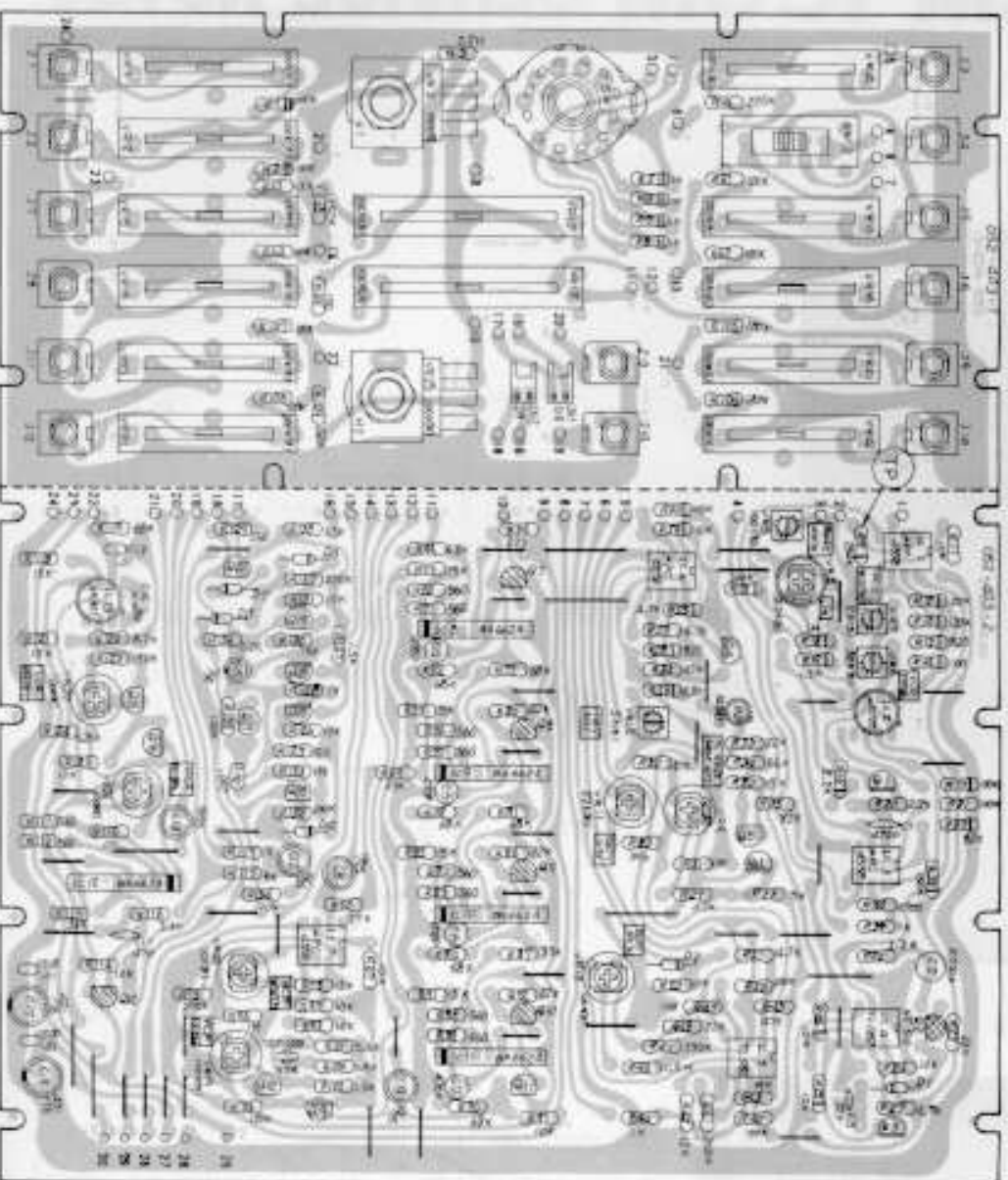


- Power switch
 SDG5P-001-1 (13129101) 100V
 SDG5P-001-2 (13129102) 117V
 SDG5P-502 (13129103) 220/240V

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

M-110

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

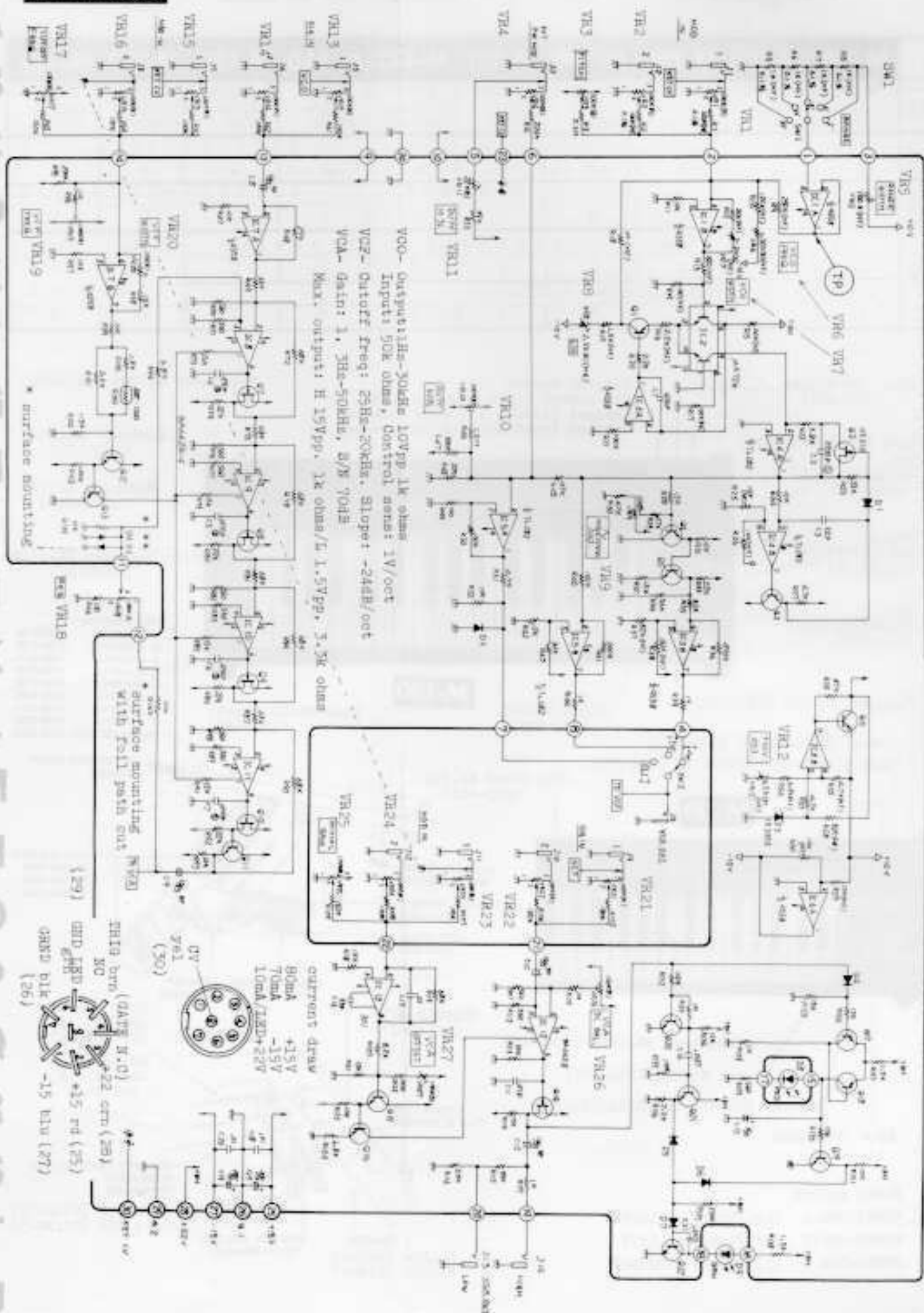


REFERENCE	DESCRIPTION	PART NO.	MANUFACTURE DATE
J-1-16		13449402	84-405-1-2
SW-1		13119401	SRM1029172
SW-2		13159304	SRM02335
VR-1,2,13,14,21,22		13339301	BVA-B04015A15
VR-3, 25		13219220	VM10R100 K20 100XB
VR-4,15,16,23,24		13339304	BVA-B04015B15
VR-5		13289901	ZHR22H10LH
VR-6		13289508	ZHR22H03H
VR-7		13289504	ZHR22H202H
VR-8		13289542	CR19R 222KB
VR-9, 20		13289114	SR19R 10KB
VR-10,19,26,27		13289117	SR19R 100KB
VR-11		13289115	SR19R 22KB
VR-12		13289907	ZHR22H502H
VR-17		13339402	BVA-TOA015A15
VR-18		13339401	BVA-TOA015A15
FR-1, 2		2219510600	Holder N-106
CR-1, 2		13439902	3024-020
IC-1, 3, 6, 7		13189105	AFR45580
IC-2		15219101	WA726HC
IC-4, 5		15189118	T10820P
IC-8, 9, 10, 11		15229802	TA662-A
IC-12		15229803	TA662-B
IC-13		15189109	UA301HC
Q-1,3,4,13,16,17,18		15119112	ZSAL015-Y
Q-2		15139110	HF510
Q-3,6,11,12,15,19		15129115	ZS01815-Y
Q-7,8, 9, 10, 14		15139105	ZBR30A1R-3R
D-1,2,4,5,6,7		15019103	1B2473
D-3		15019625	1B2453 sensor
C-2		1356911790	00095TH225-Y
C-4, 5, 6, 7		1356912170	00095TH4718-Y
R-104	thermistor	15229908	SR-1000

- DRB L/4 PX 15
- DRB L/4 PX 0.15
- polygreen
- bi-polar
- tantalum

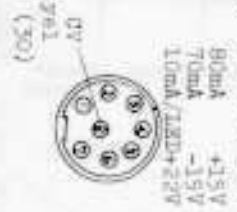


M-110 VCO-VDF-VCA



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

5 6 7 8 9 10 11 12 13 14 15 16 17 18 19



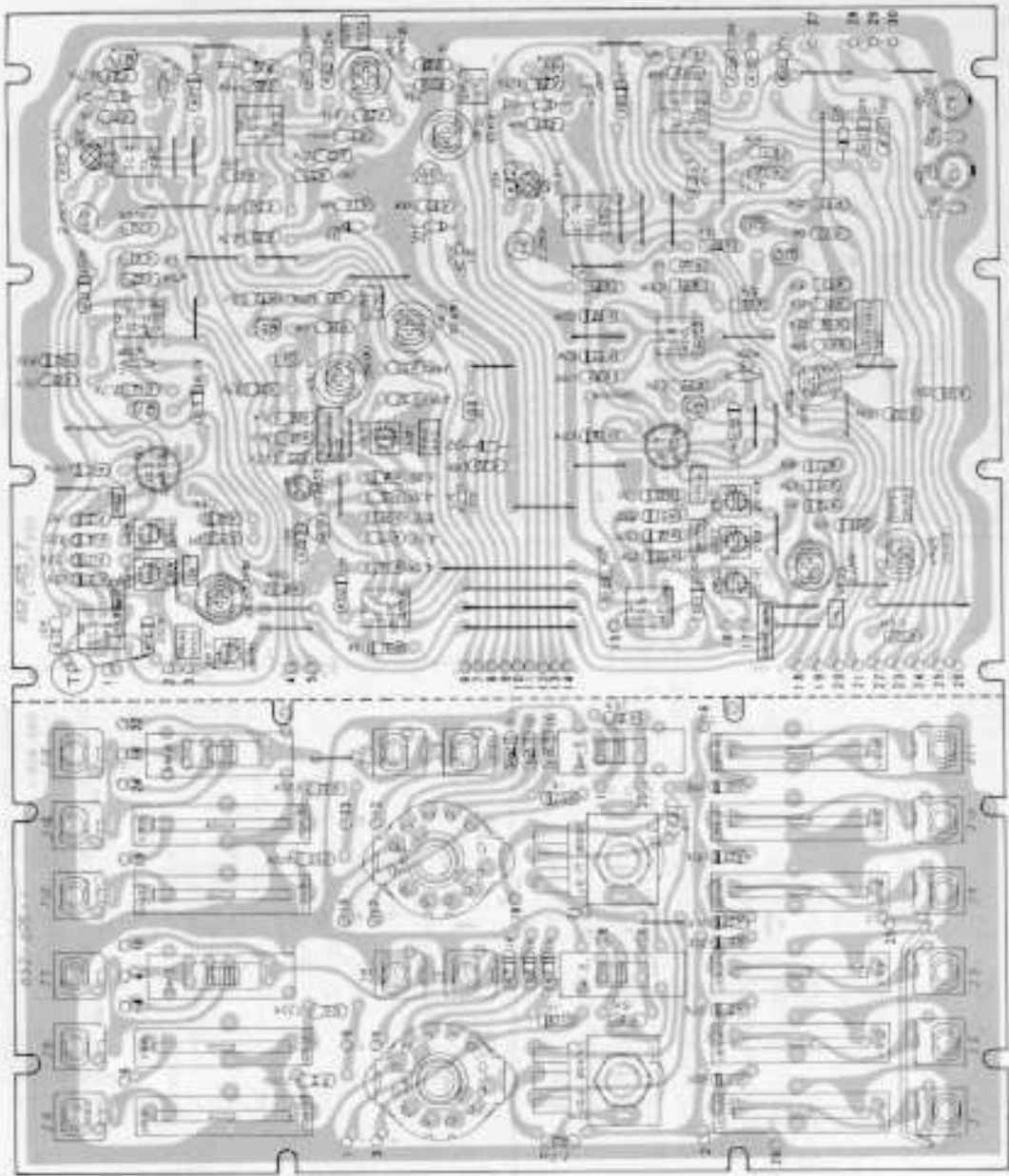
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21

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

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

VCO output: 1k, 10V p-p
 Input: 50k

Freq: 3Hz-30kHz
 Control Sens: 1V/oct

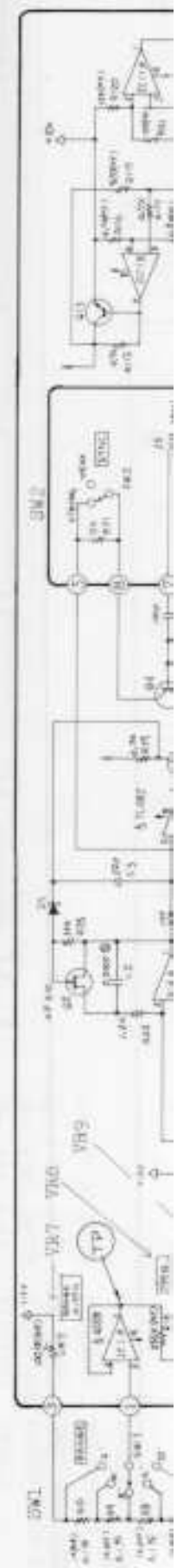


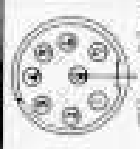
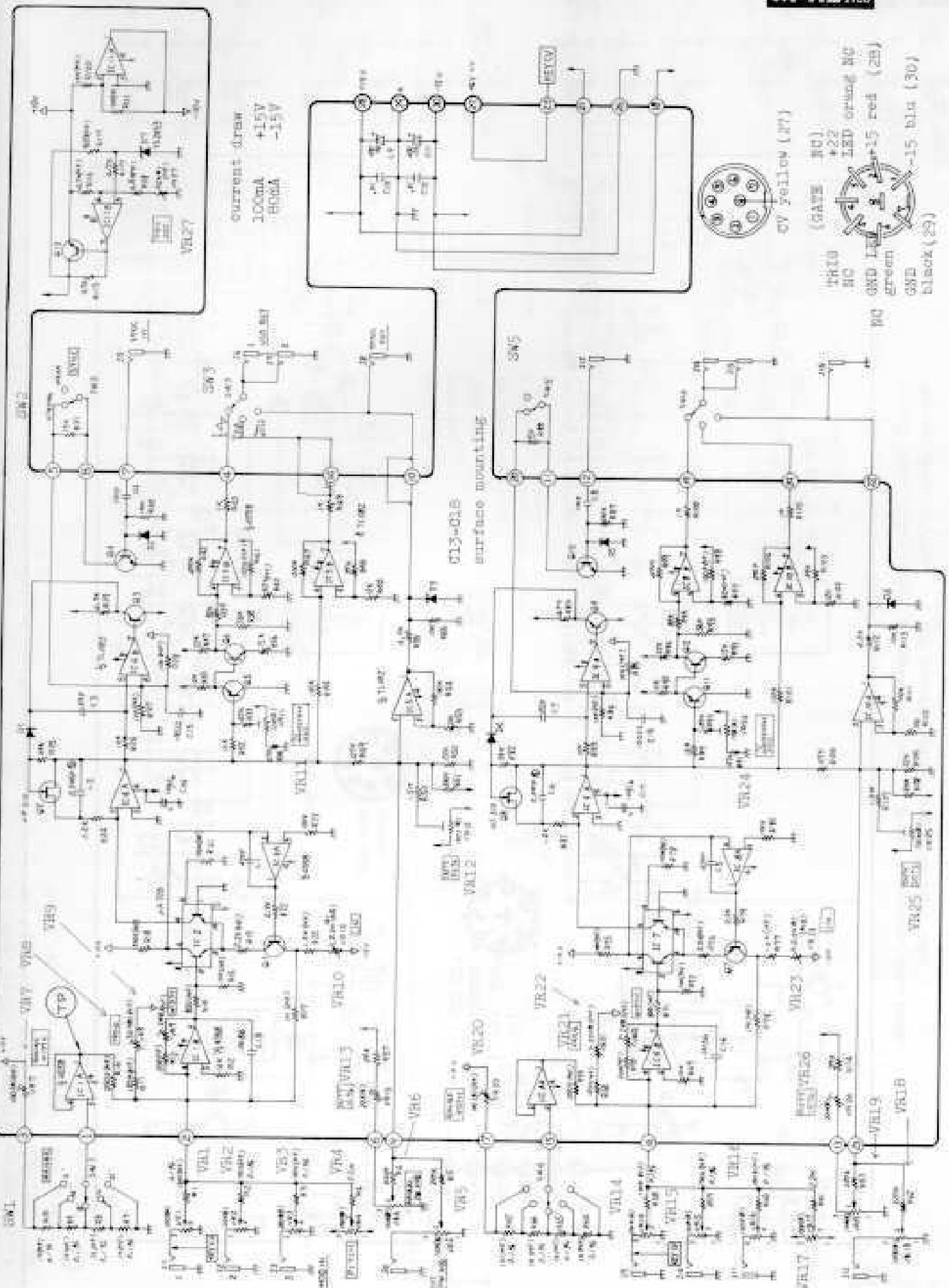
SYMBOL	DESCRIPTION	QTY	REF. DESIG.	VALUE	PART NAME
J-	1-16				3J-409-1-2
SW-	1, 4				GMN-1025172
SW-	2, 5				BGB-02242
SW-	3, 6				SBB-02335
VR-	1-3, 14-16				EVA-H04015A15
VR-	4, 17				VNLORR100 100K
VR-	5, 6, 18, 19				EVA-H04015B15
VR-	7, 20				PM92-2H101H
VR-	8, 21				PM92-2H503H
VR-	9, 22				PM92-2H202H
VR-	10, 23				CH19R 2.2K
VR-	11, 24				DM19R 10K
VR-	12, 25				DM19R 100K
VR-	13, 26				SHU9R 22K
VR-	27				PM92-2H502H
H-	1, 2				Holder K-106
IO-	1, 3, 6, 8, 11				uPC4558C
IO-	2, 7				uA726BC
IO-	4, 5, 9, 10				SL082
Q-	1, 3, 5, 7, 9, 11				2BA1015-T
Q-	2, 8				MP510
Q-	4, 6, 10, 12, 13				PM01615-T
D-	1, 2, 3, 4, 5, 6				182475
D-	7				182453
C-	2, 6				C009011770 C00901H2220-V polyethylene

Metal film
 GRN 1/4PT 0.1% 250-
 METAL FILM
 GRN 1/4PT 1% 28A-

TOP VIEW

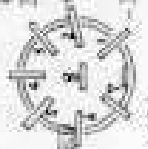
uPC4558C
NJM4558
TLO82CP
 BP-INPUT
 JFET-INPUT





0V yellow (27)

(GATE) NO.
 +22



NO
 0V
 green
 -15 bla (30)
 black (28)

18D orange NO

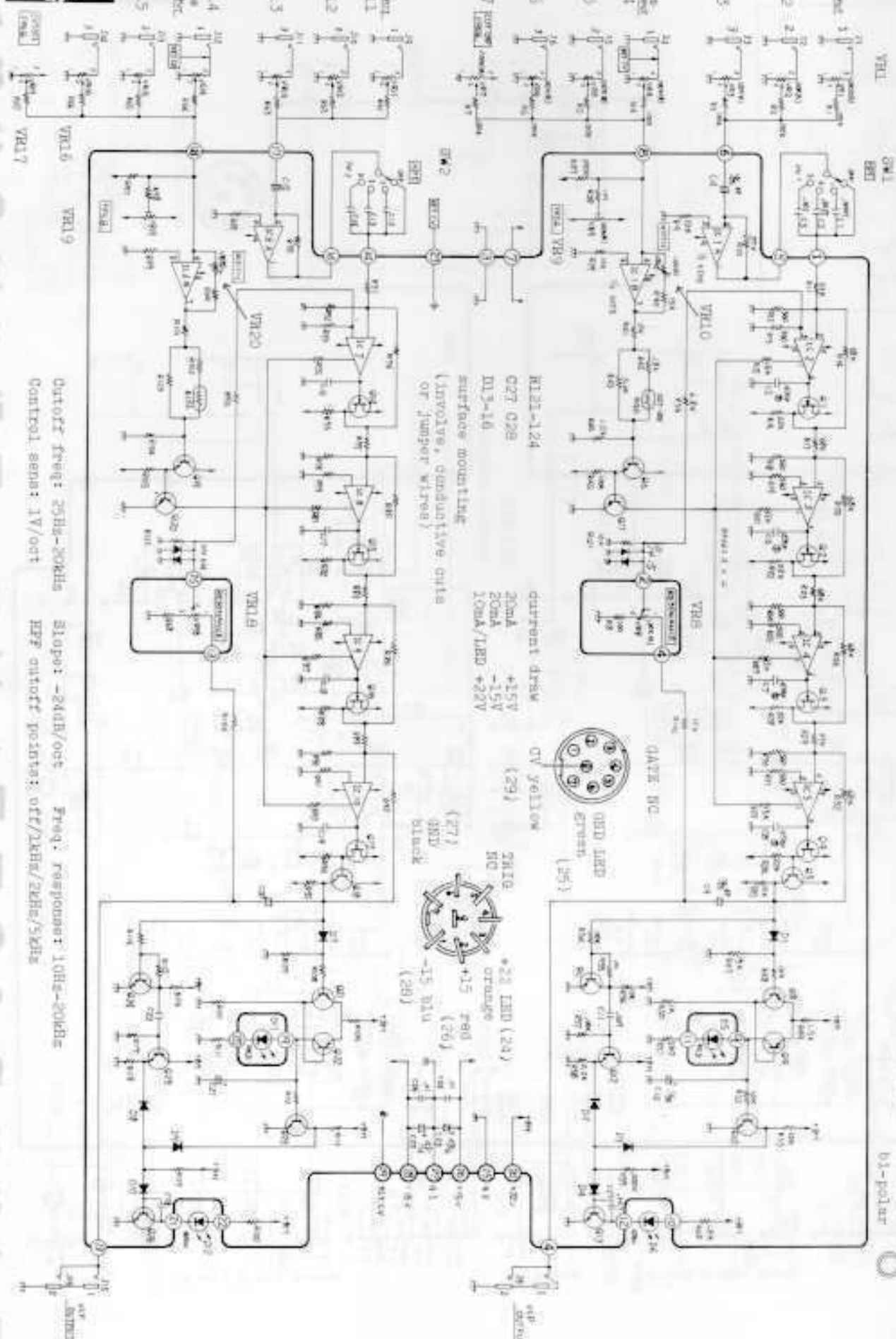
18D orange NO

18D orange NO

18D orange NO

18D orange NO

M-121 100



Output freq: 25Hz-20kHz
Control sens: 1V/oct

Slope: -24dB/oct Freq: response: 10Hz-20kHz
HPF cutoff points: off/2kHz/20Hz/5kHz

R123-124
Q27, Q28
DL3-16
surface mounting
(Involves, conductive cuts
of jumper wires)

current draw
20mA
+15V
-15V
100mA/LRD +22V



0-4, 9, 15, 20 13699932

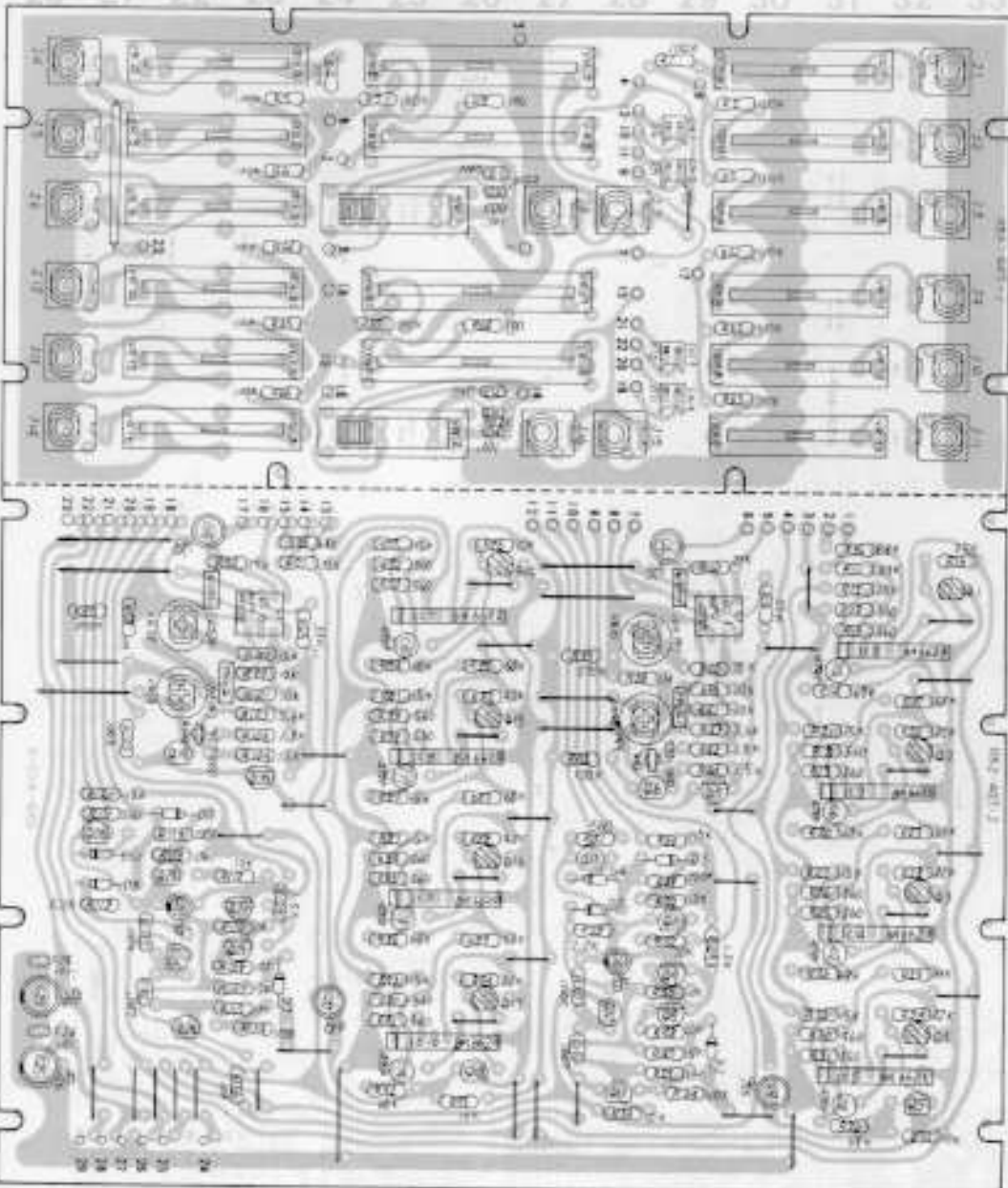
01-polar



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

M-121

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



HA726 M-110 R-112

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

ABSOLUTE MAXIMUM RATINGS

Operating Temperature Range 0 to +85°C

Supply Voltage ±18V

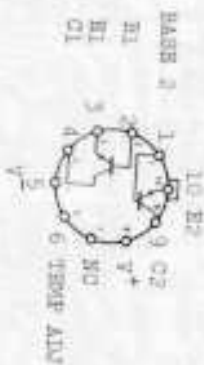
Internal Dissipation 500mW

Collector to Emitter Voltage 30V

Collector to Base Voltage 40V

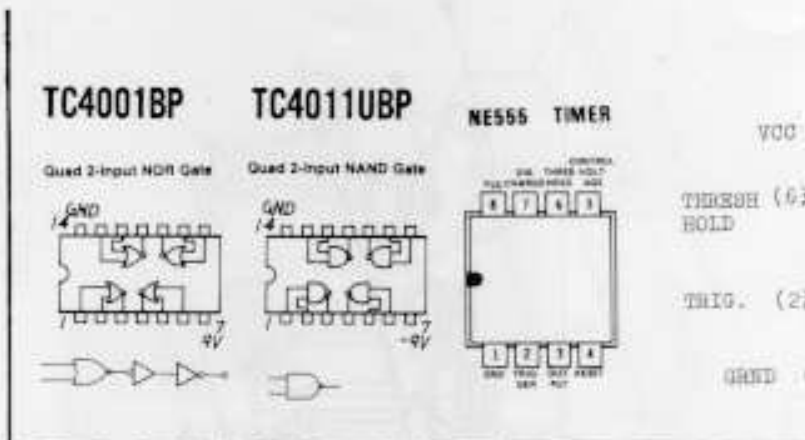
Emitter to Base Voltage 5V

Collector Current 5mA

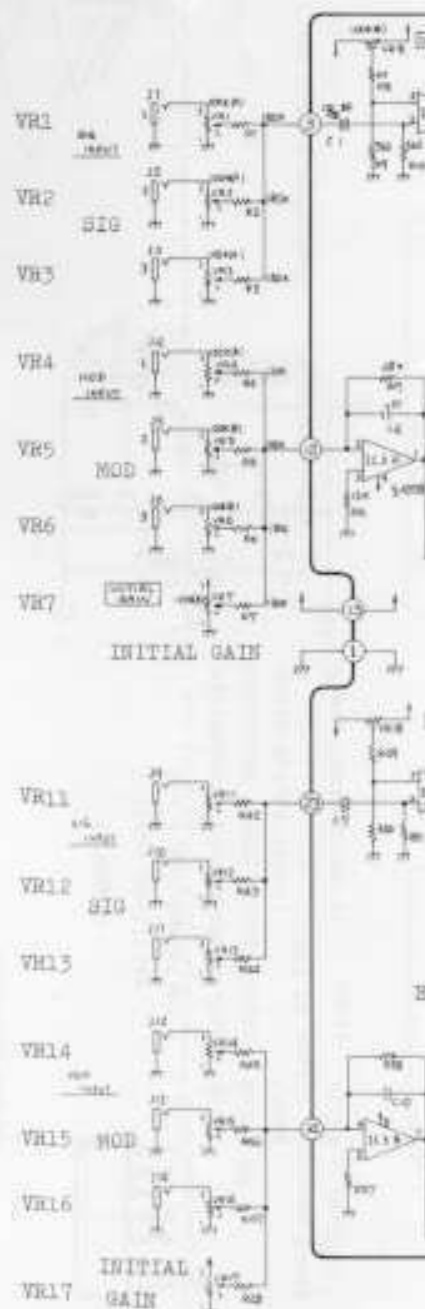
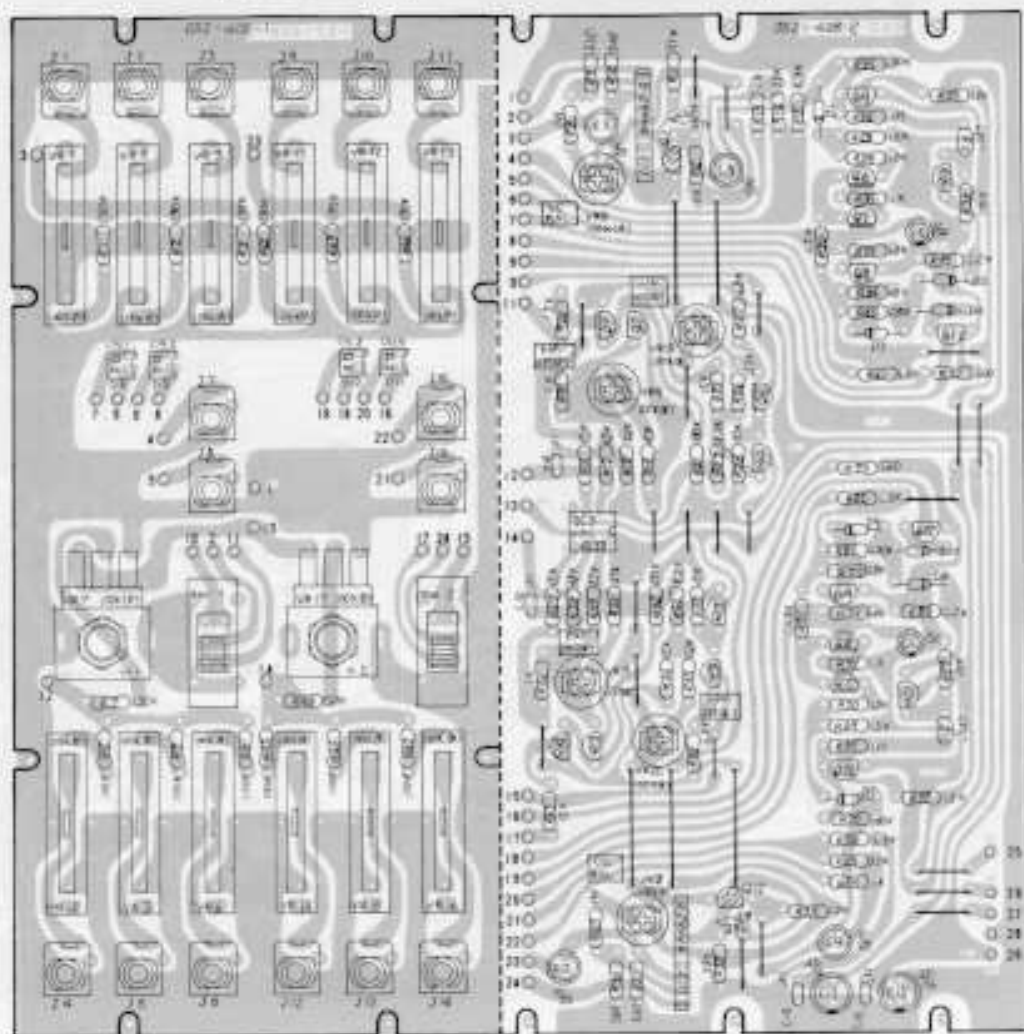


NOMENCLATURE	PART NO.	PART NAME
Z- 1-16	15449402	BJ-409-1-2
SW- 1, 2	13159503	DIODE-12P
VR- 1-3, 11-13	13339501	BVA-104-Q15A15
VR- 4-6, 14-16	13339504	BVA-104-Q15B15
VR- 7, 17	13339402	BVA-104-Q15B15
VR- 8, 18	13339401	BVA-104-Q15A15
VR- 9, 19	13299117	BR-19R 10KBP
VR- 10, 20	13299114	BR-19R 10KBP
OR- 1, 2, 3, 4,	13439502	3024-Q20
IC- 1, 6	15189105	WFO495BC
IC- 2, 3, 4, 5, 7-10	15229802	BA65-A
Q- 1-4, 14-17	15139103	ZGR-XOATH-6H
Q- 5, 6, 10-13	15129115	Z801815-1
Q- 18, 19 23-26	15119112	Z8A1015-1
Q- 7-9, 20-22	15019103	1B2475
D- 1-4, 7-10	15569121TO	QO981BA719-V
C- 5-6, 16-19	15229908	BDT-1000
R- 46, 106	13639932	BWS-A25810
C- 4, 9, 15, 20		

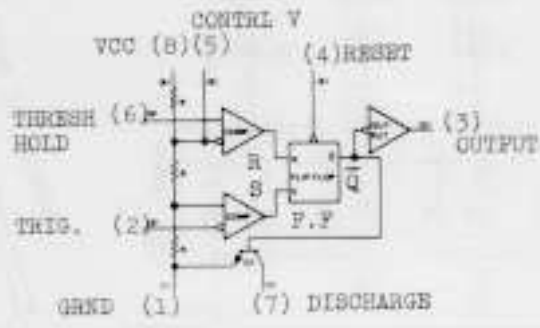
NOMENCLATURE	PART NO.	PART NAME
J- 1-16	13449402	87-409-1-2
SW- 1, 2	13159103	88B-022-42
VR- 1-3, 11-13	13339301	EVA-H04-C15A15 100KA
VR- 4-6, 14-16	13339304	EVA-H04-C15B15 100KB
VR- 7, 17	13219220	VM10RB100K20 100KB
VR- 8, 10, 18, 20	13299117	SR19R 100KB trimmer
VR- 9, 19	13299115	SR19R 22KB
ON- 1-4	13439502	3024-02C
IO- 1, 2	15229803	BA662-B
IO- 3	15189105	uPC4558C
Q- 1, 12	15139103	28K30ATM-GR. FBT
Q- 2, 4, 8-11	15129115	28C1815-Y
Q- 3, 5-7	15119112	28A1015-Y
D- 1-4, 7-10	15019103	182473
C- 10mfd/25V	13639932	Bi-polar ECB-A25W



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



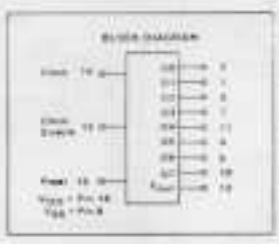
555 TIMER



MC14022B OCTAL COUNTER/DIVIDER

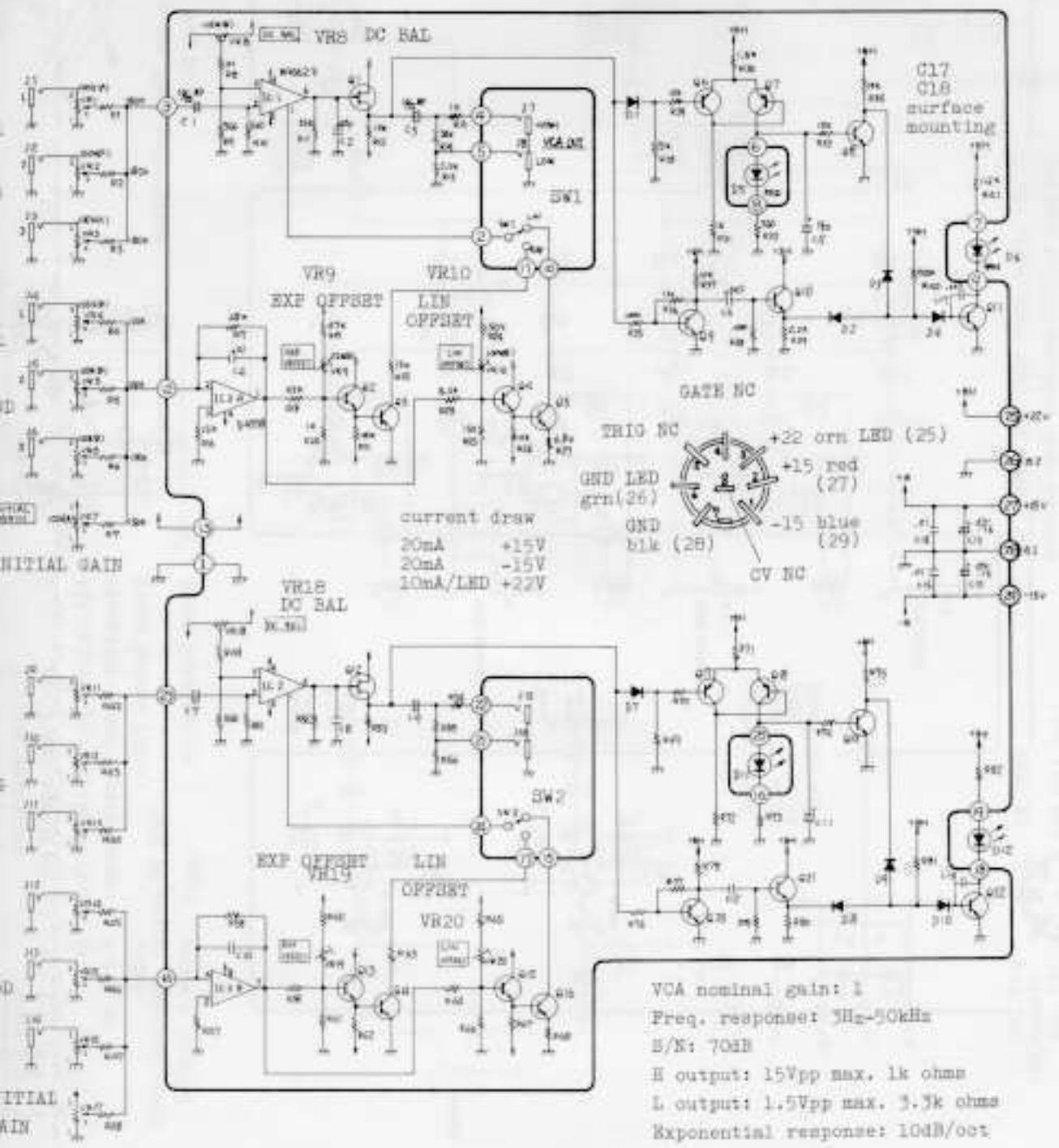
TRUTH TABLE

Four stage Johnson octal (Positive Logic) counter with built-in code converter.

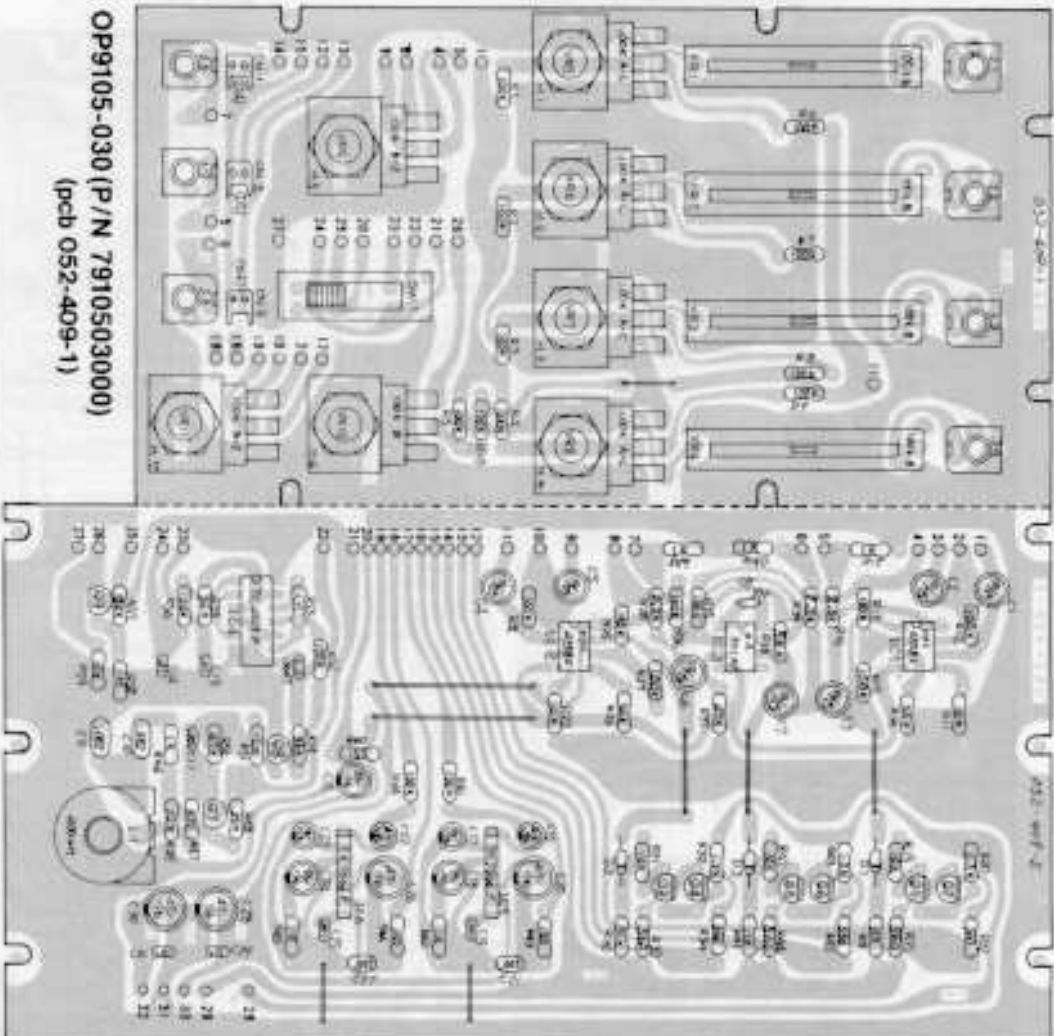
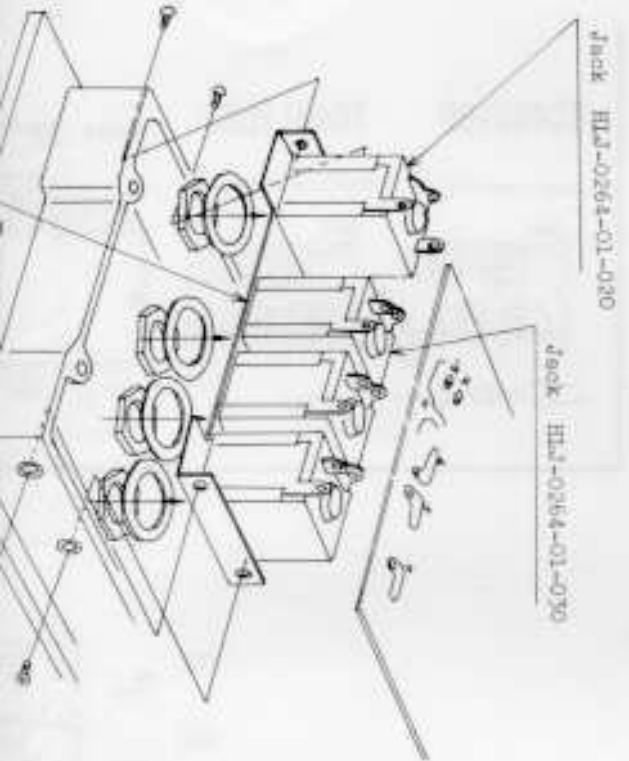


CLK	EN	CLR	OUTPUT
0	X	0	n
X	1	0	n
0	0	0	n+1
1	X	0	n
1	0	0	n+1
X	X	0	n
X	X	1	Q0

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

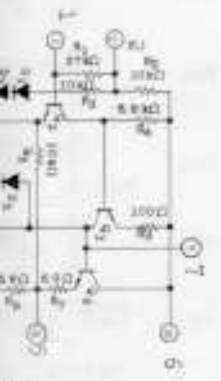


NUMERICAL CODE	PART NO.	PART NAME
J- 1-5, 7-9	13449402	SJ-409-1-2
J- 6, 8, 10	13449115	HLJ-0264-01-030
J- 11	13449114	HLJ-0264-01-020
SM- 1	13159503	8QPR24-12F
VR- 1-4	13339402	8VA-10A-015H15
VR- 5-8	13219806	8WT0910E K20 100K-A/D
VR- 9, 11	13219807	8WT0910E K20 100K x 2
VR- 10	13219220	8VLC0810Q K20 100K8
H- 6	2219019000	Holder K-190
D- 4-6	15029110	GL-3AR-1
IC- 1, 2	15189105	8PC458C
IC- 3	15189109	8A301HC
IC- 4	1515910520	TC4013BP
IC- 5, 6	15199502	TA7066AP
Q- 1-6	15119112	2SA1015-Y
Q- 7-9	15129115	28Q1815-Y
D- 1-3	15019105	182475
L- 1	2244021200	Coil W04RV 400MH
Q- 61-polar	1363993220	8CBA20H10 10HTD/29V

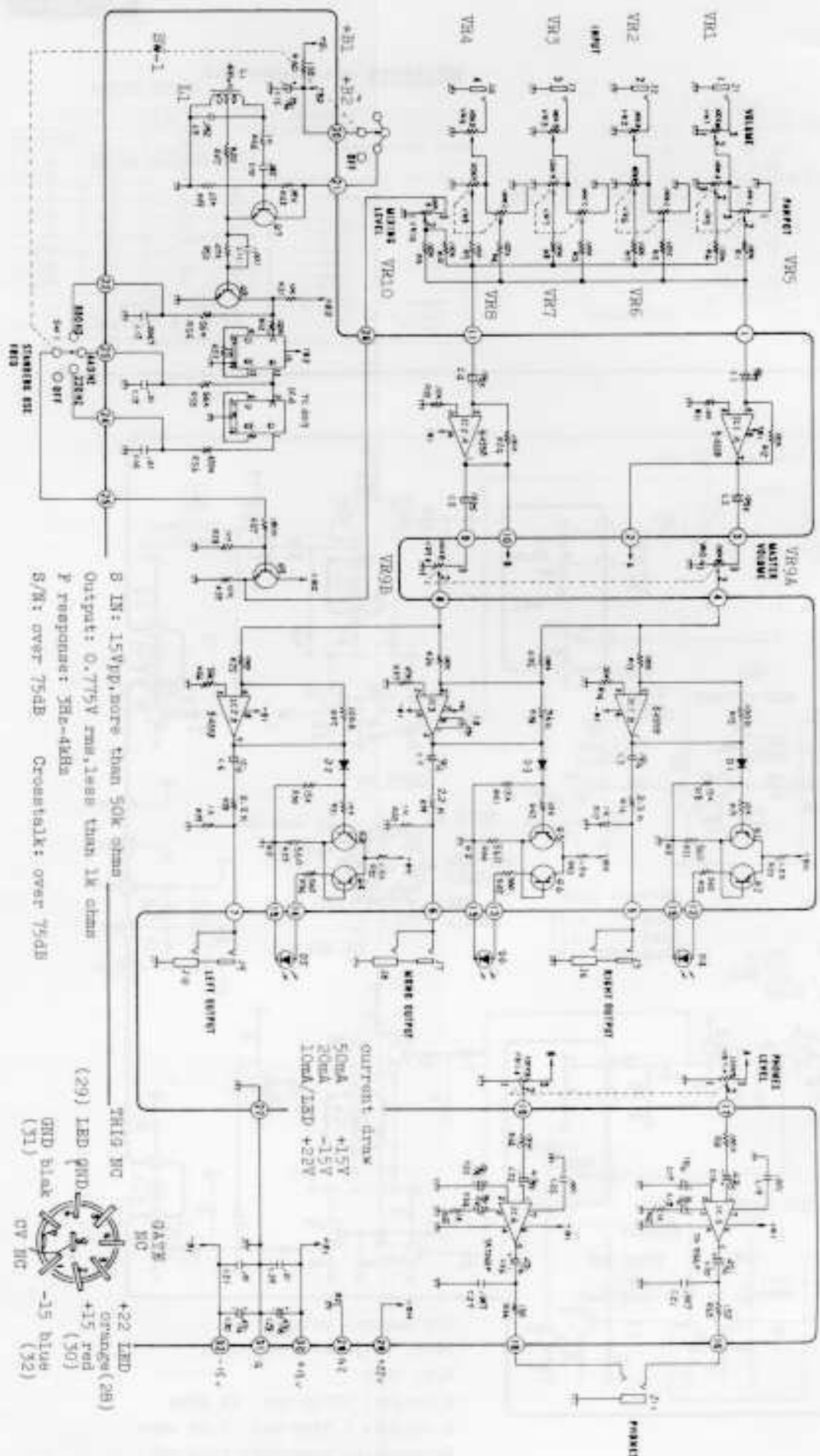


M-131

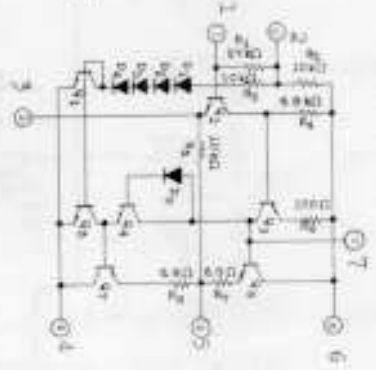
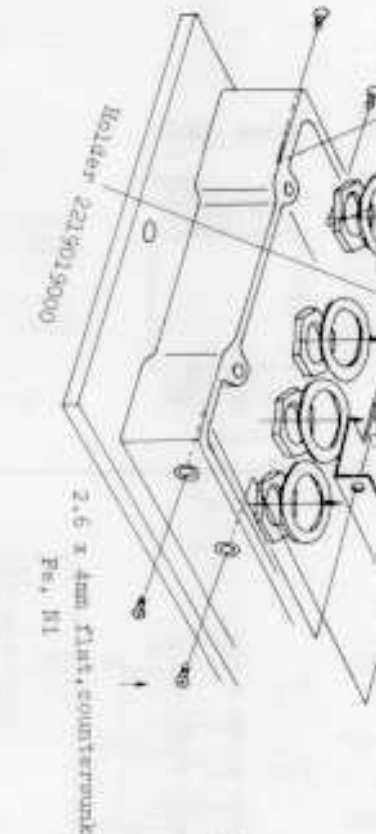
OP9105-040 (P/N 7910504000)
(pcb 052-409-2)



M-131 OUTPUT MIXER



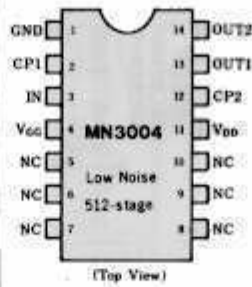
8 IN: 15V_rp, more than 50k ohms
 Output: 0.775V rms, less than 1k ohms
 F response: 3rd-4th
 S/N: over 75dB Crosstalk: over 75dB



TA7066P
 Voltage Amplifier
 Low Power Amplifier
 Equivalent Input Noise Voltage: 2 μ V
 Operative Power Supply Range: 6-25V DC
 Audio Output Power: 150mW
 (20V DC supply, 150-ohm load)
 Power Dissipation: + (max) 400mW @ T_a=25°C

NOMENCLATURE	PART NO.	PART NAME
J-	1-18	13449402 SJ-409-1-2
VR-	1-8	13339304 EVA-H04C15B15
VR-	9, 10	13339402 EVA-TOAC15B15
VR-	11,12	13299544 GR19R 22KB

IC-	1-4	15189105	uPC4558C
Q-	1-4	15119112	28A1015-Y
D-	1-4	15019103	182473
C-		13639149J0	ECE-A16V47 47/16V

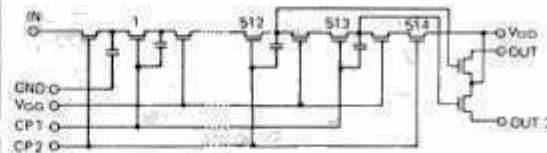


(Top View)

BBD

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

+SIG IN
GAIN ADJ
GAIN ADJ
-SIG IN

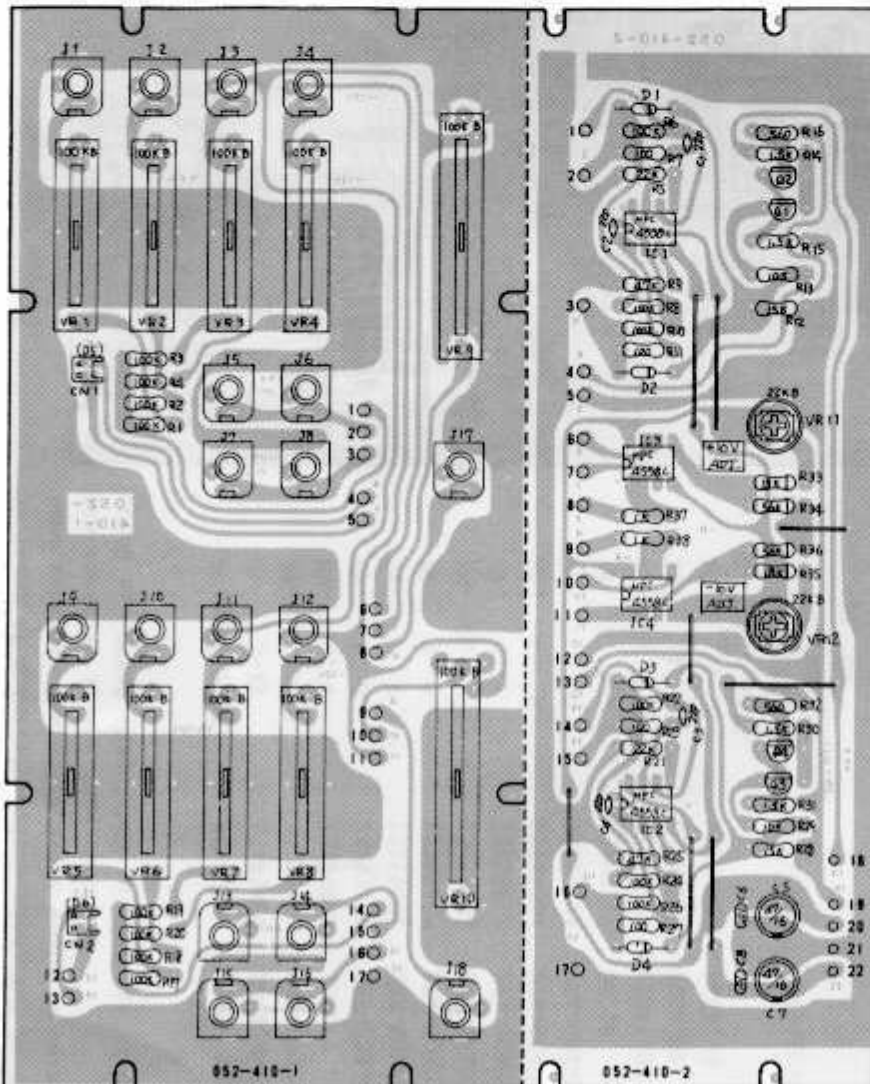


+SIG
GAIN
GAIN
-SIG
BIAS
+OUT

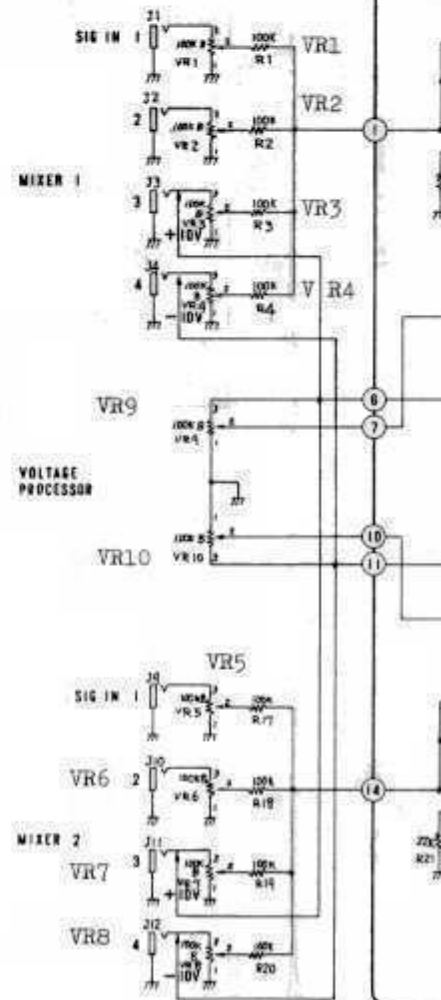
OP9106-030 (P/N 7910603000)
(pcb 052-410-1)

M-132

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

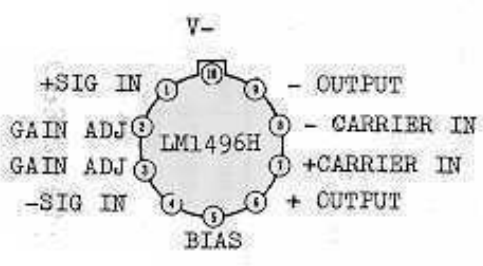


Signal input: $\pm 10V_{pp}$ max. u
Output: $\pm 10V_{pp}$ max. 1k oh
F. response: DC-40kHz



BD

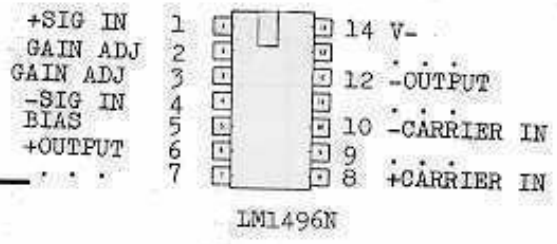
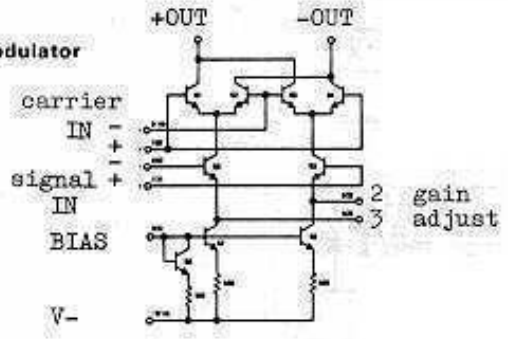
Delay Time
-25.6ms
85dB typ
-15V
-14V
0.4%



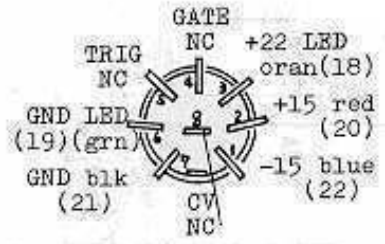
Output voltage is proportional to the product of an input (signal) voltage and a switching (carrier) signal.

Carrier Suppression: 65dB typ. @ 0.5MHz
50dB typ. @ 10MHz

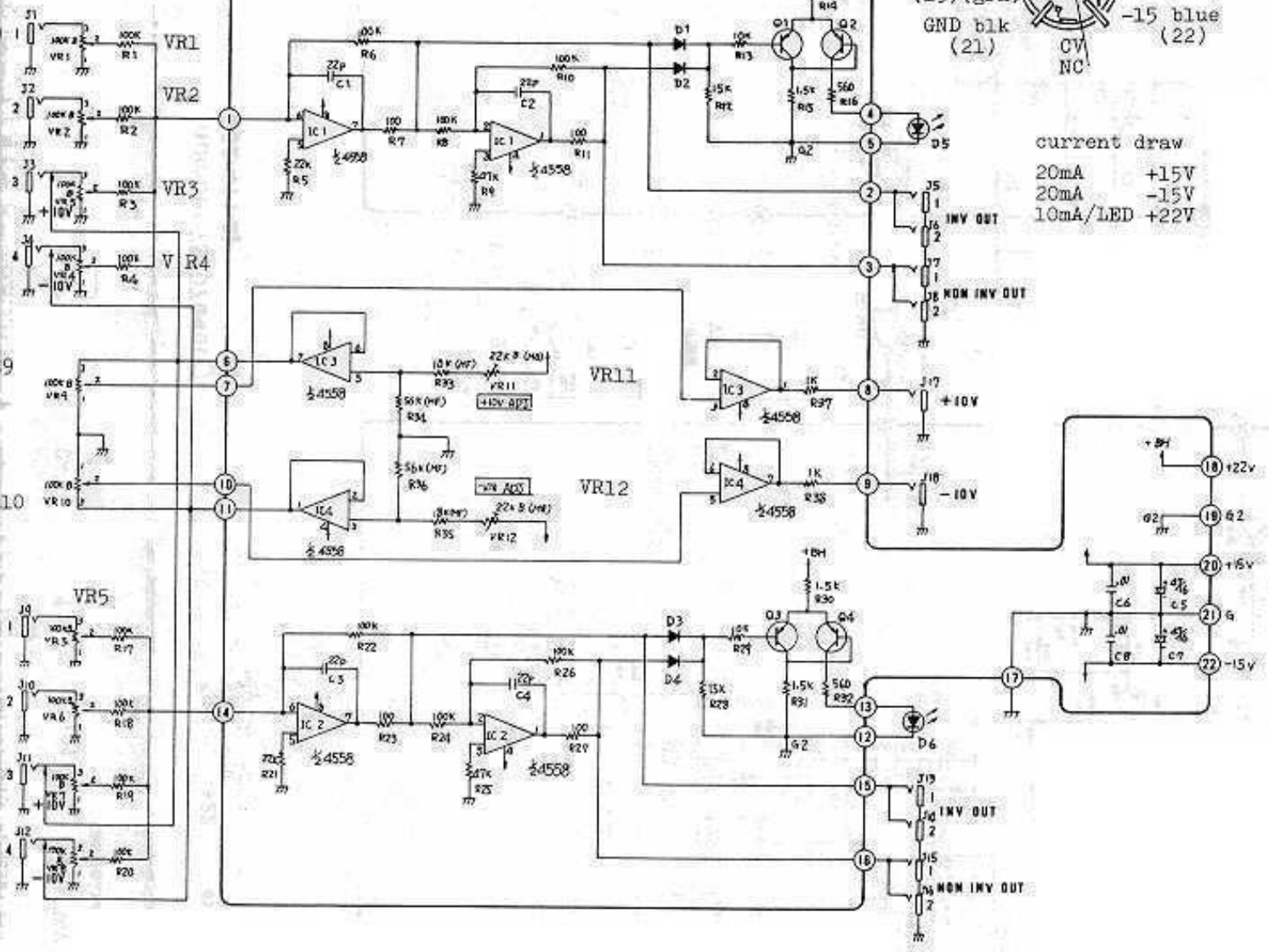
LM1496
balanced modulator-demodulator



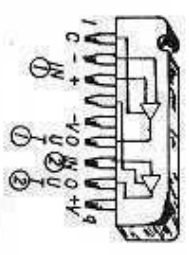
Input: $\pm 10V_{pp}$ max. more than 50k ohms
Output: $\pm 10V_{pp}$ max. 1k ohms
Response: DC-40kHz
S/N: over 90dB



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

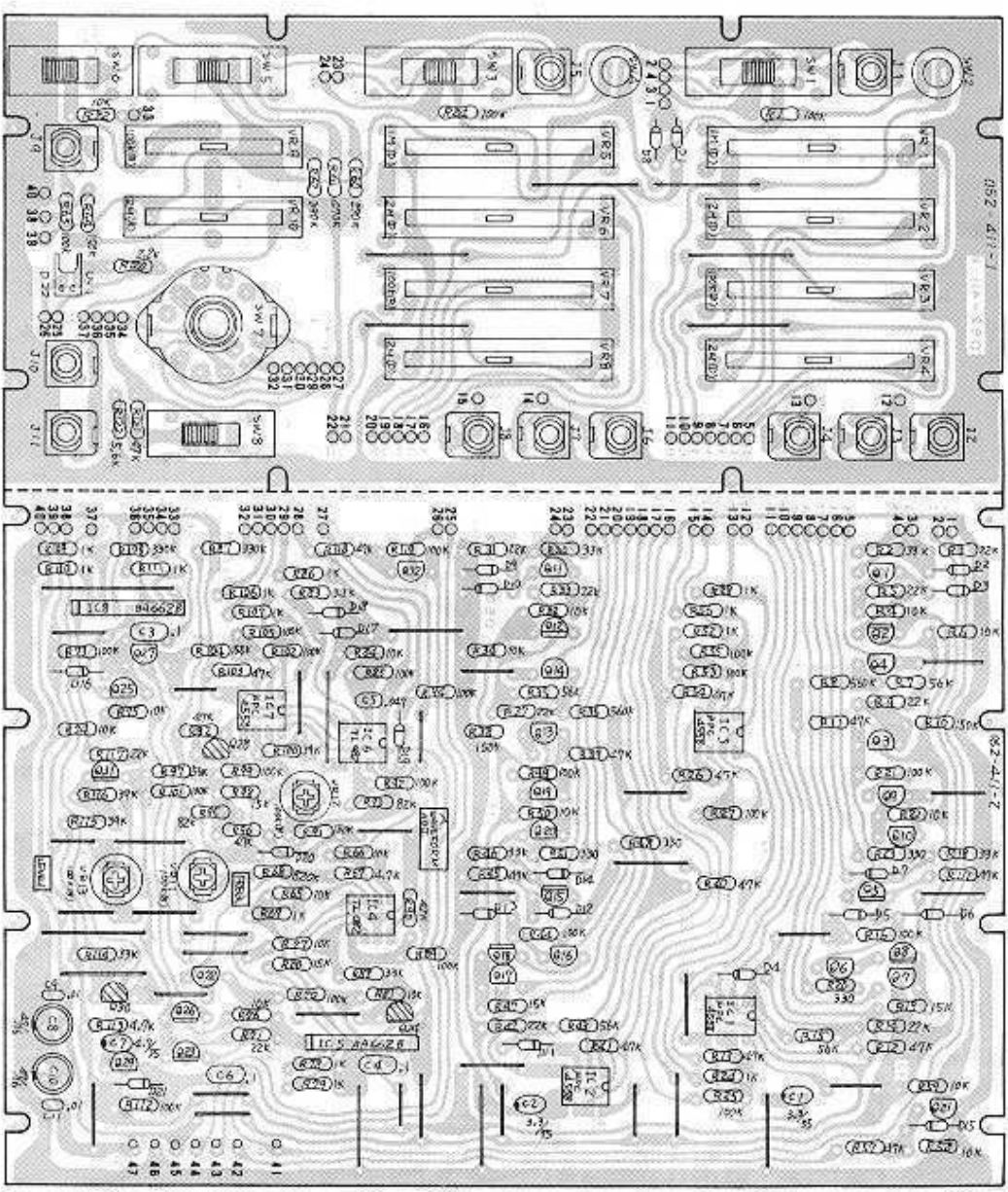


**BA662 A
BA662 B**



Roland Custom-made DC Controlled Variable Transconductance (g_m) 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's" are 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.

NO	NO	NO	NO
Q-2,5,8,12,15,18,25,26,31	15119112	2841015-Y	
Q-24,28,30	15139103	28F30A1W-GH	
D-1-21	15019103	182475	
C-1,2	13619710NO	3.3mF/35V tantalum	
C-7	13619711NO	4.7mF/35V tantalum	
Q-1,3,4,6,7,9-11,13,14,16,17,19-22,25,27,29,32	15129115	2601815-Y	
VR-2,4,6,8	13339404	NVA-TOA015D16	
VR-3,7	13339402	EVA-TOA015H15	
VR-9	13339304	EVA-HO4-015B15	
VR-10	13339303	EVA-HO4-015A26	
VR-11,12,13	13289117	SR19R LOOKB	
IC-1,2,3,7	15189105	uP04558C	
IO-4,6	15189118	TU0820P	
IO-5,8	15229805	BA662-B	
Q-1-11	13449402	BU-409-1-2	
SW-1,3,5	13159304	SSB-02335	
SW-2,4	13129901	DS-102 red	
SW-6,8	13159105	SSB-022-42	
SW-7	13119401	SRM-1025172	
VR-1,5	13339403	EVA-TOA015D16	
VR-2,4,6,8	13339404	NVA-TOA015D26	
VR-3,7	13339402	EVA-TOA015H15	
VR-9	13339304	EVA-HO4-015B15	
VR-10	13339303	EVA-HO4-015A26	
VR-11,12,13	13289117	SR19R LOOKB	
IC-1,2,3,7	15189105	uP04558C	
IO-4,6	15189118	TU0820P	
IO-5,8	15229805	BA662-B	



OP9107-030(P/N 7910703000)

OP9107-040(Part number 7910704000)

GAIN white(41)

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
 A B C D E F G H I J K L M N O P Q R S T U V

M-140 2ENV-LFO

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

M-140 **OP9107-040 (Part number 7910704000)**
 (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)

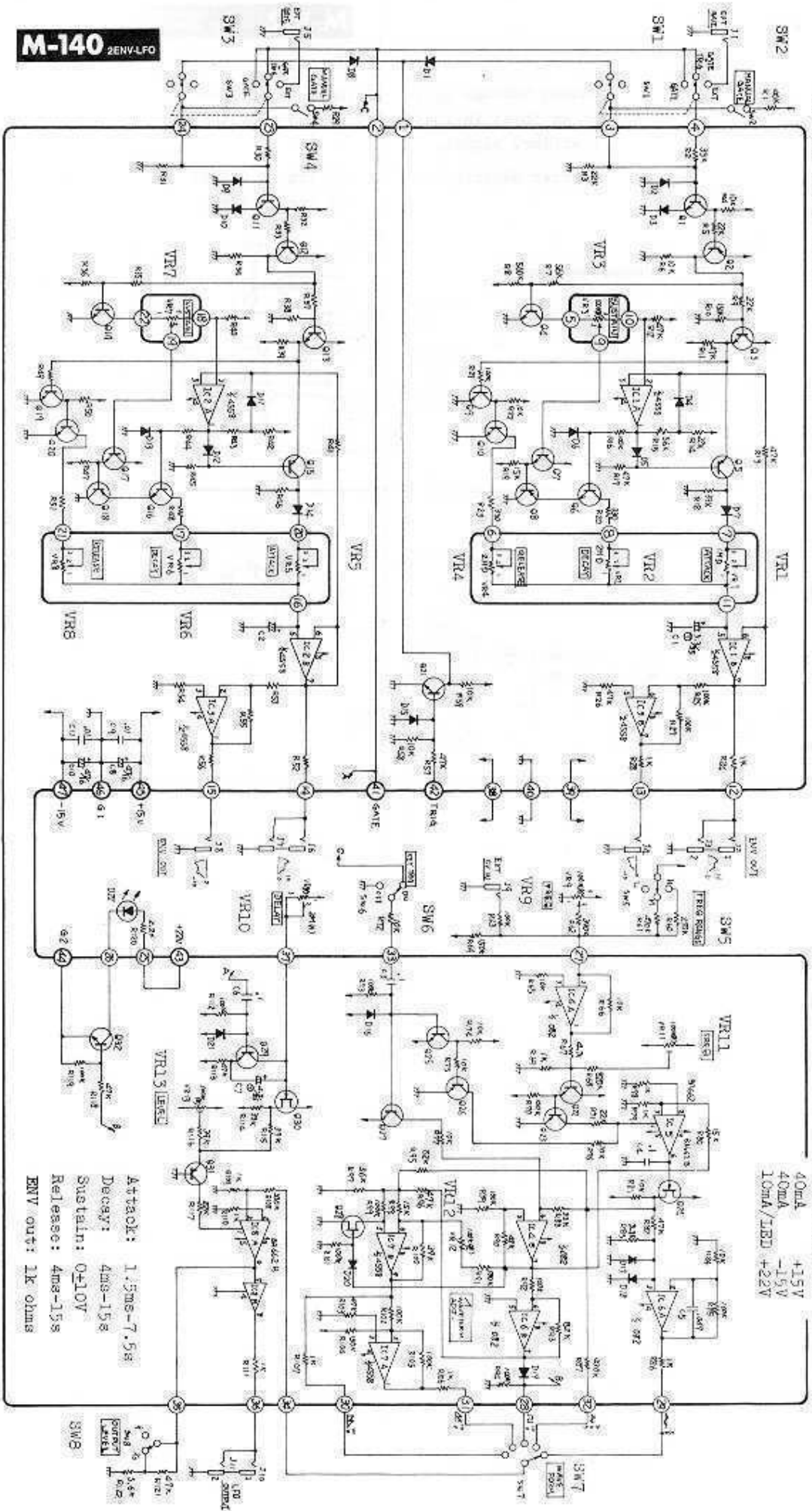
TRIG brn(42) +22 LED grn (43)

Gnd LED brn(44) +15 red(45)

Gnd blk (46) -15 blk(47)





40mA +15V
 40mA -15V
 10mA/LED +22V
 current green

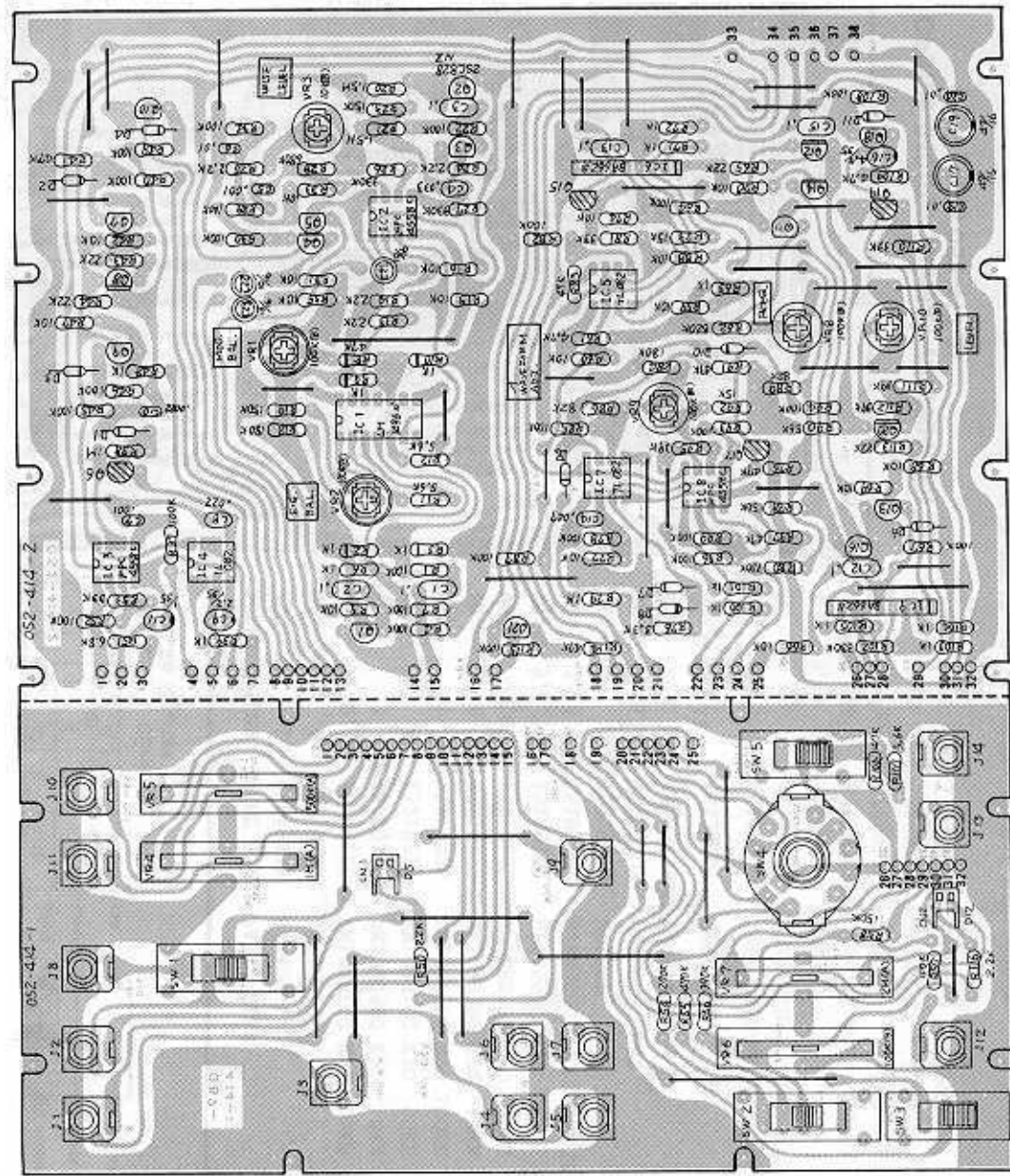


Attack: 1.5ms-7.5s
 Decay: 4ms-15s
 Sustain: 0-10V
 Release: 4ms-15s
 ENV out: 1k ohms

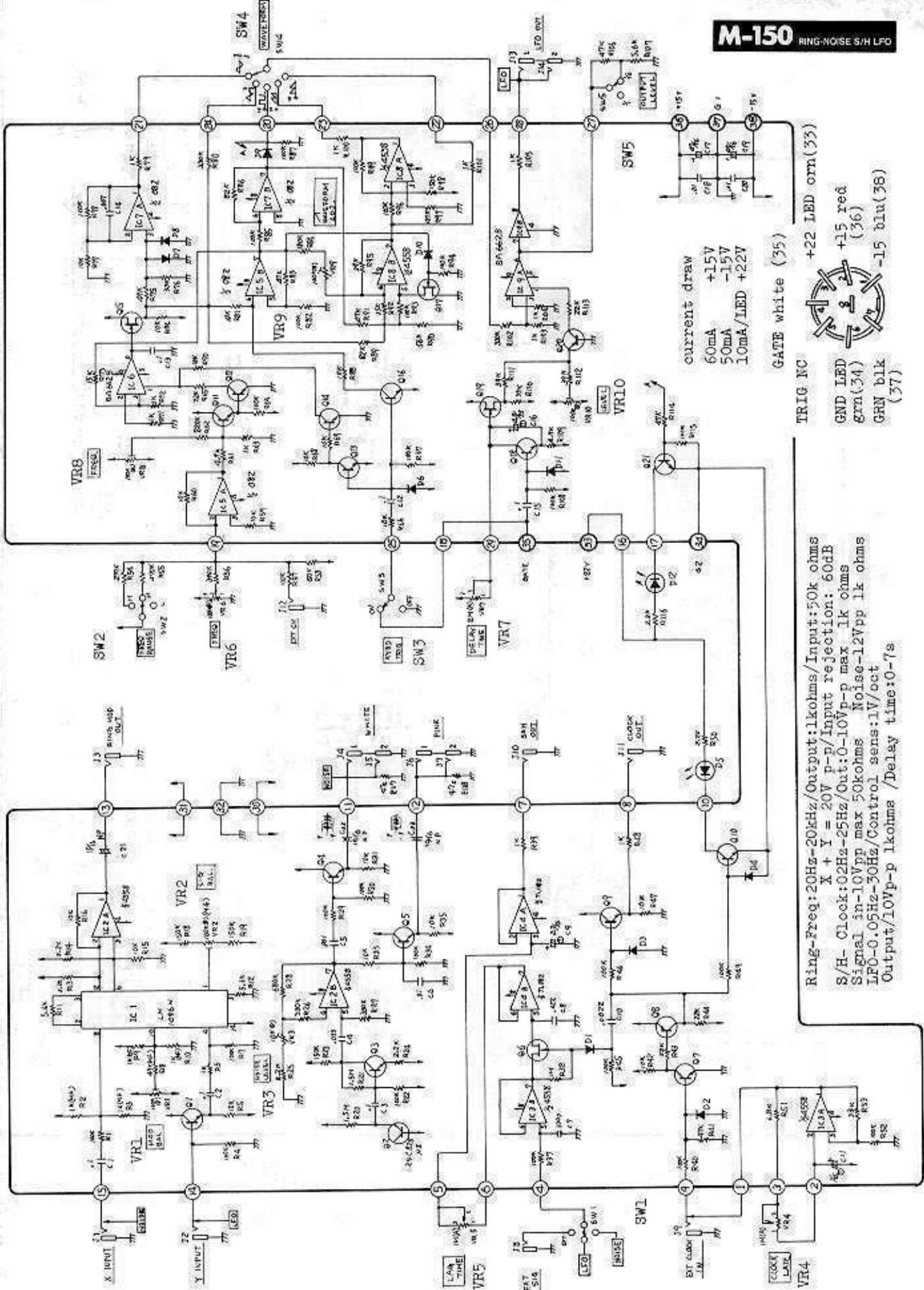


NOMENCLATURE	PART NO.	PART NAME
J- 1-14	13449402	SJ-409-1-2
SW- 1, 2	13159304	SSB-02335
SW- 3, 5	13159103	SSB-02242
SW- 4	13119401	SRNL025172
VR- 1, 2	13299546	CR19R 100KB
VR- 3	13299114	SR19R 10XB
VR- 4	13339302	EVA-H04C15A16
VR- 5	13339305	EVA-H04C15A55
VR- 6	13339304	EVA-H04C15B15
VR- 7	13339303	EVA-H04C15A26
VR- 8, 9, 10	13299117	SR19R 100KB
CR- 1, 2	13439502	3024-02C
IC- 1	15219106	LM1496N
IC- 2, 3, 8	15189105	uPC4558C
IC- 4, 5, 7	15189118	TL082CP
IC- 6, 9	15229803	BA662-B
Q- 1, 3-5, 7	15129115	28C1815-Y
Q- 9-11, 13, 16, 18, 21		
Q- 2	151291050A	280828R selected for noise generator
Q- 6, 15, 17	15139103	28K30ATN-GR
Q- 19		
Q- 8, 12, 14	15119112	28A1015-Y
Q- 20		
D- 1-4, 6-11	15019103	182473
C- 9	13619709NO	2.2mfd/35V
C- 11	13619707NO	1mfd/35V
C- 16	13619711NO	4.7mfd/35V
C- tantalum		
C- 	13639149J0	EC6A16V47 47mfd/16V
C- 	13639022J0	EC6A16N10 bi-polar

OP9108-030 (P/N 7910803000) **M-150** OP9108-040 (Part number 7910804000) (pcb 052-414-2)



M-150 RING-NOISE S/H LFO



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



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

GATE white (35)

TRIG NC

GND LED

grn(34)

GRN blk

(37)

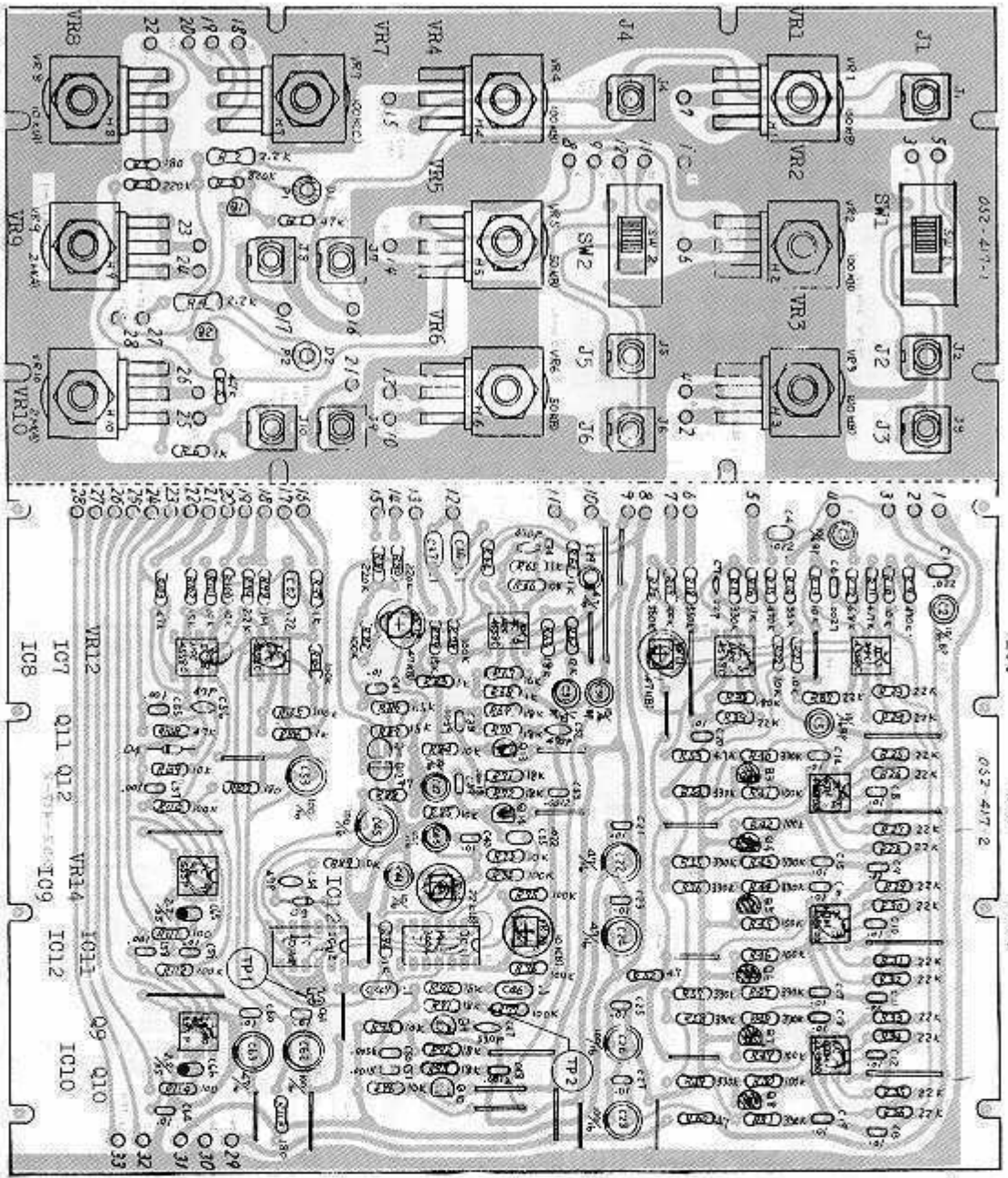
+22 LED orn(33)

+15 red

(36)

-15 blu(38)

(37)



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

M-172

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

PH. SHIFL-200Hz-9KHz/1080°P resp: 20Hz-20KHz
S/N: 60dB/In: 10V, 50kohm/Out: less 1kohm
EXTCV: 10V max 50kohm/Out: less than 1kohm

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

IC1
IC5 Q13 IC2
VR11
Q3 Q4 Q5 Q6 Q7 Q8
IC6 Q14 VR13
IC3
IC4

VR12
IC7 Q11 Q12
VR14
IC9
IC10
Q9 Q10
Q32
Q31
Q30
Q29
Q28
Q27
Q26
Q25
Q24
Q23
Q22
Q21
Q20
Q19
Q18
Q17
Q16
Q15
Q14
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Q12
Q11
Q10
Q9
Q8
Q7
Q6
Q5
Q4
Q3
Q2
Q1

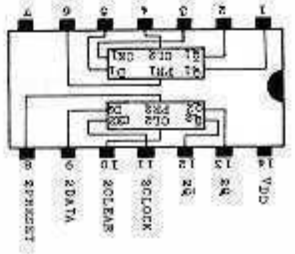
TRUTH TABLE

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

*: Don't Care
.: No Change

4013B

DUAL TYPE D FLIP-FLOP



NOMENCLATURE

NOMENCLATURE	PART NO.	PART NAME
J- 1-10	13449402	8J-409-1-2
SW- 1, 2	13159103	SSB02242
VR- 1, 2, 4	13219220	VM10RH10C K20 100KB
VR- 3	13219225	VM10RC380 K20 100KB
VR- 5, 6	13219219	VM10RH10C K20 50KB
VR- 7	13219226	VM10RC380 K20 100KB
VR- 8	13219222	VM10RC380 K20 10KA
VR- 9, 10	13219221	VM10RC380 K20 2MA
IC- 1, 5, 6, 7, 8	15189105	UPC45580C
IC- 2, 3, 4	15189102	NJM4558DD HP MONO Dual
IC- 9, 10	15219109	NE555P
IC- 11	15219203	VM3004 BBD
IC- 12	15159105F0	VC4013BP
Q- 1, 2, 9-11 13, 14	15129107	28C945-Q
Q- 3-8	151391030A	28K30ATM-GR selected
Q- 12	15119106	28A733-Q
D- 3, 4	15019103	1S2473
C- 65, 66	13619709NO	tantalum 2.2/35V
VR- 11, 12	13299116	SR19R 47KB
VR- 13	13299114	SR19R 10KB
VR- 14	13299115	SR19R 22KB

IC1

Q 8

IC4

Q 7

Q 6

IC 3

Q 5

Q 4

IC 2

Q 3

IC 5

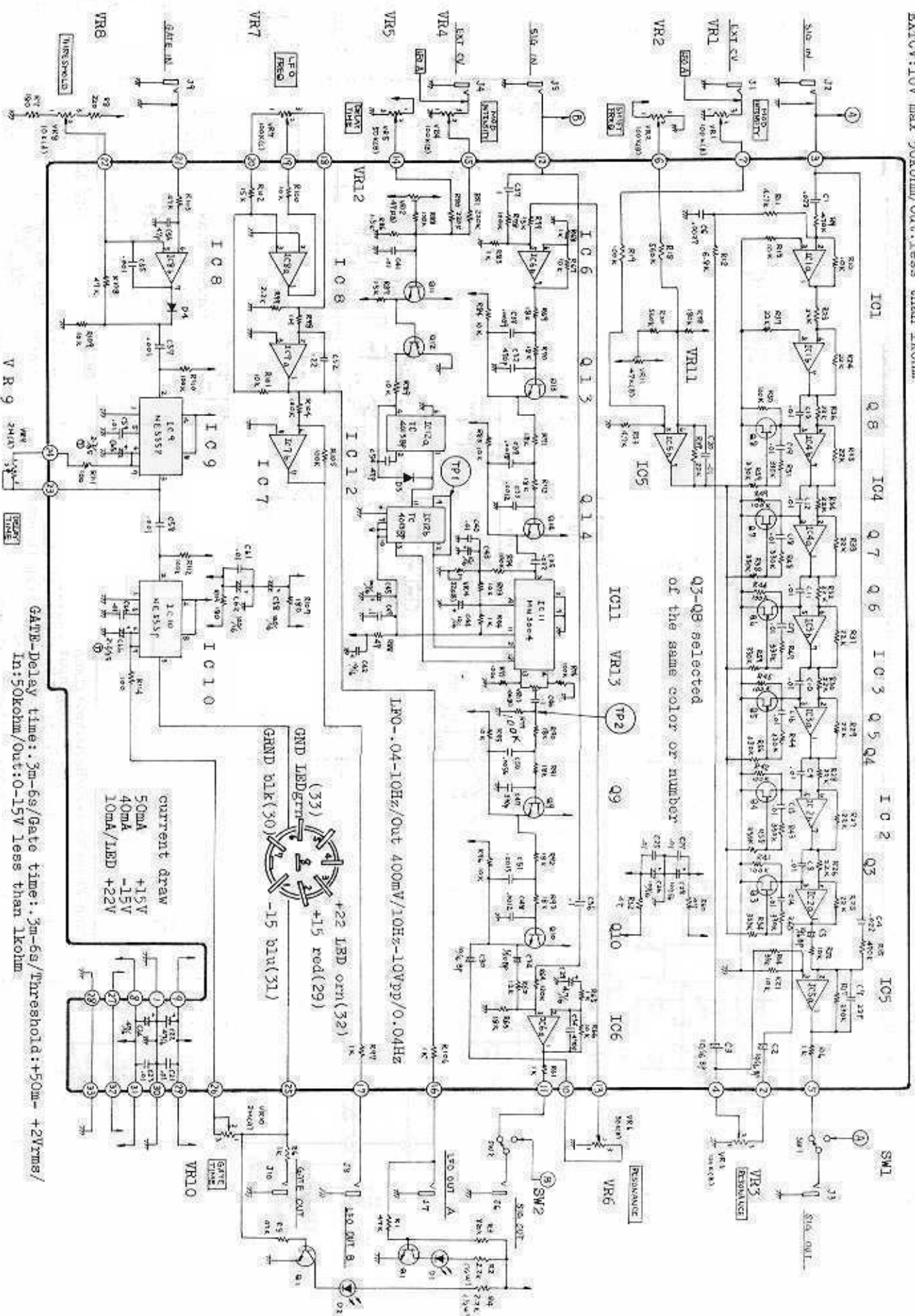
SW1

PH: SHIF1-200Hz-8kHz/1080°/F resp: 20Hz-20kHz
 S/N: 60dB/In: 10V/50kohm/Out: less 1kohm
 EXCV: 10V max 50kohm/Out: less than 1kohm

(pcb 052-417-1)

(pcb 052-417-2)

A. DELAY-0m-7ms/70Hz-20kHz/S/N: 60dB/In: 10V
 50k/Out: less 1k/EXCV: 10Vmax 50kohm



GATE-Delay time: 3m-6s/Gate time: 3m-6s/Threshold: +50m- +2Vrms/
 In: 50kohm/Out: 0-15V less than 1kohm

current draw
 50mA
 40mA
 -15V
 10mA/LED +22V

(33) +22 LED (Q22)
 (29) +15 LED (Q29)
 -15 diu (31)

LR0-.04-10Hz/Out 400mV/10Hz-10Vpp/0.04Hz

Q3-Q8 selected
 of the same color or number

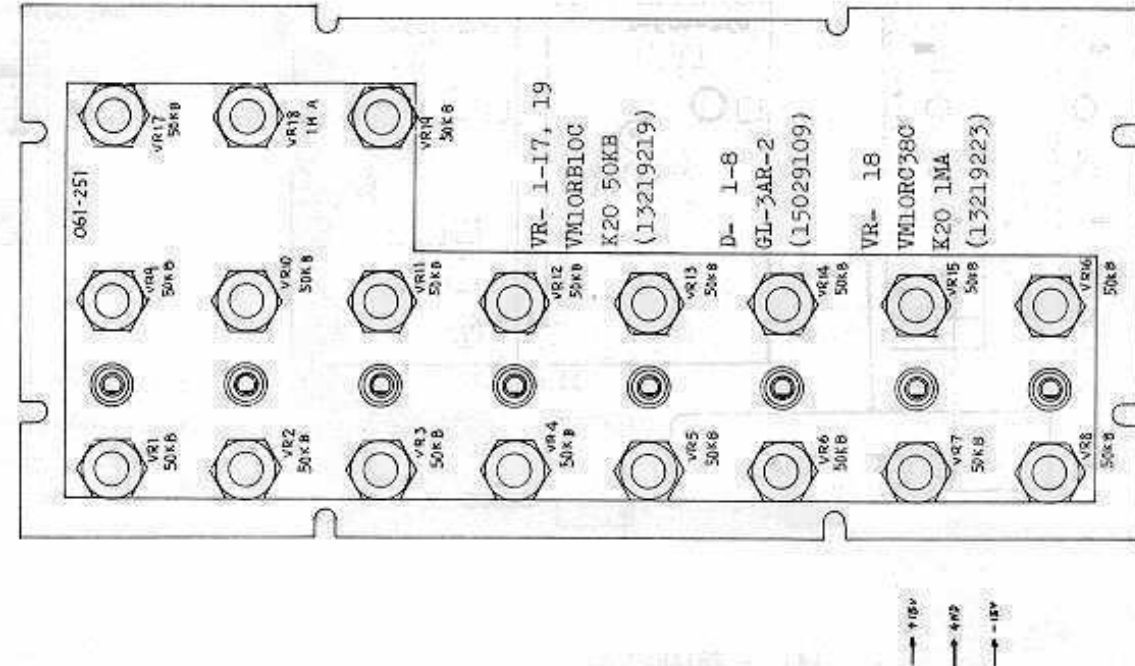
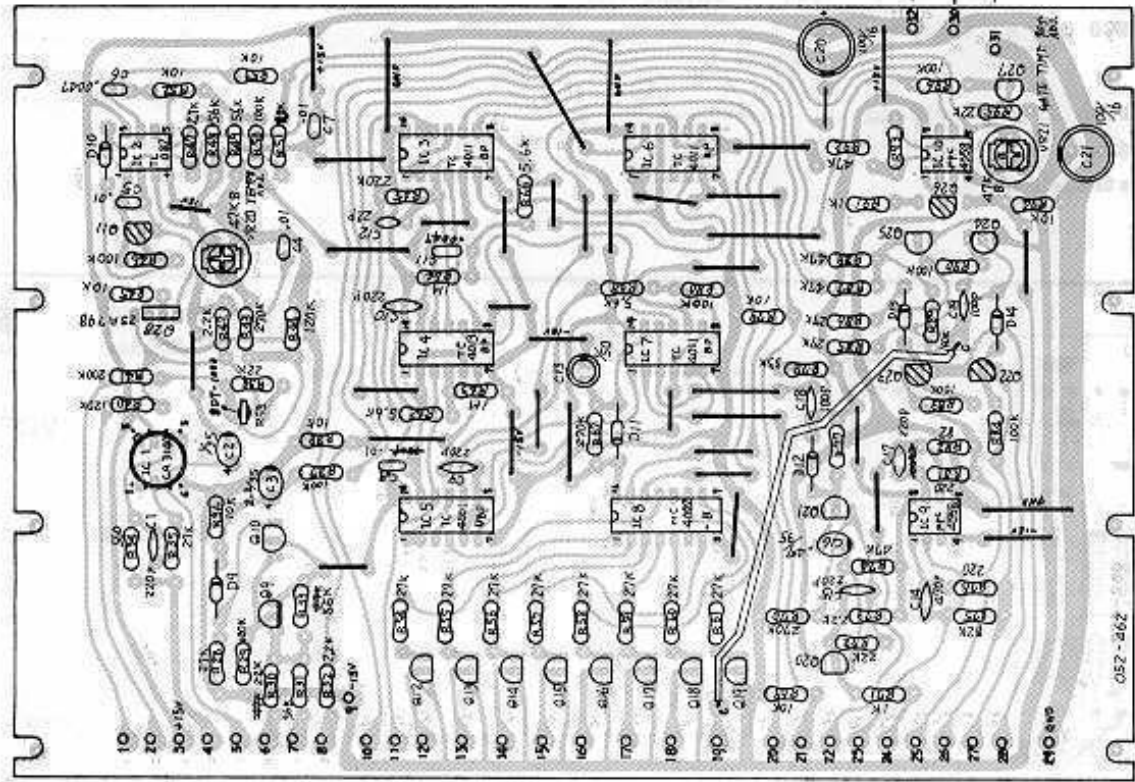
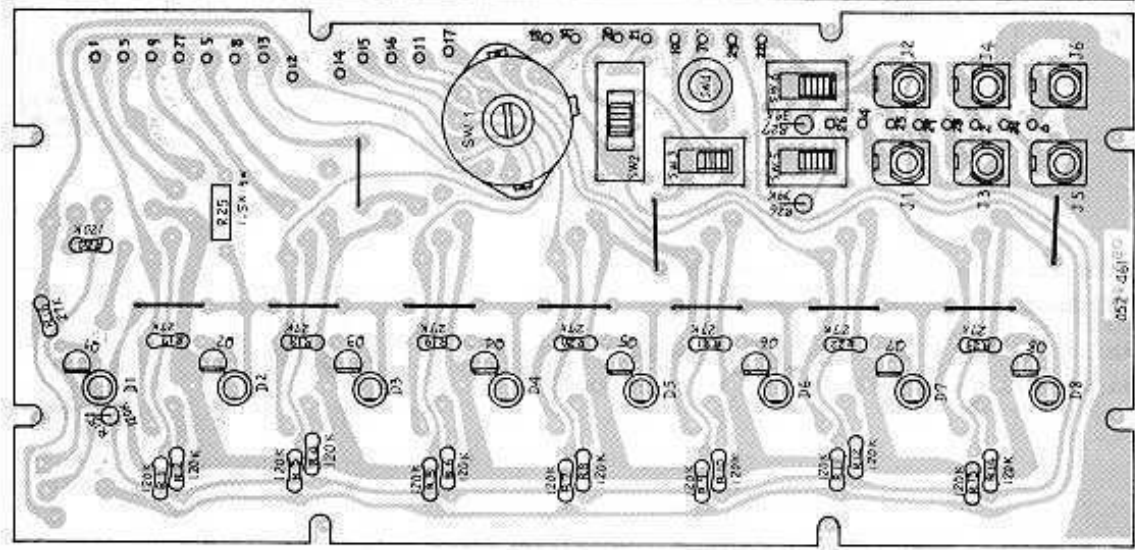
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21

M-172 PHASE SHIFTER/AUDIO
 DELAY/GATE DELAY

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

- | | | | | | | | | | | | |
|-----------|----------|------------|-----------|------------|------------|----------|------------|-----------|--------------------------|----------|----------|
| J- 1-6 | 13449402 | SJ-409-1-2 | SW- 4 | 13129901 | DS-102 red | IC- 4 | 15159105T0 | TC4013BP | Q- 1-8 | 15119106 | 28A733-Q |
| SW- 1 | 13119702 | SRM1018112 | IC- 1 | 15189121 | CA3140T | IC- 5 | 15159102T0 | TC4001UBP | Q- 9 | 15119108 | 28A798-G |
| SW- 2 | 13159302 | SBA04301 | IC- 2 | 15189118 | TL082CP | IC- 8 | 15159107Z0 | MCL4022B | Q- 10,12-21,
24,25,27 | 15129107 | 280945-Q |
| SW- 3,5,6 | 13159102 | SBA04202 | IC- 3,6,7 | 15159104T0 | TC4011BP | IC- 9,10 | 15189105 | uPC4558C | | | |

See bottom for remainders.



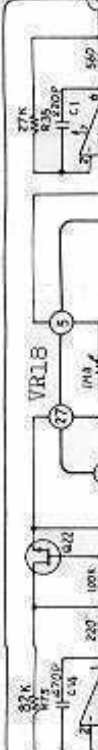
OP110-030 (P/N 7911003000)
M-182
(pcb 052-461)

OP11-040 (Part number 7911004000)
M-182
(pcb 052-462)

Tempo: 7ns-3ms (0.14Hz-33Hz)
Gate time: 10-90%
CV out: 0.3-10V

Gate out: +14V
less than 2k ohms
Tempo in: 0-10V/120K

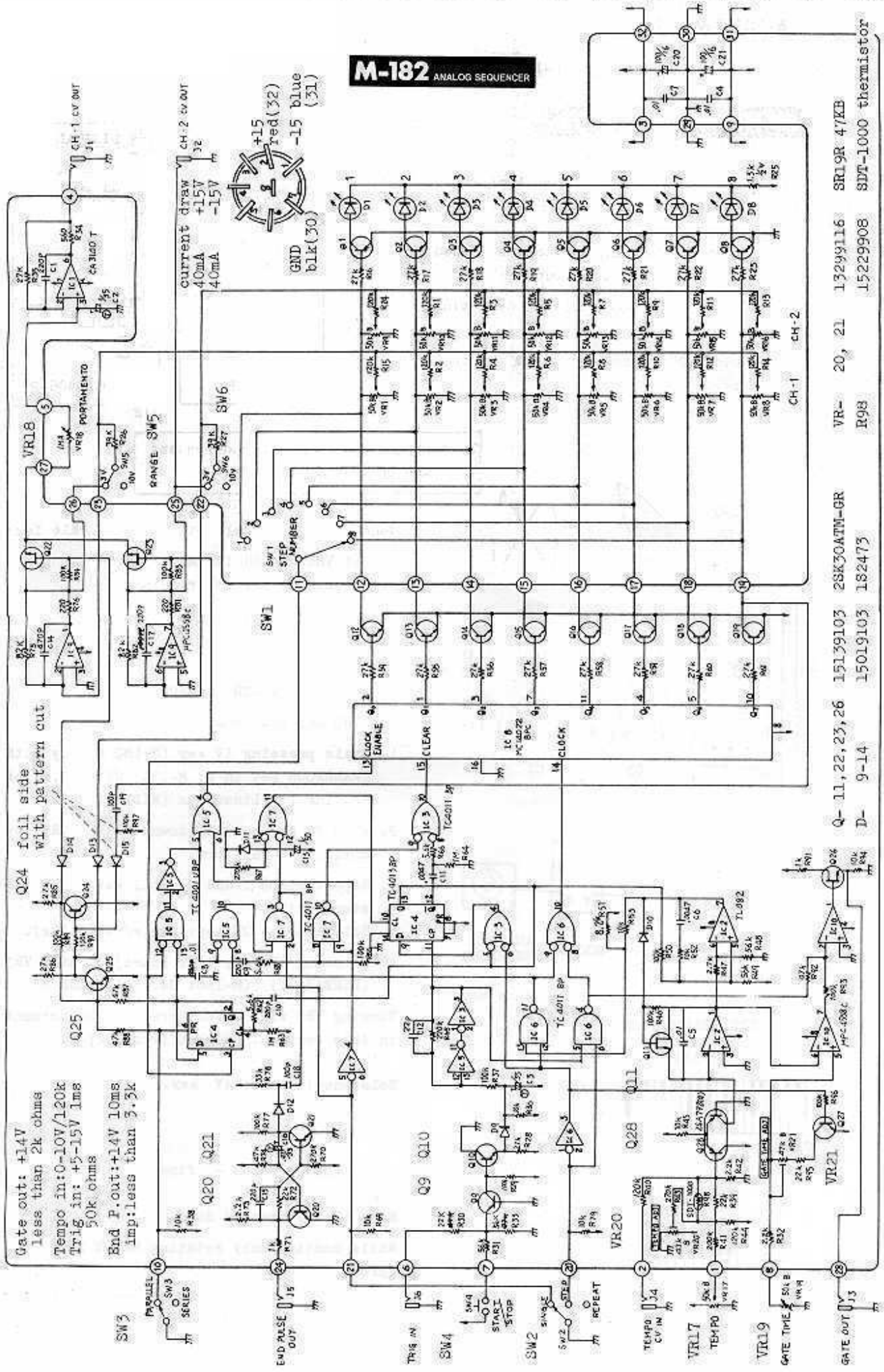
Q24 foil side
with pattern cut



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

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

Tempo: 7s-3ms (0.14Hz-33Hz)
Gate time: 10-90%
CV out: 0.3-10V

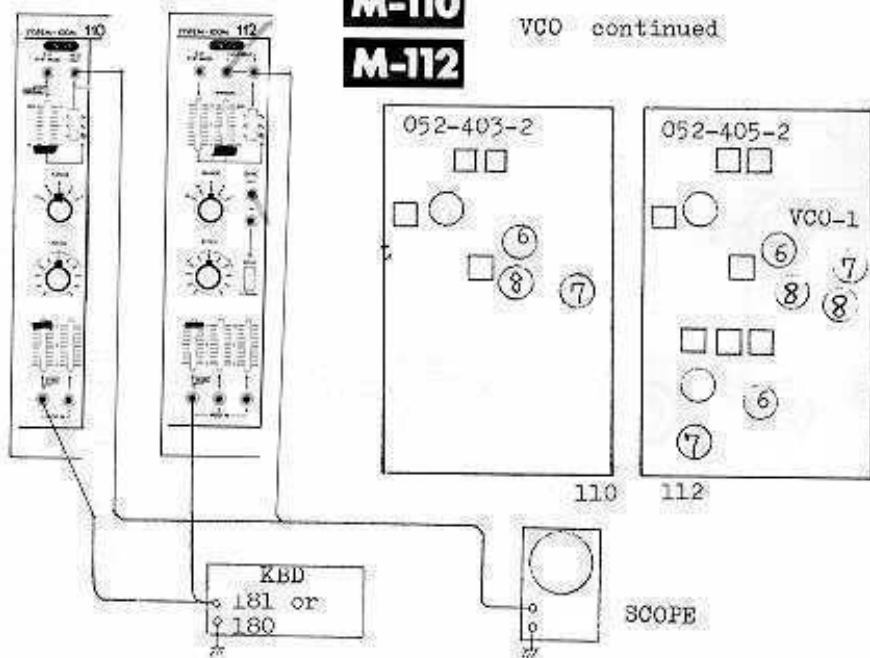


Q- 11, 22, 23, 26 15139103 2SK30ATM-GR
D- 9-14 15019103 182473
VR- 20, 21 13299116 SR19R 47KB
R98 15229908 SDT-1000 thermistor

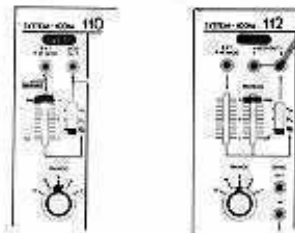
M-110
M-112

VCO continued

(5) - RECTANGULAR -

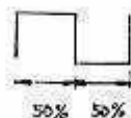


Set OUT switch to



Set MANUAL to 50% (0).

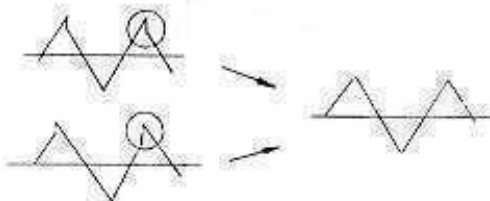
While pressing 2V key, adjust VR7 for 50% duty ratio.



(4) - TRIANGULAR -

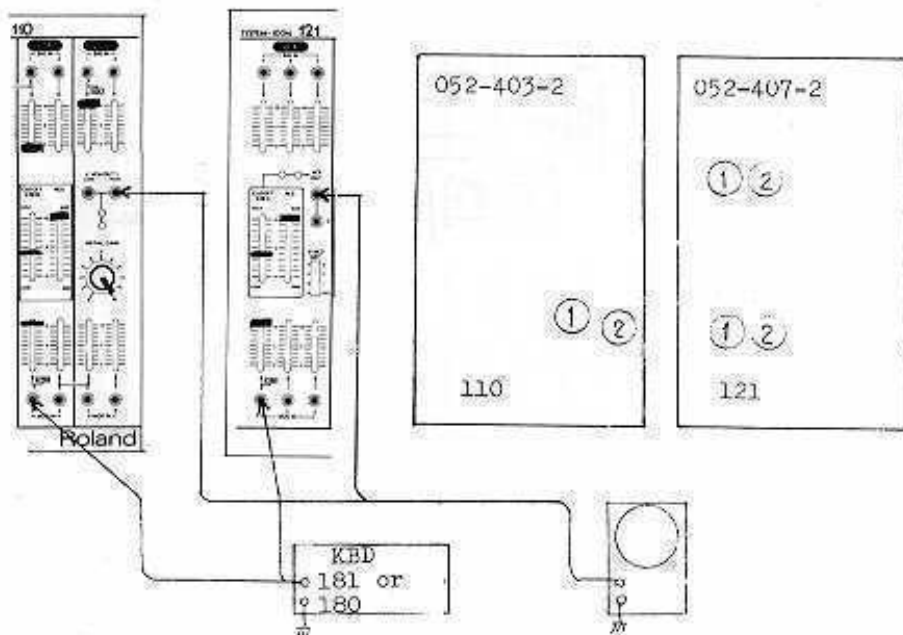
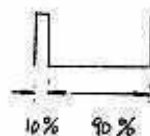
VCO OUT switch:

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



Set MANUAL to MIN (10).

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

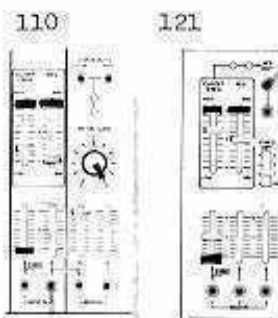


M-110 VCD-VCF-VCA

M-121 2VCF

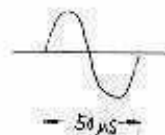
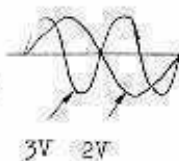
VCF

(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).

ADJUSTMENT

VCO

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

(1) - RANGE - coarse

M-110 VCO-VCF-VCA

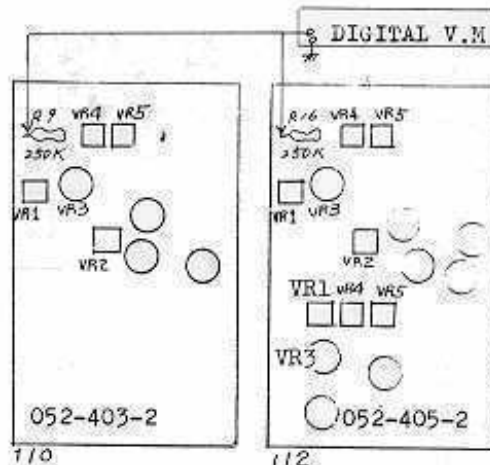
M-112 2VCO

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

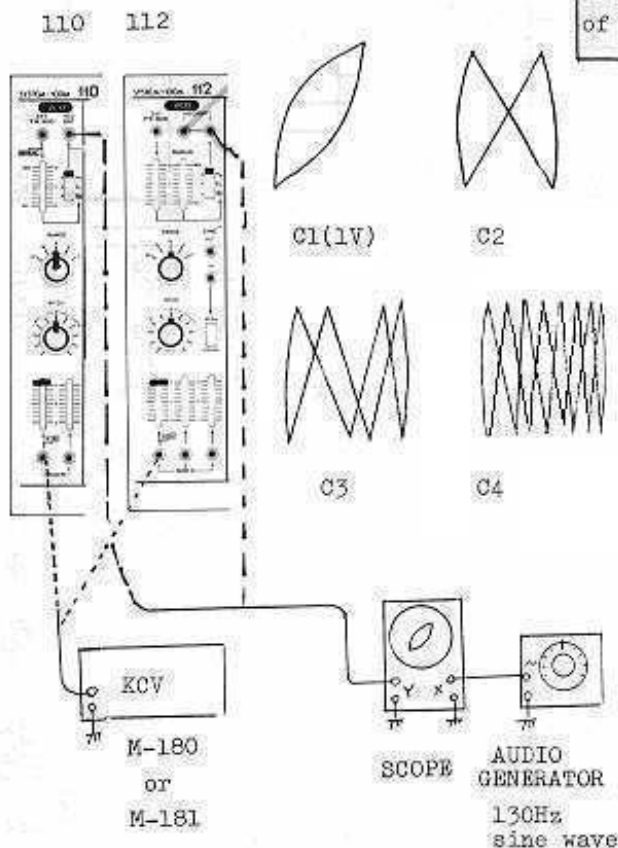
Leave the test and testing equipments turned on for 20-30 minutes as a warmup period.

Keep room at a normal and constant operating temperature.

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



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.

KEY DESIGNATION

M-181



M-180

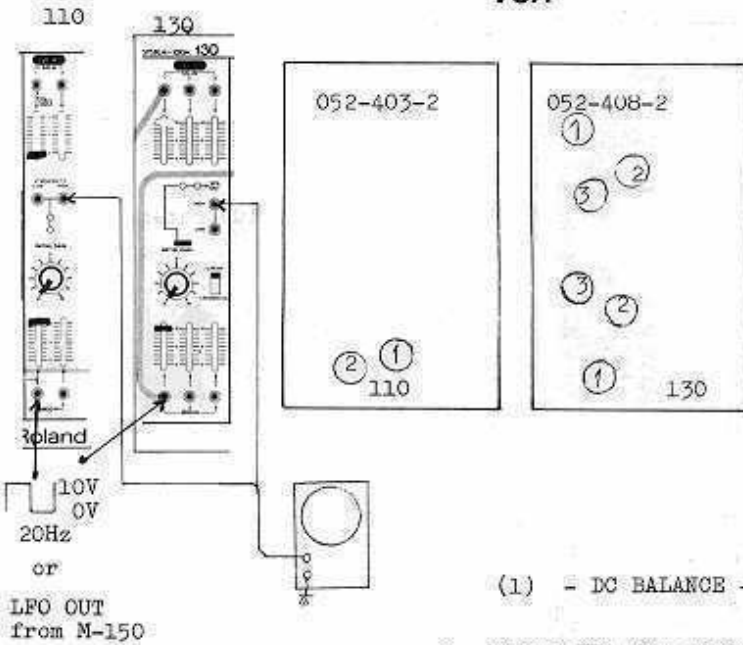


(3) - RANGE - fine

Keep 1V key pressed down.

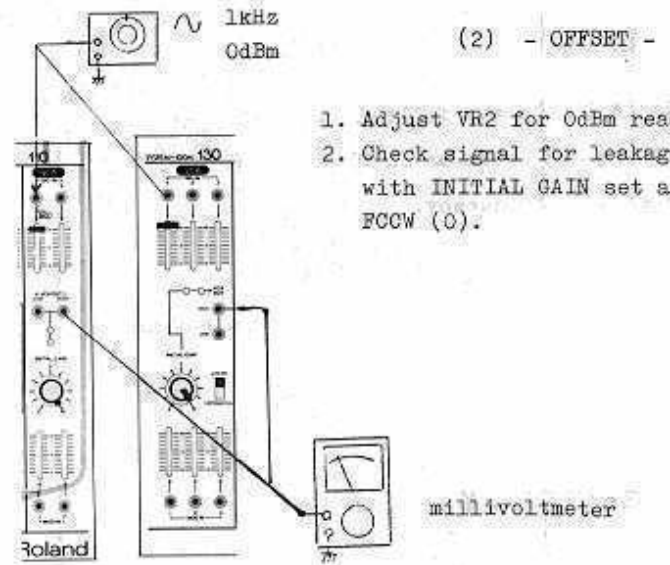
While continuously rotating RANGE knob across full travel range, adjust VR1 for the least detune at every RANGE setting.

VCA



(1) - DC BALANCE -

1. Adjust VR1 for minimum amplitude. Increase scope's Vertical gain as the output reduces.



(2) - OFFSET -

1. Adjust VR2 for 0dBm reading
2. Check signal for leakage with INITIAL GAIN set at FCCW (0).

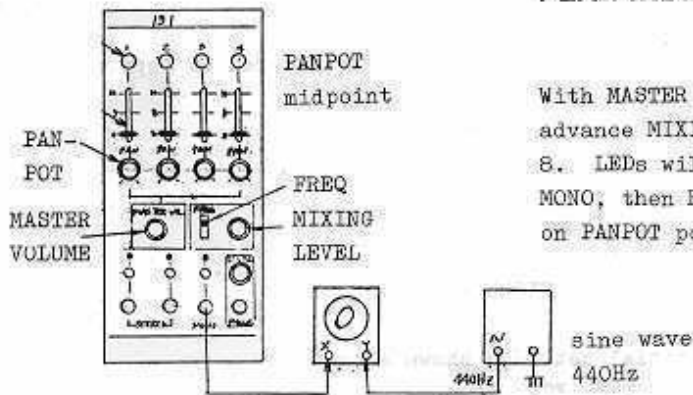
(3) - VCA GAIN - M-130 only

1. Set Changeover switch to EXPONENTIAL.
2. Adjust VR3 for 0dBm reading.

PEAK INDICATOR

M-131 OUTPUT MIXER

STANDARD OSC



With MASTER VOL set FCCW, advance MIXING LEVEL to 8. LEDs will come on - MONO; then R or L (depends on PANPOT position).

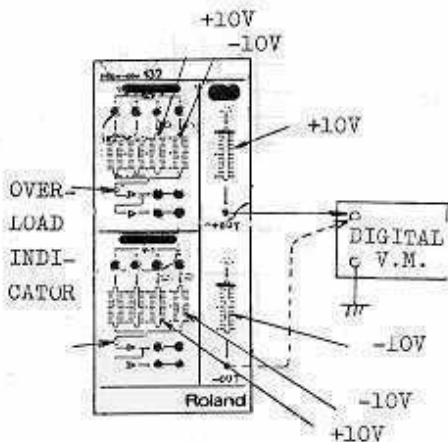


1. Set FREQ in 440Hz.
2. Set MASTER VOL and MIX LEVEL for proper level.
3. Turn L1 with nonferrous metal tool for 1:1 Lissajous.

M-132 DUAL CV/AUDIO MIXER & VOLTAGE PROCESSOR

VOLTAGE PROCESSOR

MIXER-1.2

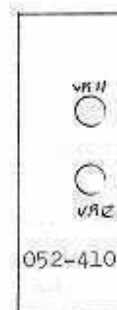


(1) - +10V -

1. Set +OUT slider at +10.
2. Adjust VR11 for $10.5 \pm 10mV$.

(2) - -10V -

1. Set -OUT slider at -10.
2. Adjust VR12 for $-10 \pm 10mV$.



- OVERLOAD INDICATOR -

Check that LEDs light respectively under the following settings.

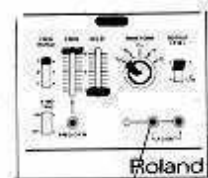
MIXER-1

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

MIXER-2

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

LFO

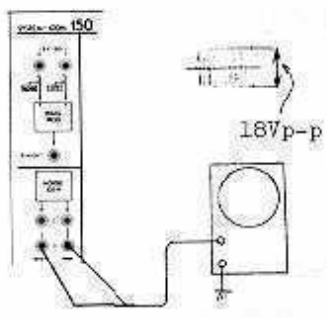
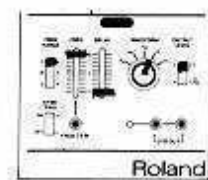
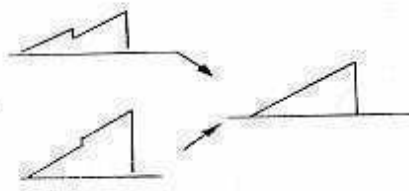
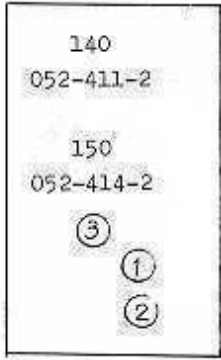


(1) - FREQUENCY -
Adjust VR1 for 30Hz (33ms).

(2) - AMPLITUDE -
Adjust VR2 for 10V p-p.

Change WAVEFORM to SAWTOOTH.

(3) - SAWTOOTH -
Adjust VR3 for straightness.



M-150 RING-NOISE S/H LFO

NOISE

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



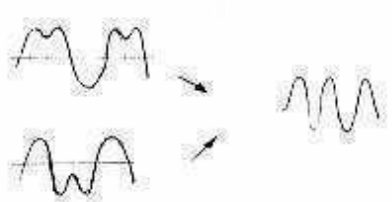
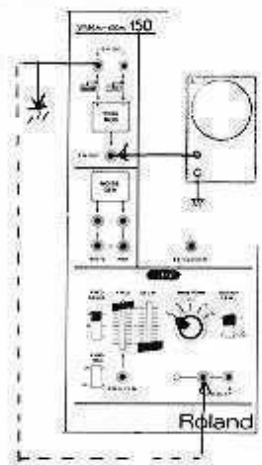
RING MODULATOR

(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.

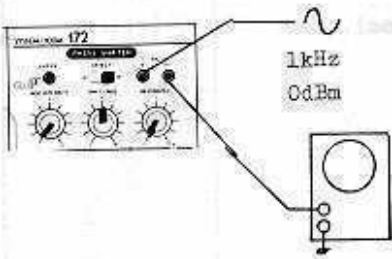
(2) - MODULATION BALANCE -

Connect EXT SIG X to LFO OUT.
Adjust VR3 for distortion free output.
Modulated waveform doubles the input in frequency.



PHASE SHIFTER

- SHIFT FREQUENCY -

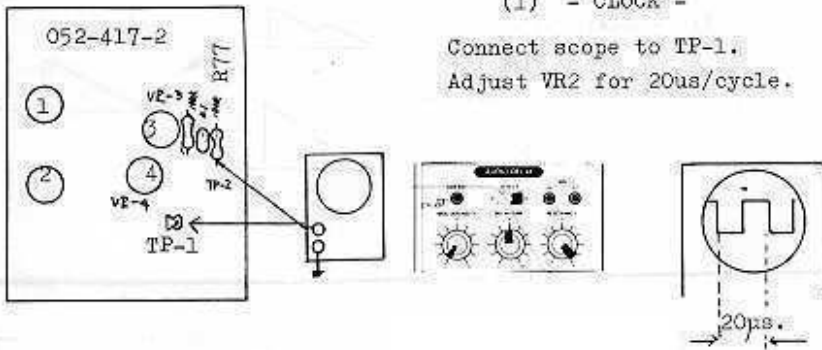


1. Rotate VRI FCCW to/from FCCW; level of PHASE SHIFTER output will decrease to minimum three times per full rotation.
2. Stop the rotation at the 2nd, and fine-tune VRI for the minimum waveform level.

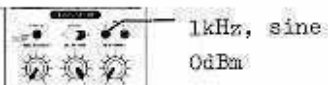
AUDIO DELAY

(1) - CLOCK -

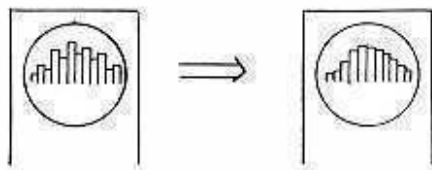
Connect scope to TP-1.
Adjust VR2 for 20us/cycle.



(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

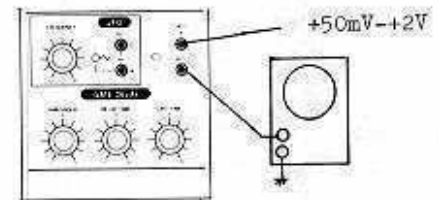
Amplitude varies with frequency.

10V p-p at 0.04Hz

400mV p-p at 10Hz

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

GATE DELAY



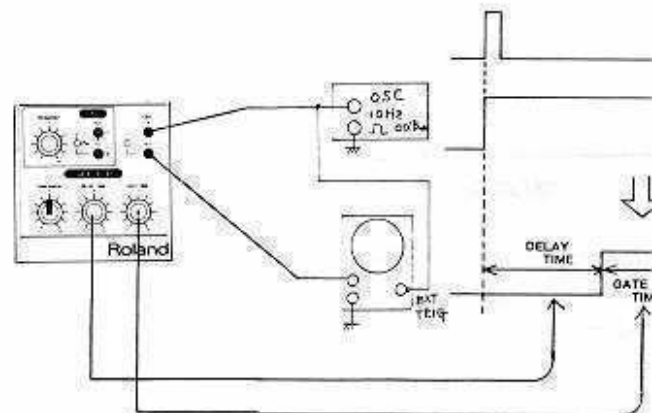
(1) - THRESHOLD

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

input +50mV±10% THRESHOLD FC

input +2V±20% THRESHOLD P

(2) - DELAY TIME & GATE TIME -



Lengths of DELAY TIME and GATE TIME are as

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

for the following:
 4Hz-10Hz as FREQUENCY advances.
 h frequency.
 4Hz
 0Hz
 and B are 180° out of phase with

E DELAY

+50mV-+2V

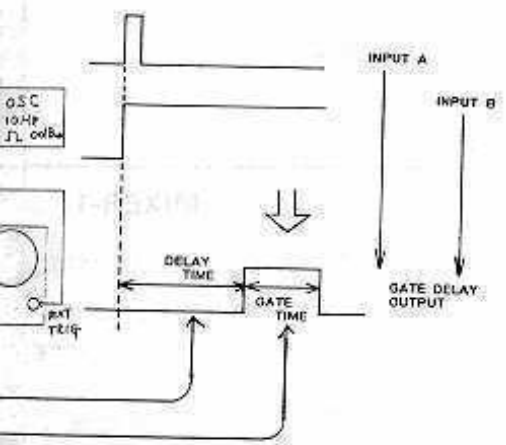


(1) - THRESHOLD -

provides +15V in the following
 ings:

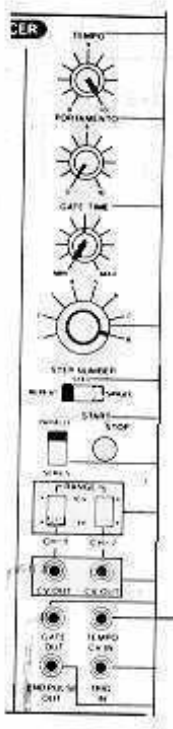
- 0% . . . THRESHOLD FCCW
- . . . THRESHOLD PCW

TIME & GATE TIME -



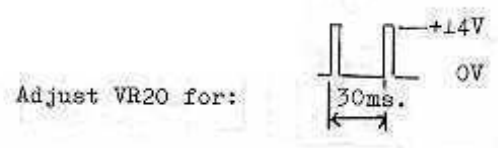
and GATE TIME are as follows:

me	GATE TIME	gate time
	FCCW (0)	0.3ms
	PCW (10)	6s



GATE

(1) - TEMPO -
 Set controls as illustrated at left.



(2) - LED ON/OFF TIMING -

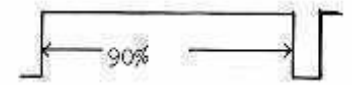
With TEMPO at "0", a LED stays on for 7 seconds before the next LED lights.

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

(3) - DUTY CYCLE -

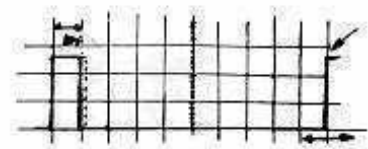
Keep initial settings shown above.
 Turn GATE TIME PCW.

Adjust VR21 for 90±2% duty ratio.



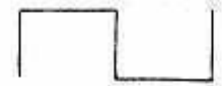
Reverse GATE TIME (FCCW).

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



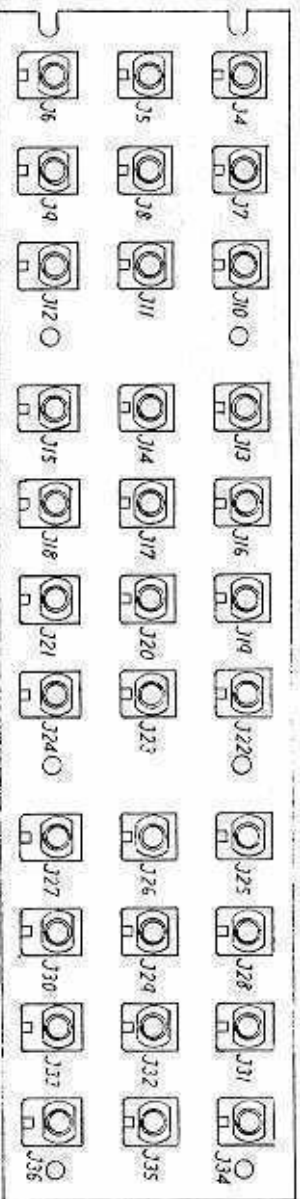
Set GATE TIME at "4".

Check that duty ratio is 50% (±7%)



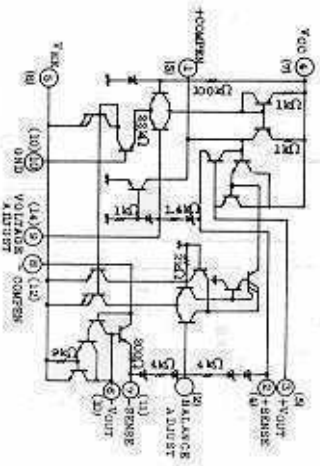
M-191J OPH53 (149H053) (pcb 052-423)

JACKS HSJ040Q-01-020



IC-	1	1511911090	TA7179M
Q-	1	15119800	2SB434-0
Q-	2	15129801	2SD234-0
D-1-4		15019210	1R5BZ61 or 1M4003 1.5A 100V
D-	5	019-020	LR0601R LED
VR-	1	13299117	SR19R 100KB
R-	1, 2	044-589	ERG-01AND 0.82 ohms 1/2W
P.T.		022H025J	100V
		022H025C	117V
		022H025D	220/240V

EQUIVALENT CIRCUIT



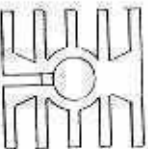
TA7179M

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

ABSOLUTE MAXIMUM RATINGS (T=25°C)

Input voltage	(+) (-) 30V
Output current	(+) (-) 100mA
Power dissipation	500mW
Operating temperature	-30°C to +75°C

Heat sink no. 52

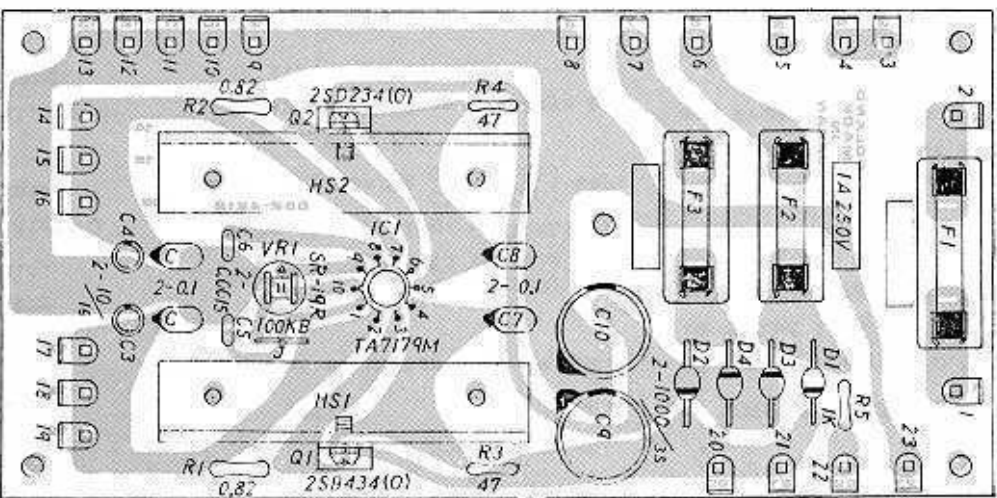


Fuse holder	100/117V	220/240V
F- 1-3	12559114 MGC 1.0A 100V	12559511 OEB 1500mA
F- 1-3	012H022 P-3265	12199516 S-N5054
F- 1-3	12559301 MGC0001 117V	F- 2, 3 12559515 OBB 51A
HS- 1, 2	046-052	Heat sink no. 52
HS- 3	048H025	
RH-21 (101)		

M-190 **M-191J**

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

(pcb 052-421B)



EXPANDER MODULE-1 MODULE-2 TRNG GATE MODULE-3 MODULE-4 MODULE-5

KEYBOARD
DLEH

NOMENCLATURE	PART NO.	PARTS NAME
SW- 1	13139131	SLB-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	28C1815-Y
Q- 6, 7	15119112	28A1015-Y
Q- 8	15139103	28K30ATM-GR
D- 1	15019627	182454 zener
D- 2-7	15019103	182473
C- 4	polypropylene	ECQF-2334MZ
C- 5	tantalum	lmfd 35V
R- 23,24		CRB+FX 0.1% selected
R-		CRB+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.

1. With PB-4 lever left at neutral, position VR-5 wiper for 0±mV reading.
2. With the lever held at leftmost position, set VR-7 on OP-9B for -5V reading.
3. With the lever held at rightmost, set VR-6 for +5V reading.

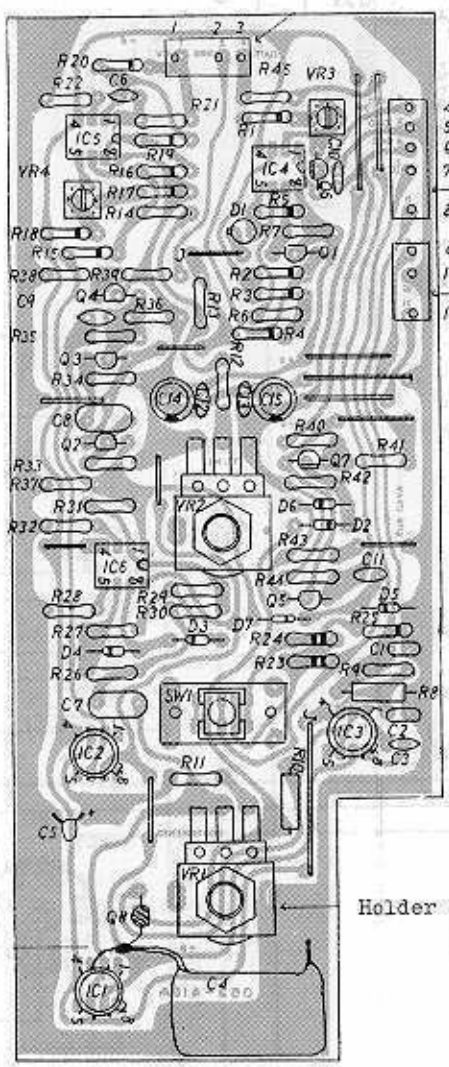
TUNING

Connect vo

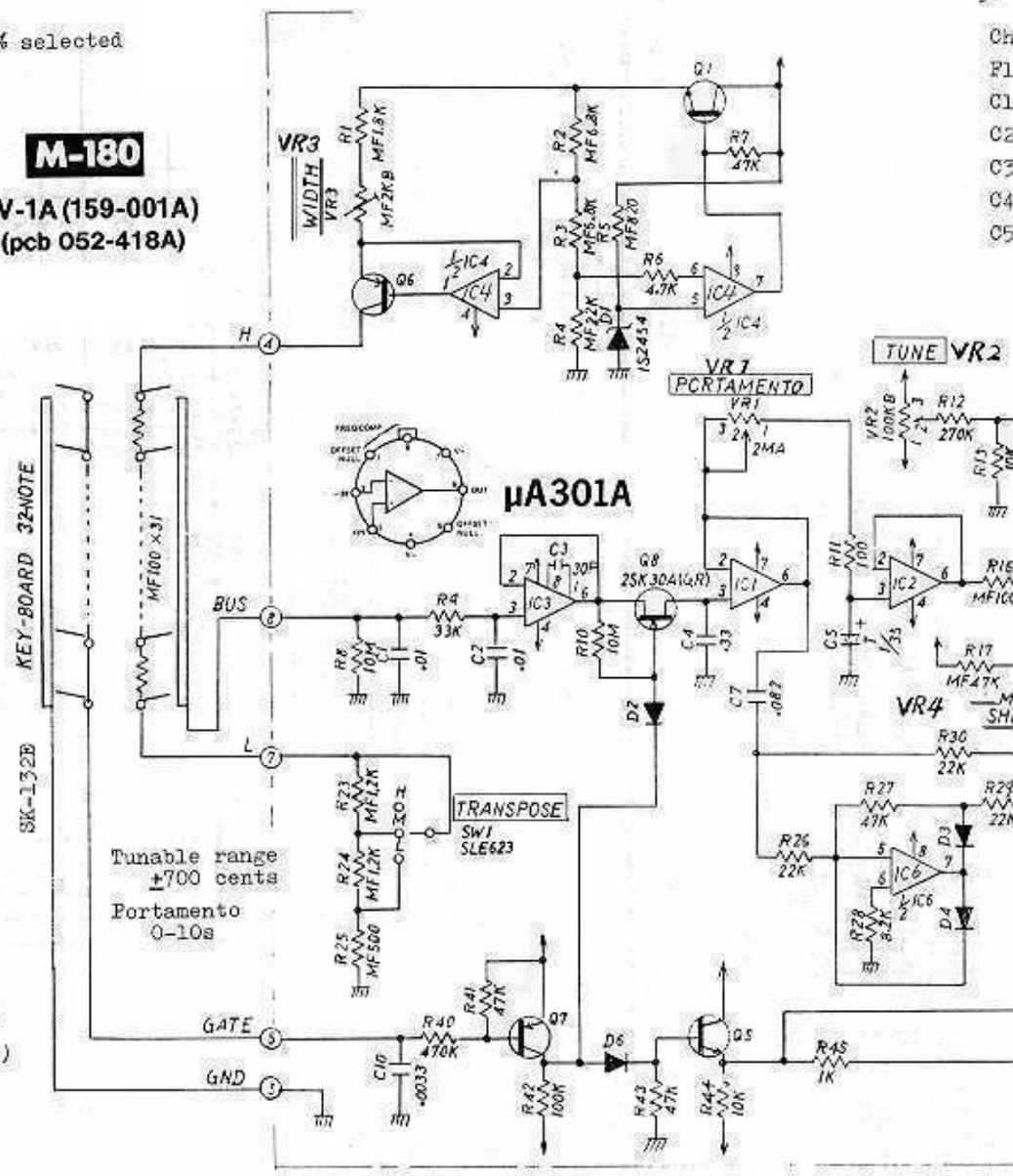
1. WIDTH
 - a. While pre
 - b. While pre
 - c. Check the
 note the
adjust VR
in 1V/oct
2. SHIFT

While pressi

VR-4 for 2V
3V



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



TUNING

Connect voltmeter into CV OUT.

1. WIDTH

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

2. SHIFT

While pressing C2 (M-180) key, set VR-4 for 2V reading.
VR-4 for 5V reading.

Check:

- F1 = 1.416V (M-180)
- O1 = 1V (M-181)
- C2 = 2V
- C3 = 3V
- C4 = 4V
- C5 = 5V (M-181)

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

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

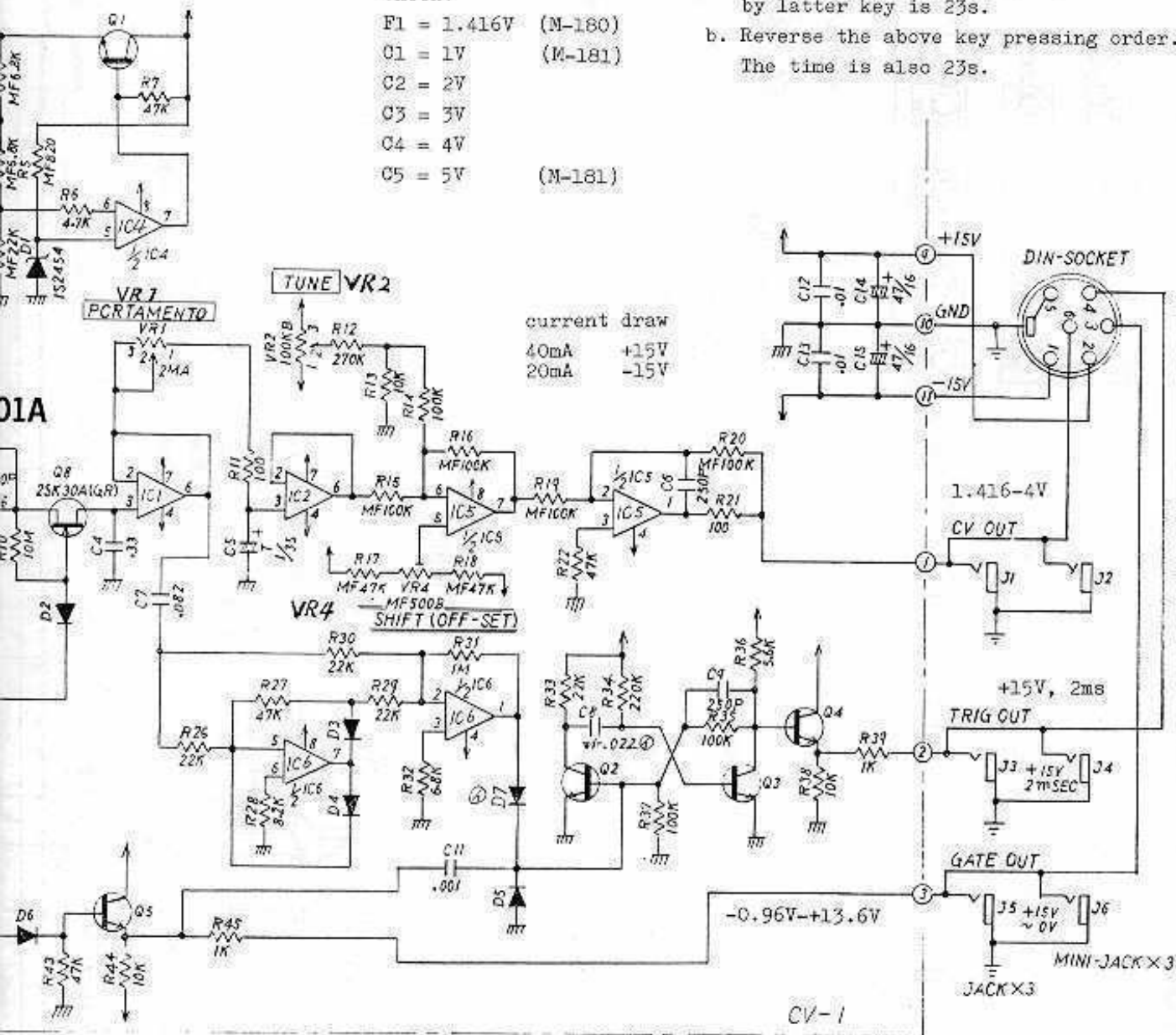
CV should vary by 1V when TRANSPOSE is set from M position to L or H.

5. PORTAMENTO

(M-181 - SW-2 on -)

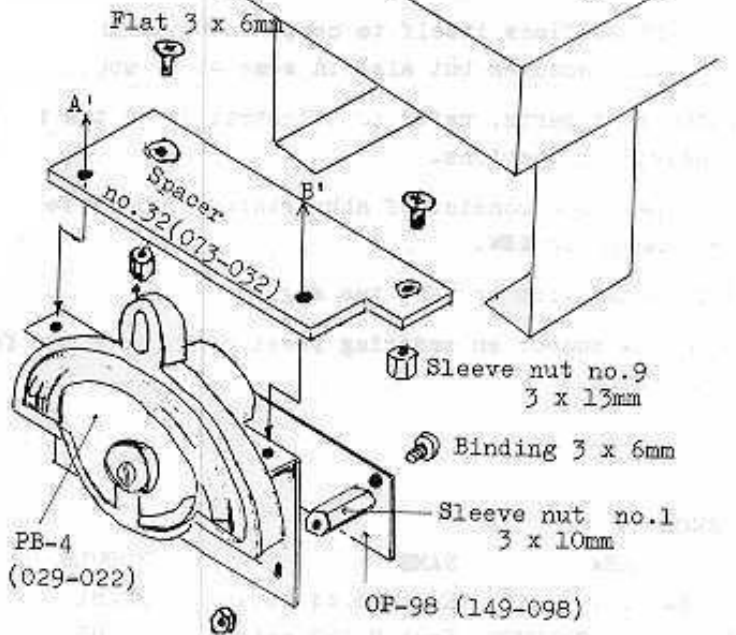
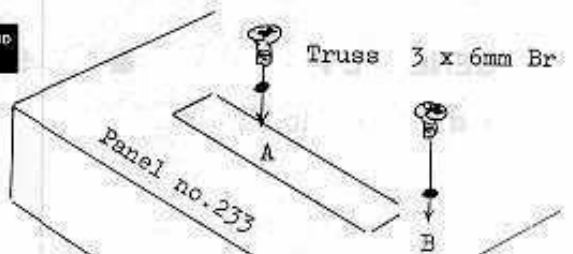
Turn PORTAMENTO fully clockwise.

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

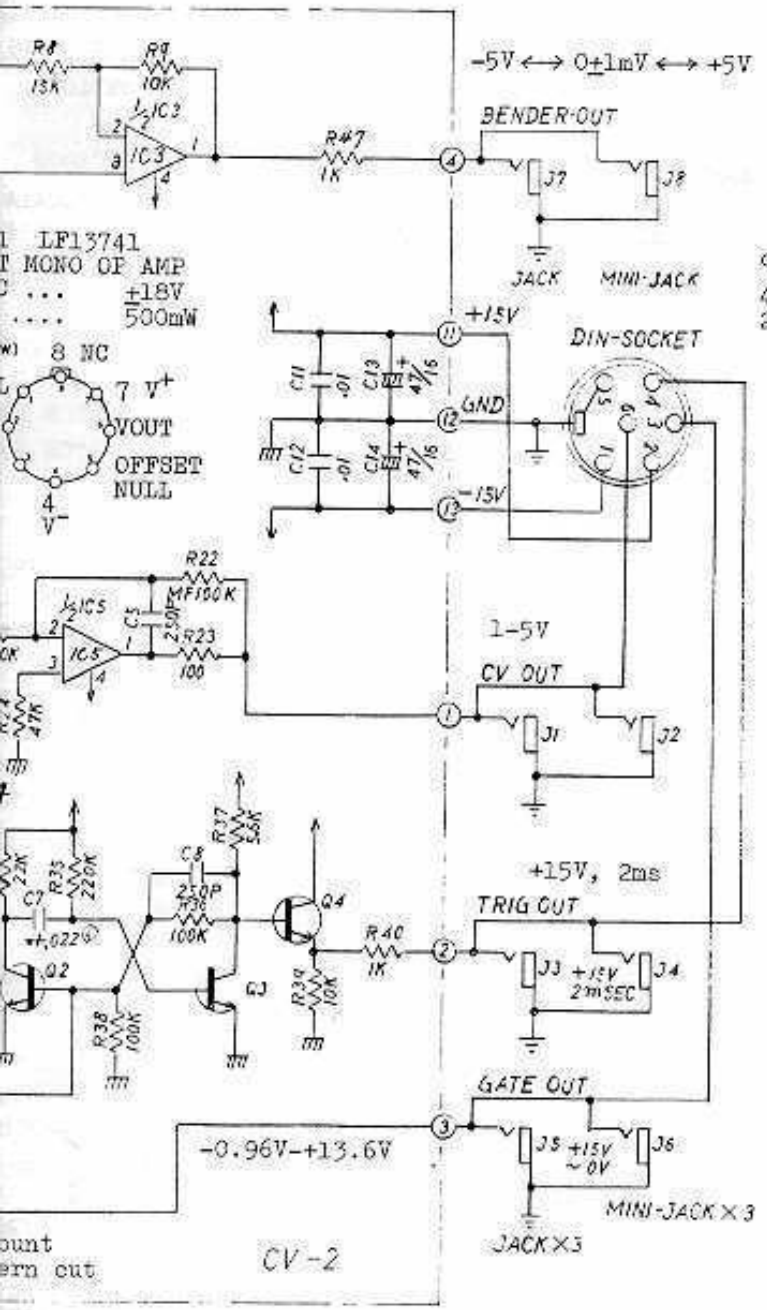
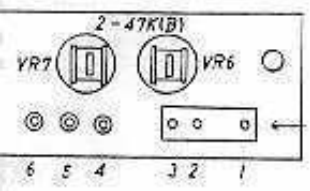


M-181 48-KEY KEYBOARD CONTROLLER

Q-	1-5	15129115	28C1815-Y
Q-	6, 7	15119112	28A1015-Y
Q-	8	15139103	28K30ATM-GR
D-	1	15019627	182454 zener
D-	2-7	15019103	182473
R-	25, 26		CRB+FX 0.1% selected
R-			CRB+FX metal film
C-	3	polypropylene	BCQF-2334MZ 0.33mfd
C-	4	tantalum	1mfd 35V



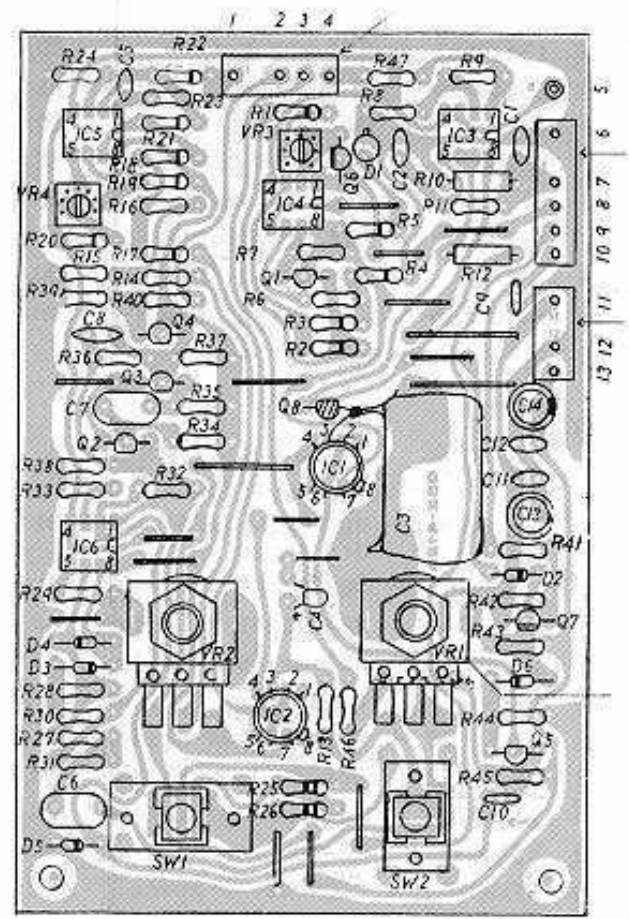
OP98 (149-098)
(pcb 052-420)



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

M-181

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



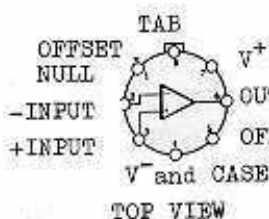
6. TRIG OUT

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.

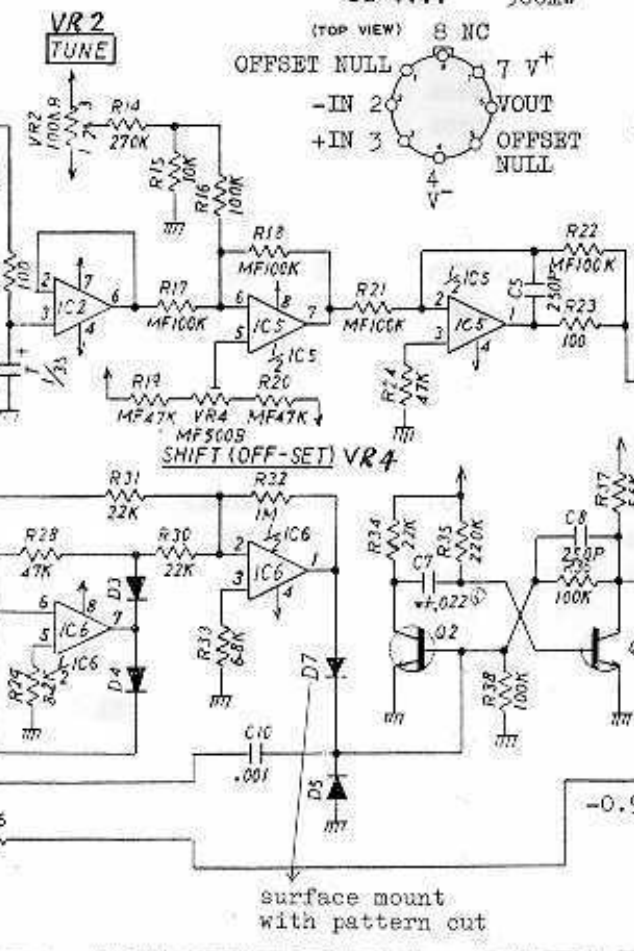
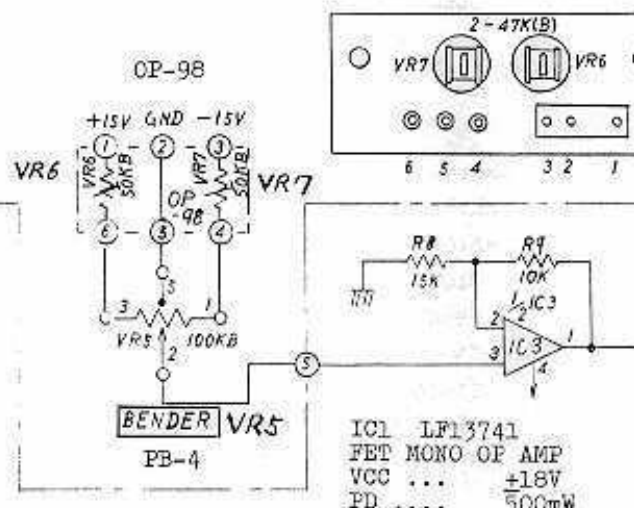
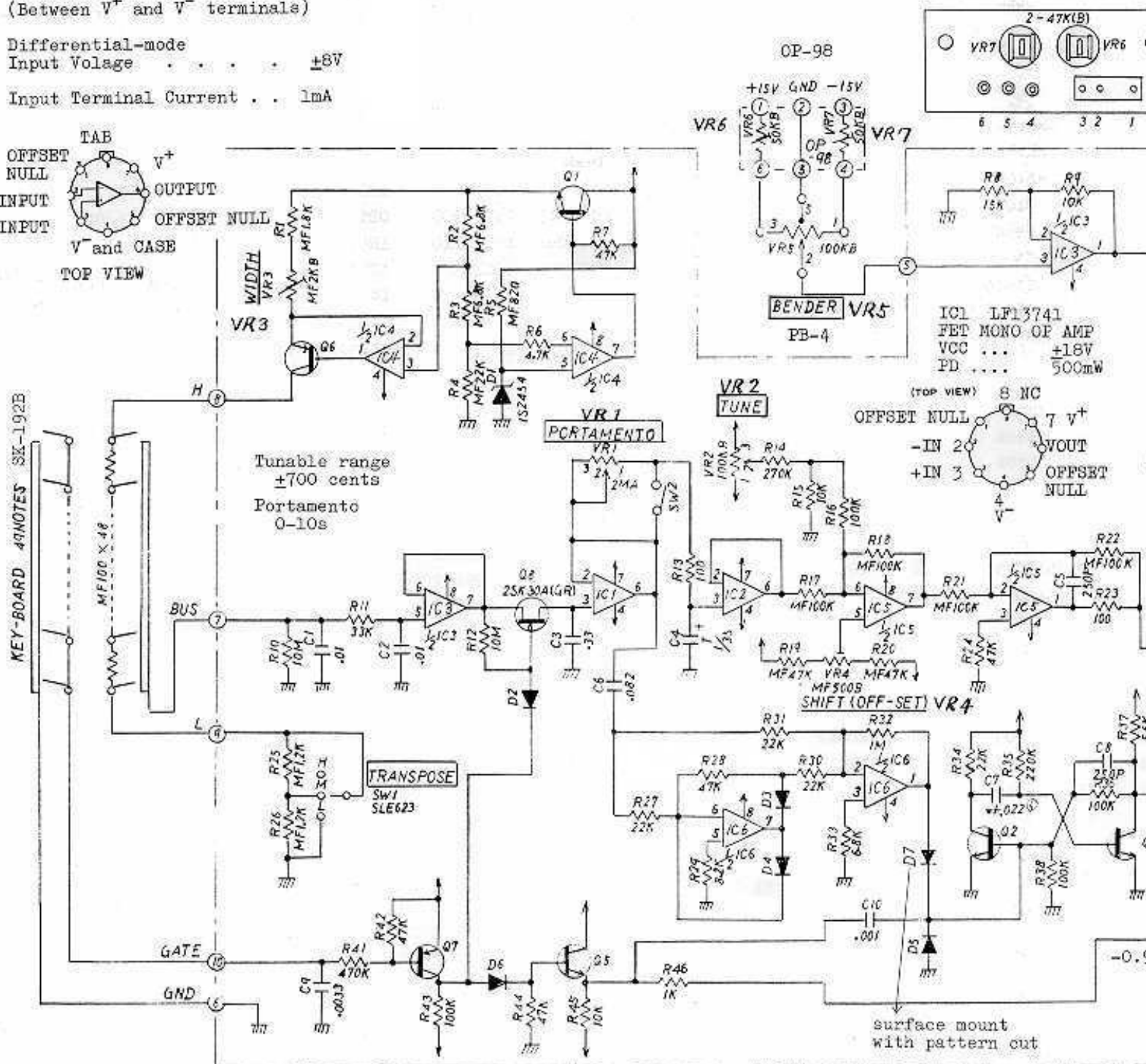
CA3140
 MOS/FET Input Bipolar Output
 DC Supply Voltage . . . 36V
 (Between V⁺ and V⁻ terminals)
 Differential-mode Input Voltage . . . +8V
 Input Terminal Current . . . 1mA

NOMENCLATURE	PART NO.	PARTS NAME
SW-	1	13139131 SLE-623-12P(S)
SW-	2	13139130 SLE-622-12P(S)
VR-	1	028-720 VM10RK15A26 2MA
VR-	2	028-727 VM10RK15B15 100KB
VR-	3	13299504 FN82-2H202H 2KB
VR-	4	13299506 FN82-2H501H 500
VR-	5	029-022 PB-4 assy
VR-	6, 7	13299116 SR19R 47KB
IC-	1	15189131 LF13741H OP amp
IC-	2	15189121 CA3140T
IC-	3-6	15189105 uPC4558C

Q-	1-5	1
Q-	6, 7	1
Q-	8	1
D-	1	1
D-	2-7	1
R-	25,26	
R-		
C-	3	p
C-	4	to



KEY-BOARD 4NOTES SX-192B



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			
OLD	NEW	NAME	MODULE
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			
OLD	NEW	NAME	MODULE
. . .	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	SQPR240120F 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 MO

POTENTIOMETER

Slider			
OLD NO.	NEW NO.	PART NAME	MO
029-519	13339301	EVA-H04C15A15	100KA 10
029-521	13339305	EVA-H04C15A55	500KA 50
029-522	13339302	EVA-H04C15A16	1MA 50
029-531	13339304	EVA-H04C15B15	100KB 10
029-523	13339303	EVA-H04C15A26	2MA 40
029-543	13339401	EVA-TOAC15A15	100KA 10
029-555	13339402	EVA-TOAC15B15	100KB 10
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 stroke	

Rotary			
OLD NO.	NEW NO.	PART NAME	MO
028-720	. . .	VM10RK15A26(L)	2MA 80
028-727	. . .	VM10RK15B15(L)	100KB 80
028-763	13219220	VM10RB10CB15	100KB 10
028-762	13219219	VM10RB10CB54	50KB 72
028-760	13219225	VM10RC38CB14	10KB 72
028-774	13219226	VM10RC38CB15	100KB 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)	
GM70R910E	terminal: L shaped pc	
028-664	13219806	GM70R910E 100KA/100KB
028-665	13219807	GM70R910E 100KB x 2

Trimmer			
OLD NO.	NEW NO.	PART NAME	MO
Carbon solid formerly named as "SR19R"			
030-465	13299114	H1051A013	10KB 10
030-467	13229115	H1051A015	22KB 10
030-469	13299116	H1051A016	47KB 72
030-471	13299117	H1051A019	100KB 10

Metal glaze formerly named as "CR19R"			
OLD NO.	NEW NO.	PART NAME	MO
030-491	13299542	H1021A009	2.2KB 10
030-497	13299544	H1021A015	22KB 32
030-501	13299546	H1021A019	100KB 5

Tantalum thin film			
OLD NO.	NEW NO.	PART NAME	MO
030-625	13299501	PN822H101H	100B 10
030-630	13299504	PN822H202H	2KB 10
030-631	13299506	PN822H501H	500B 80
030-632	13299507	PN822H502H	5KB 10
030-636	13299508	PN822H503H	50KB 10

Zener diodes 182453, 182454

Application is thermal drift compensates. Indicates identical electrical characteristics is provided with low temperature coefficient. Be a good replacement for 182453.

NAME	MODULE	OLD NO.	NEW NO.	PART NAME	MODULE
SEMICONDUCTOR					
Transistor					
HO4C15A15	100KA	10/12/21/30	017-010	15129801	2SD234-0 90/91
HO4C15A55	500KA	50	017-012	15119106	2SA733-Q 72/82
HO4C15A16	1MA	50	017-013	15129107	28C945-Q 72/82
HO4C15B15	100KB	10/12/21/30/32/40/50	017-016	15139103	28K30ATM-GR FET 10/21/30/40/50/80/81/82
HO4C15A26	2MA	40/50	017-0168	15139103A	*SK30ATM-GR selected on gm base 72
HOAC15A15	100KA	10/21	017-022	15119800	28B434-0 90/91
HOAC15B15	100KB	10/21/31/32/40	017-039	15139110	NF510 10/12
HOAC15D16	1MD	40	017-046	151291050A	28C828R NZ selected 50
HOAC15D26	2MD	40	017-105	15119112	28A1015-Y 10/12/21/30/31/32/40/50/80/81
assy		81	017-110	15129115	28C1815-Y 10/12/21/30/31/40/50/80/81
H 20mm stroke			017-124	15119108	28A798-G 82
F 30mm stroke					
HRK15A26(L)	2MA	80/81			
HRK15B15(L)	100KB	80/81			
Diode					
HRB10CB15	100KB	10/12/30/31/72	018-014	15019103	1S2473 except 90/91
HRB10CB54	50KB	72/82	018-015	15229908	SDT-1000 thermistor 10/21/82
HRC38CB14	10KB	72	018-061	15019210	1R5BZ61 100V 1.5A 90/91
HRC38CC15	100KC	72	018-078	15019625	1S2453 zener 6-7V 250mW @ 10mA 10/12
HRC38CA14	10KA	72	018-079	15019627	1S2454 see below center 80/81
HRC38CA26	2MA	72			
HRC38CA16	1MA	82			
LED					
			019-020	15029109	GL-3AR-2 red 72/82
					LRO601R 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
IC					
			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
			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	TLO820P 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	MCL4022B 82
			020-194	15159102T0	TC4001UBP 82
			020-228	15199110T0	TA7179M 90/91
			. . .	15189131	LF1374H 80/81
<p>es 1S2453, 1S2454</p> <p>ermal drift compensation. Although al electrical characteristics, 1S2454 low temperature coefficient and can ent for 1S2453.</p>					