

CONTENTS

1. SPECIFICATIONS	2
2. DISASSEMBLY and PARTS LOCATION	3
3. CIRCUIT DESCRIPTION	4
4. GENERAL BLOCK DIAGRAM	5
5. GENERAL CIRCUIT DIAGRAM	7
6. PCB ASSEMBLY and CIRCUIT DIAGRAM	8~9
6-1 SEQUENCE BOARD (OP-31)	10
6-2 REGISTER BOARD (OP-32, OP-33)	11
6-3 OUTPUT RANGE and CHANNEL SELECT BOARD (OP-34)	12
6-4 POWER SUPPLY BOARD (PS-25, PS-26)	13
7. ADJUSTING PROCEDURES	14
8. PARTS LIST	16
9. PARTS PICTORIAL	17

SPECIFICATIONS

MODEL-104

2-channel, 12-step SEQUENCER (Series out: 24 steps)

1. CLOCK OSCILLATOR

Clock Rate : 0.1 – 10Hz (X1)
 1Hz – 100Hz (X10)
 Range : X1 or X10
 Control : CLOCK RATE, GATE TIME
 Gate Time : 10% – 90%
 Gate Time Indicator: on/off LED

2. END STEP SELECTION

Step Number : 1 – 12 steps
 Channel Selector : CH-A or CH-B
 Sequence Selector : One Time or Repeat

3. CONTROL SELECTION

START	: Reset-Start	Ext. Trig +5V threshold level
CONTINUE	: Continue-Start	Ext. Trig +5V threshold level
STOP	: stop	End Pulse Out +14V Pulse
STEP	: step	Ext. Trig +5V threshold level

4. VOLTAGE REGISTER SECTION

VOLTAGE REGISTERS: CH-A, CH-B: 12-steps each
 Range : 2.5V – 5V – 10V

5. OUTPUT SECTION

Gate Outputs : X2 +14V
 Series Outputs : X2
 Parallel Outputs : CH-A X2
 CH-B X2

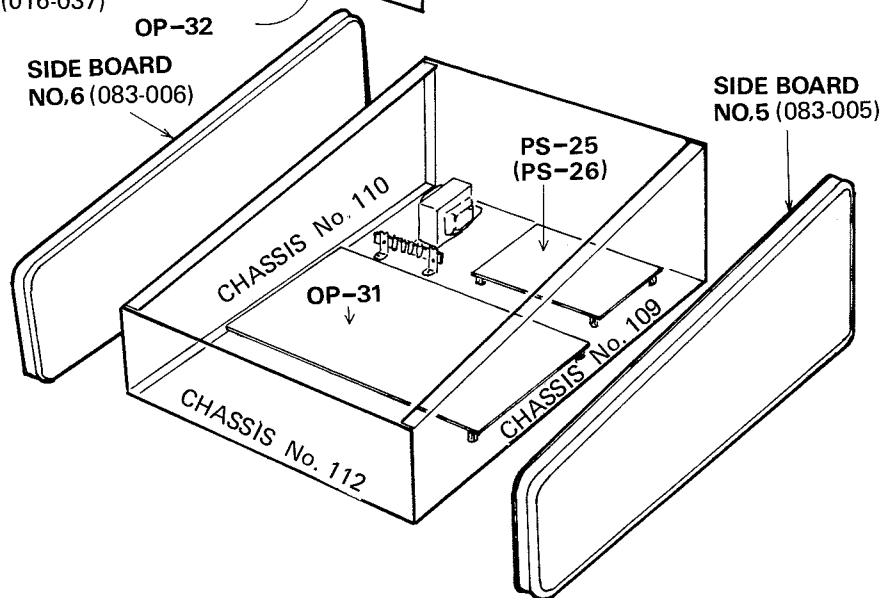
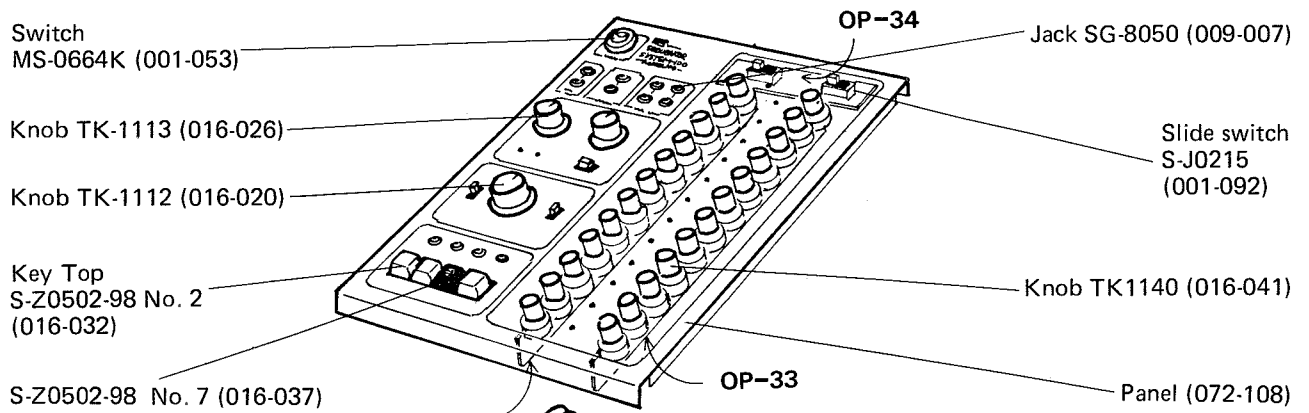
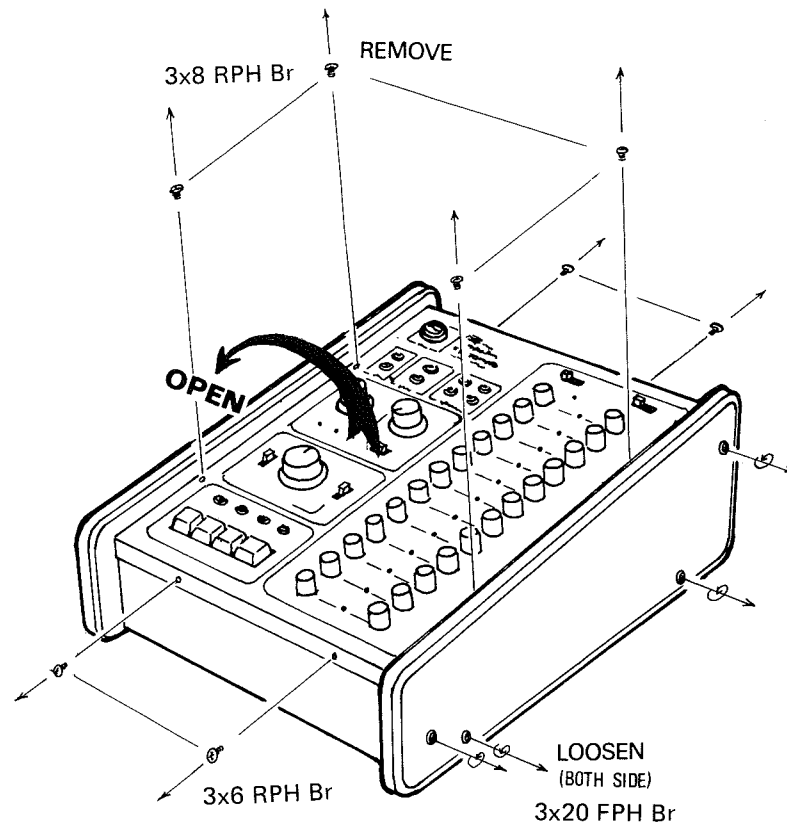
6. DIMENSIONS AND WEIGHT

Overall Size : 280mm (11") wide, 355mm (14") deep, 145mm (5¾") high,
 Net Weight : 5kg (11 lbs.)

7. POWER REQUIREMENTS

100-120V 50-60Hz : 5W max.
 220-250V 50-60Hz

DISASSEMBLY and PARTS LOCATION



CIRCUIT DESCRIPTION

1. SEQUENCE BOARD ASSEMBLY (OP-31)

1-1. CLOCK OSCILLATOR (VCO)

Saw-tooth wave is generated by charging and discharging of capacitor(s) C201, or C201 and C202. The oscillation frequency is controlled by the voltage that is controlled by CLOCK RATE potentiometer, and EXT CV INPUT voltage, if used.

The saw-tooth wave is converted into rectangular wave by comparator (1/2 IC203), whose duty ratio can be changed from 10% to 90% by GATE TIME potentiometer.

The rectangular wave acts as trigger that drives ring counter in the next stage. It also is connected to GATE OUTPUT jack.

1-2. RING COUNTER

The ring counter is composed of 12 steps of flip-flop by use of 3 IC's (LB1501). The speed of sequence is controlled by clock signal.

When CHANNEL switch is set at CH-A, outputs of Channel A, Step 1 to End Step that is set by STEP NUMBER dial, and Channel B, Step 1 to End Step are sent to Channel A and Channel B registers, respectively.

When CHANNEL switch is set at CH-B, outputs of Channel A, Step 1 to Step 12, and Channel B, Step 1 to End Step are sent to Channel A and Channel B registers, respectively.

1-3. START/STOP FLIP-FLOP

Q214 and Q215 combined is a start/stop flip-flop that controls the clock oscillator and ring counter to on or off. When clock oscillator stops, pulse comes out at END PULSE OUTPUT jack.

1-4. CH-A/CH-B FLIP-FLOP

Q225 and Q226 combined is Channel A/Channel B flip-flop whose output is sent to switching circuit of RANGE and CHANNEL SELECT board assembly (OP-34). This selects the output (Register A or Register B) that comes out at SERIES OUTPUT jack. This functions only when CHANNEL switch is set at CH-B. It switches from register B at Channel A, Step 12, and from register B to register A at Channel B, End Step.

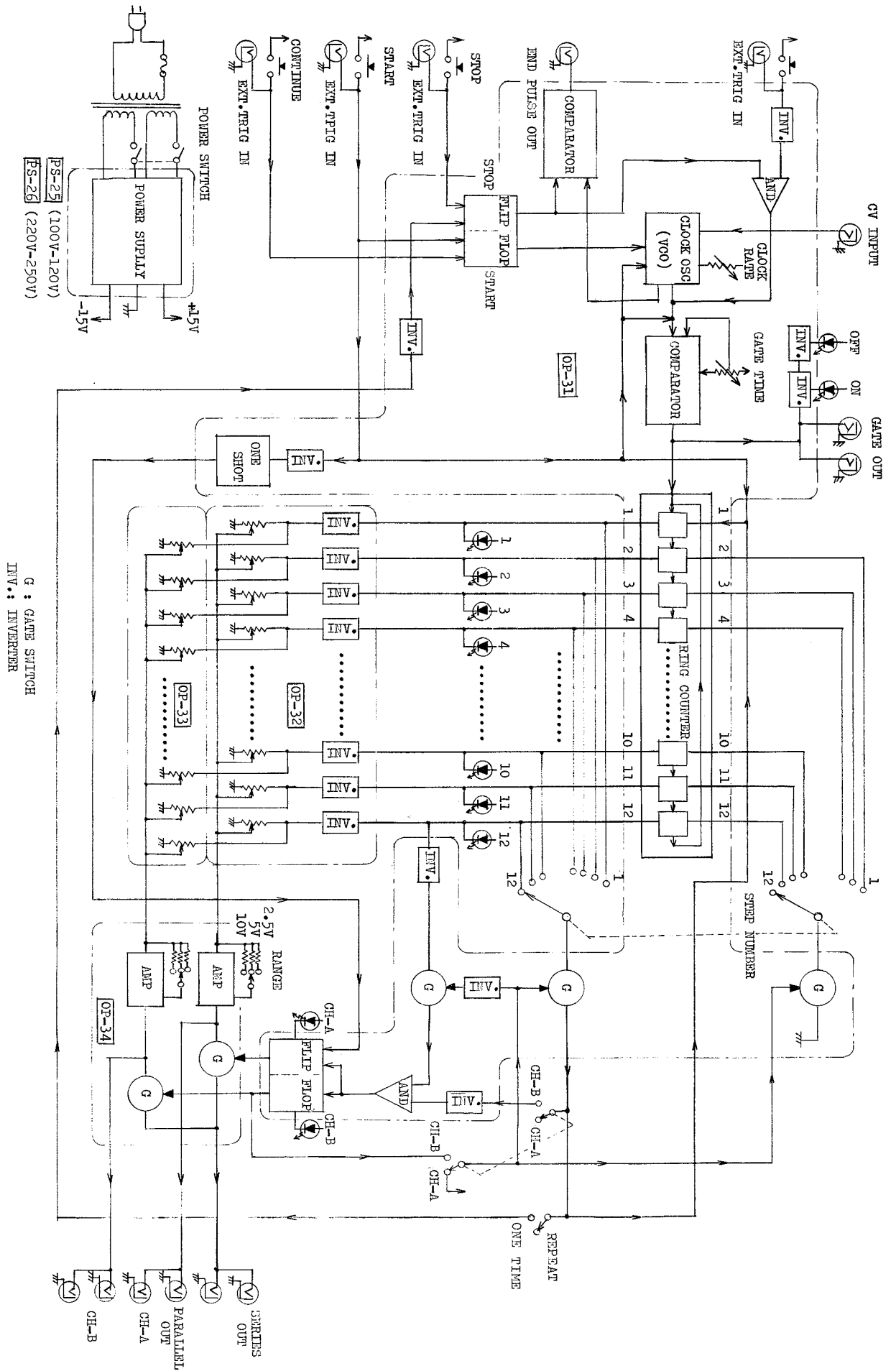
2. REGISTER BOARD ASSEMBLY (OP-32) (OP-33)

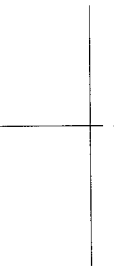
The register board assembly contains 12 combinations of transistor switching circuit and voltage register. A switching transistor, when designated by output from ring counter, conducts to send the voltage, predetermined by register potentiometer, to OP-34.

3. RANGE and CHANNEL SELECTOR BOARD ASSEMBLY (OP-34)

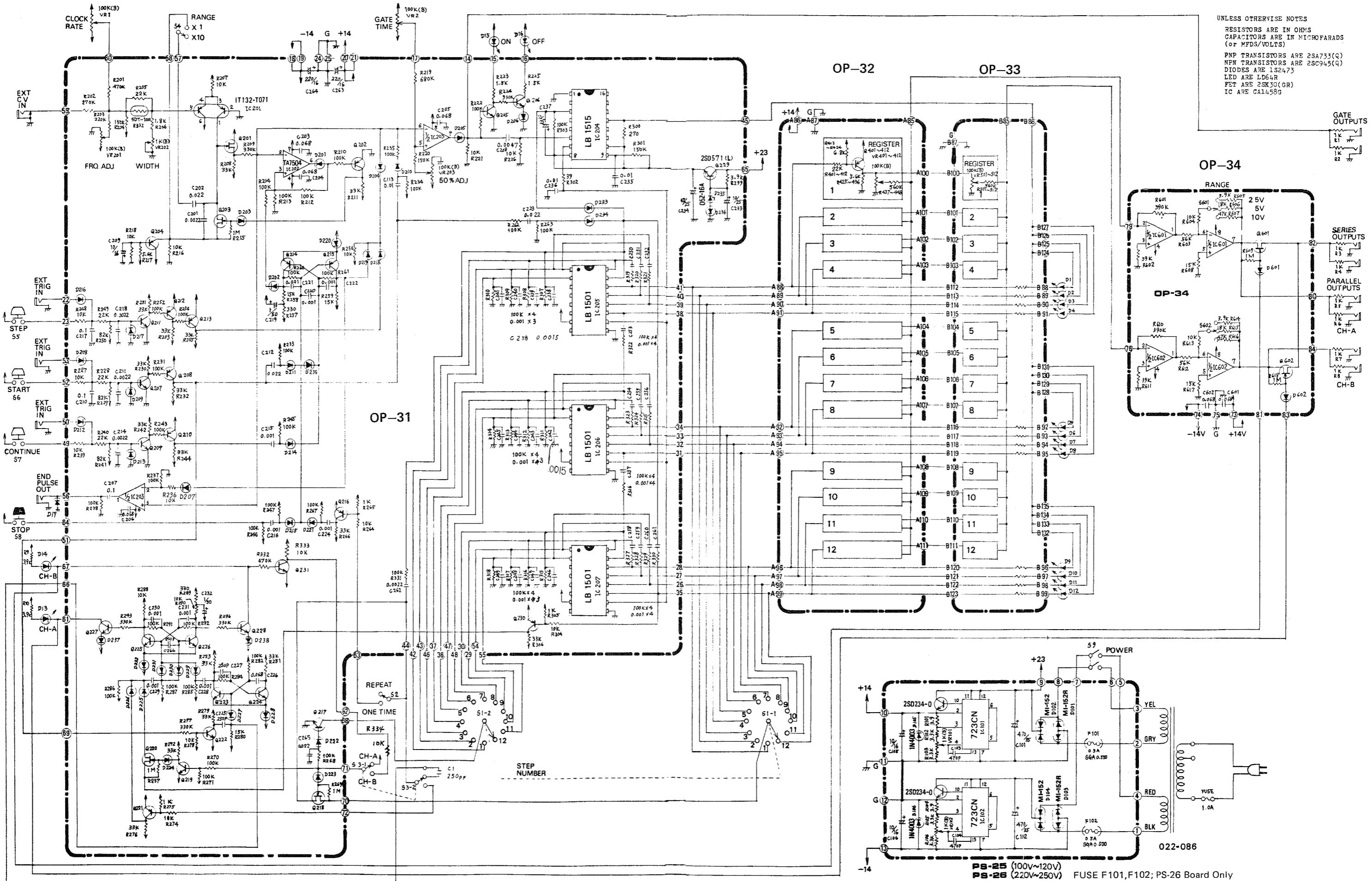
The contains two operational amplifiers and two switching FET's, each for Channel A and Channel B. The output voltage of the operational amplifier can be varied by the setting of RANGE switch, and each output is switched on and off by the switching FET. Through this assembly, the input voltage from the register is amplified and sent out to PARALLEL or SERIES OUTPUT jack that is selected.

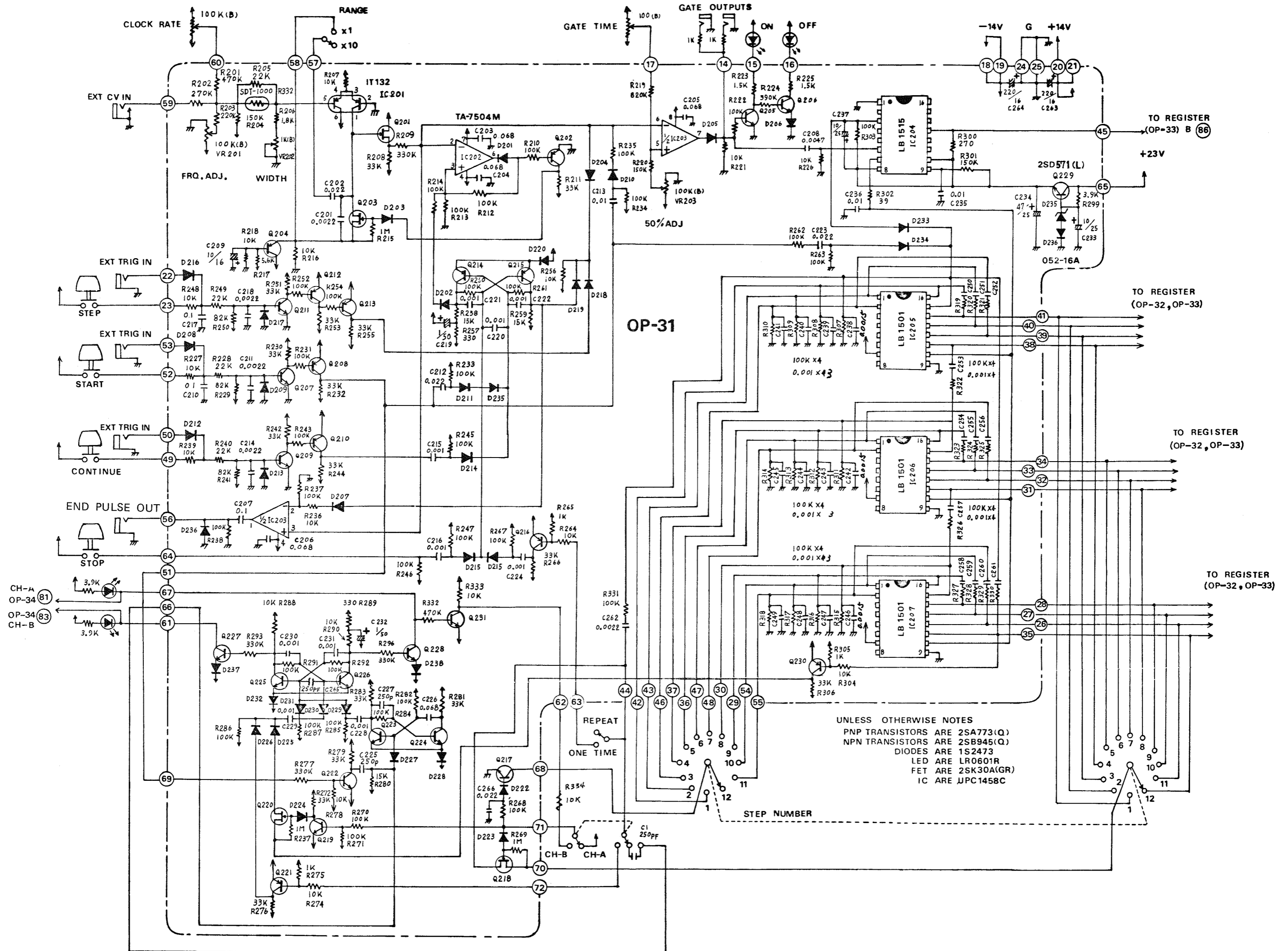
GENERAL BLOCK DIAGRAM





GENERAL CIRCUIT DIAGRAM

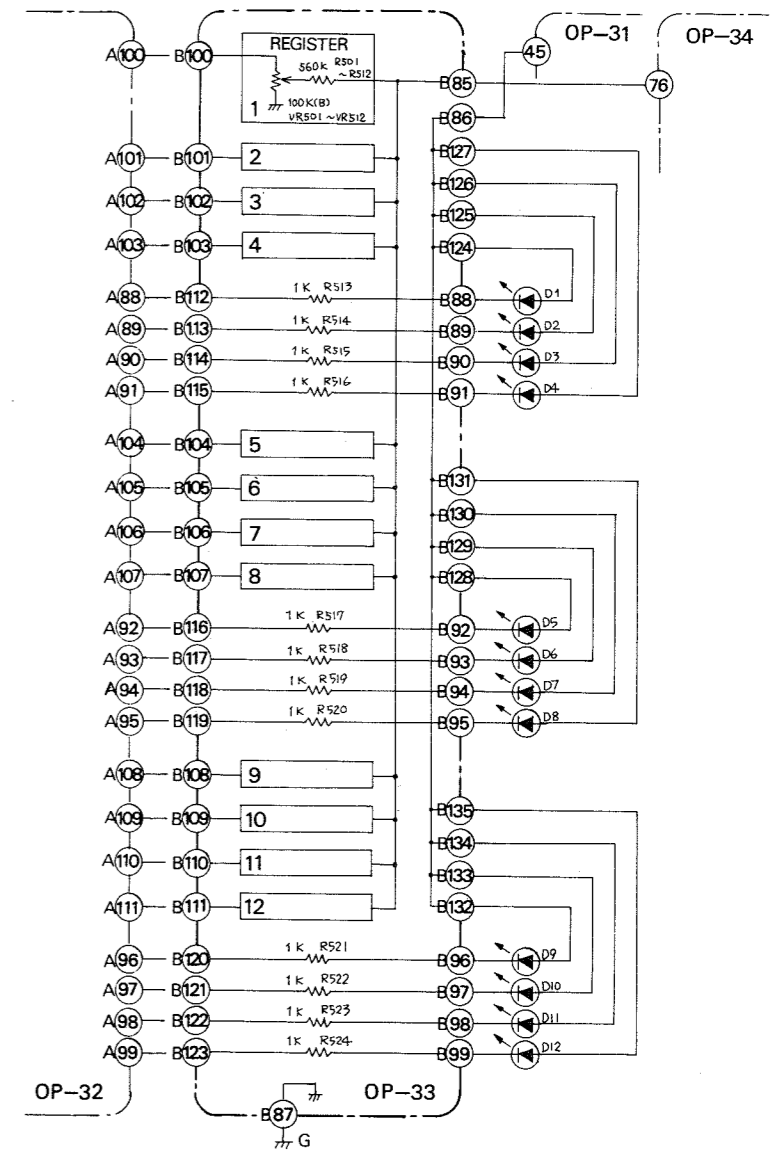
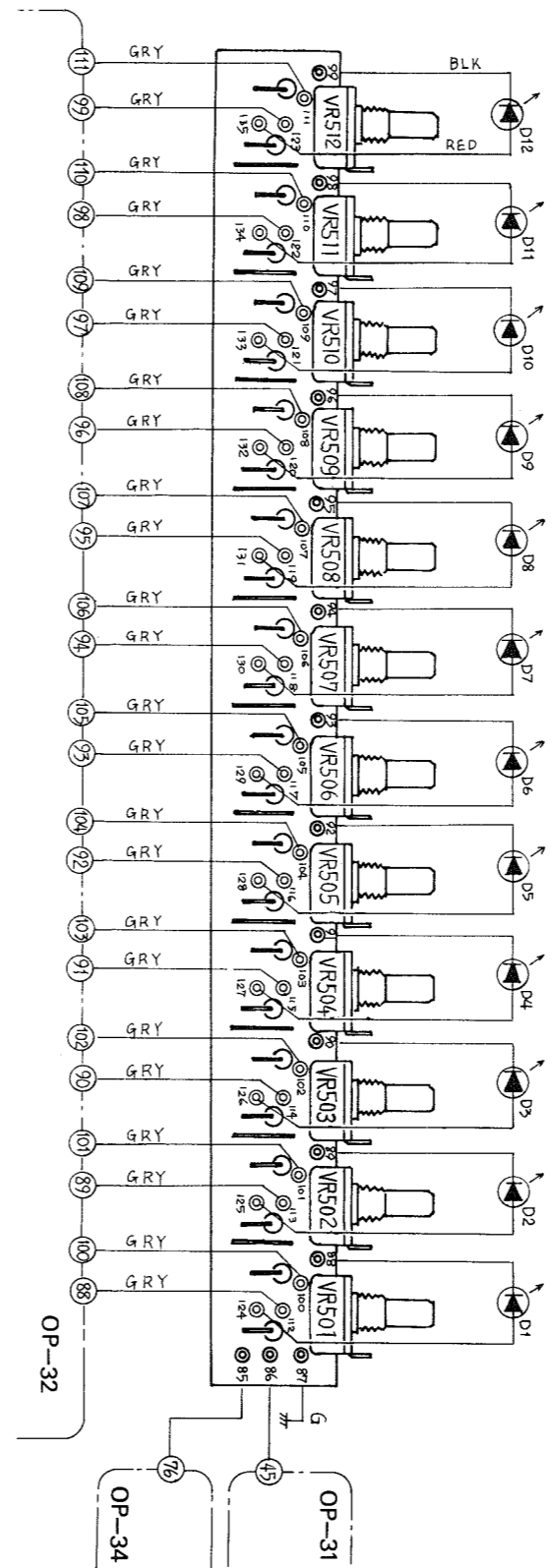
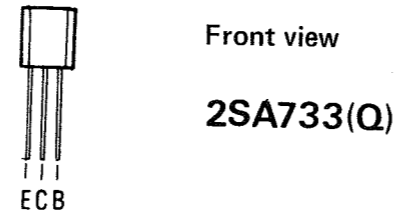
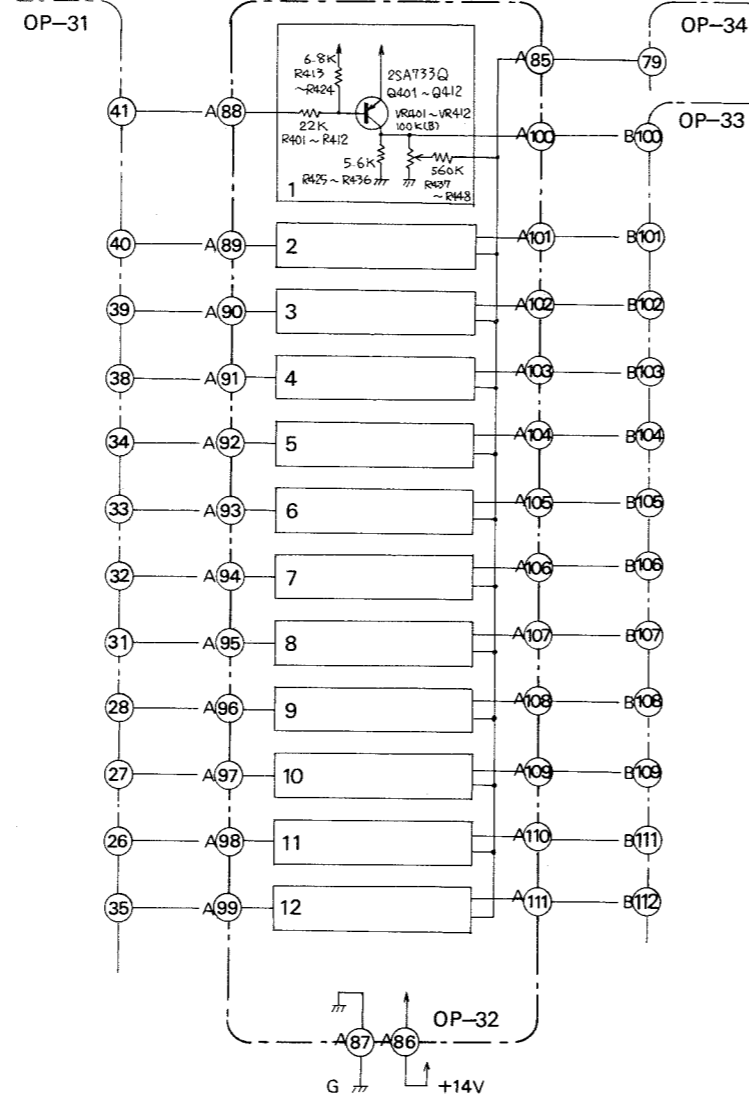
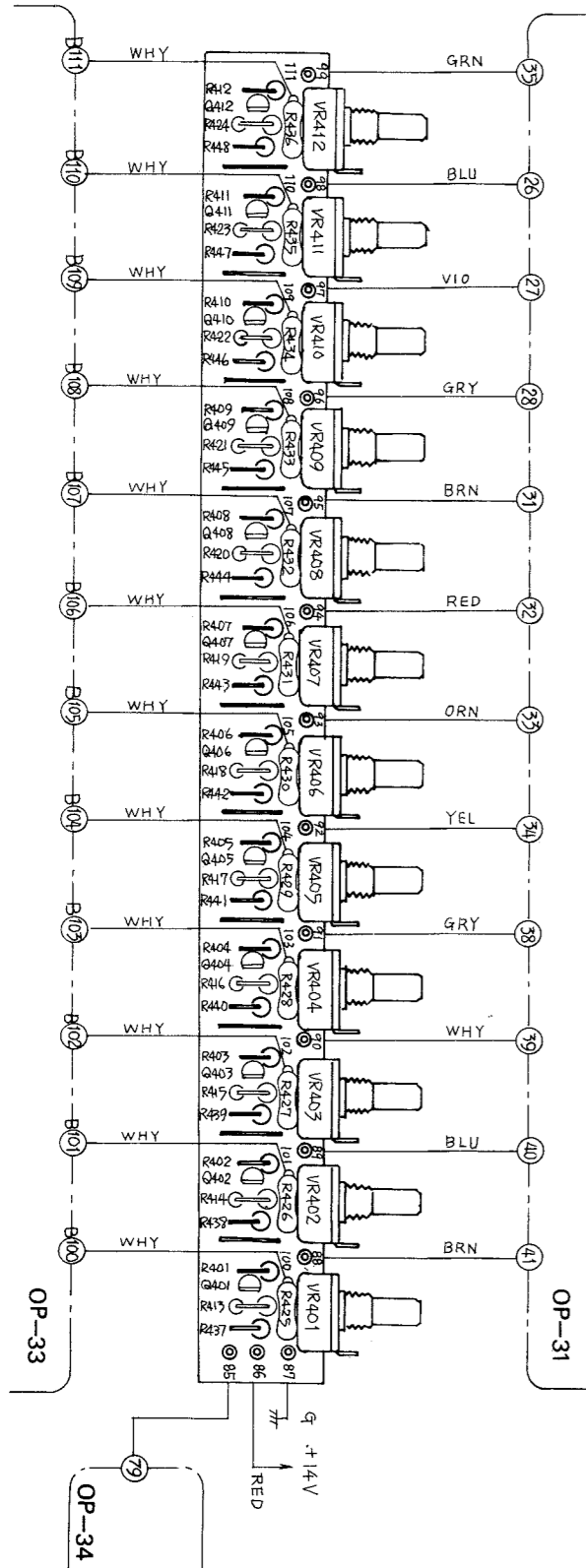




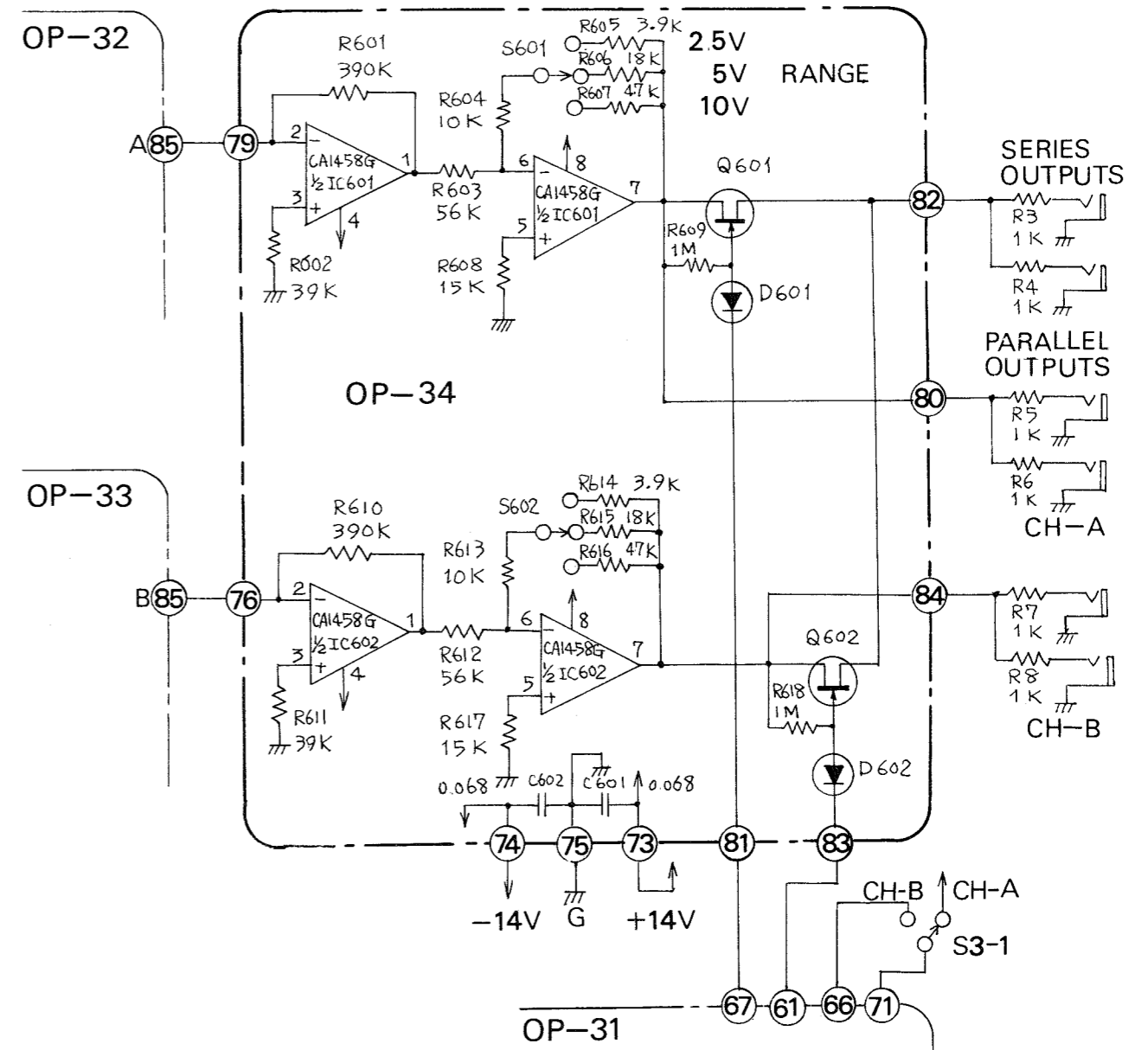
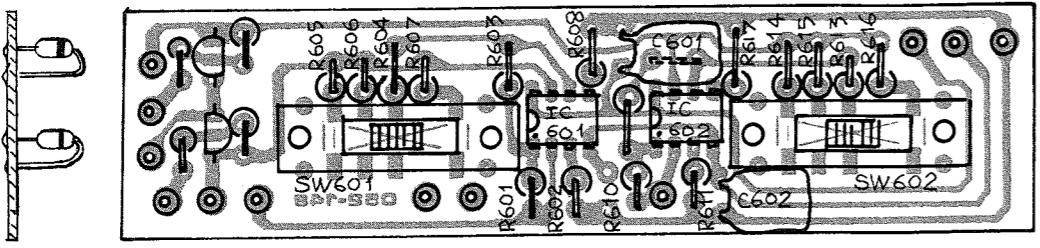
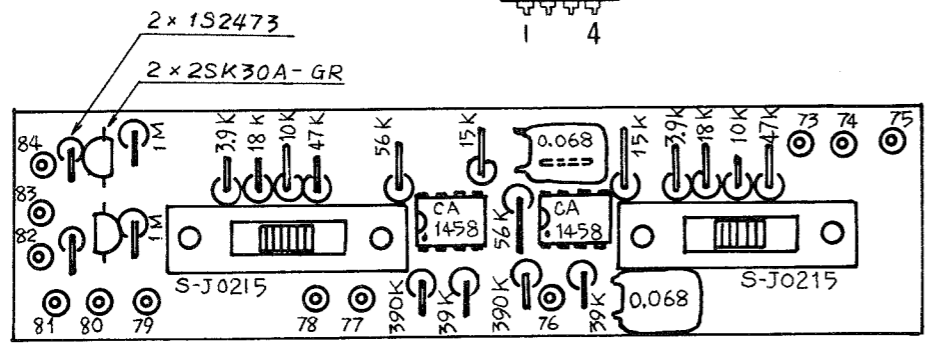
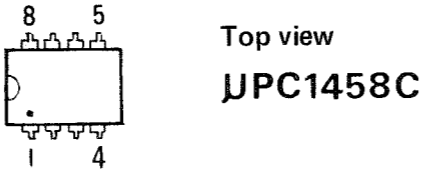
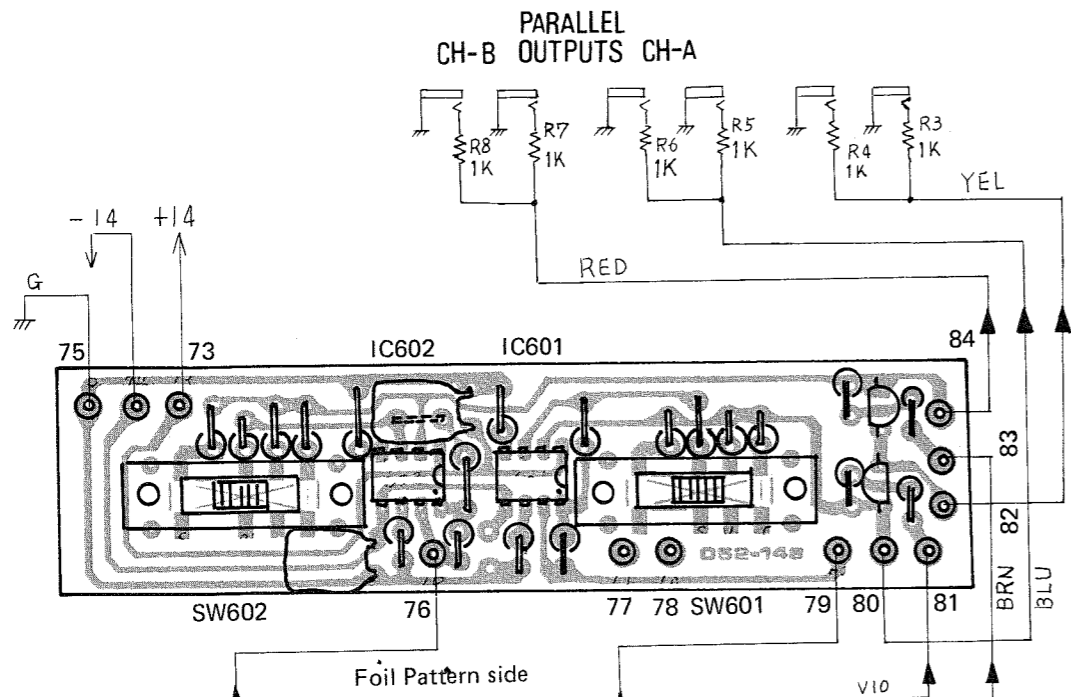
REGISTER BOARD ASSEMBLY

OP-32 (149-032)

OP-33 (149-033)

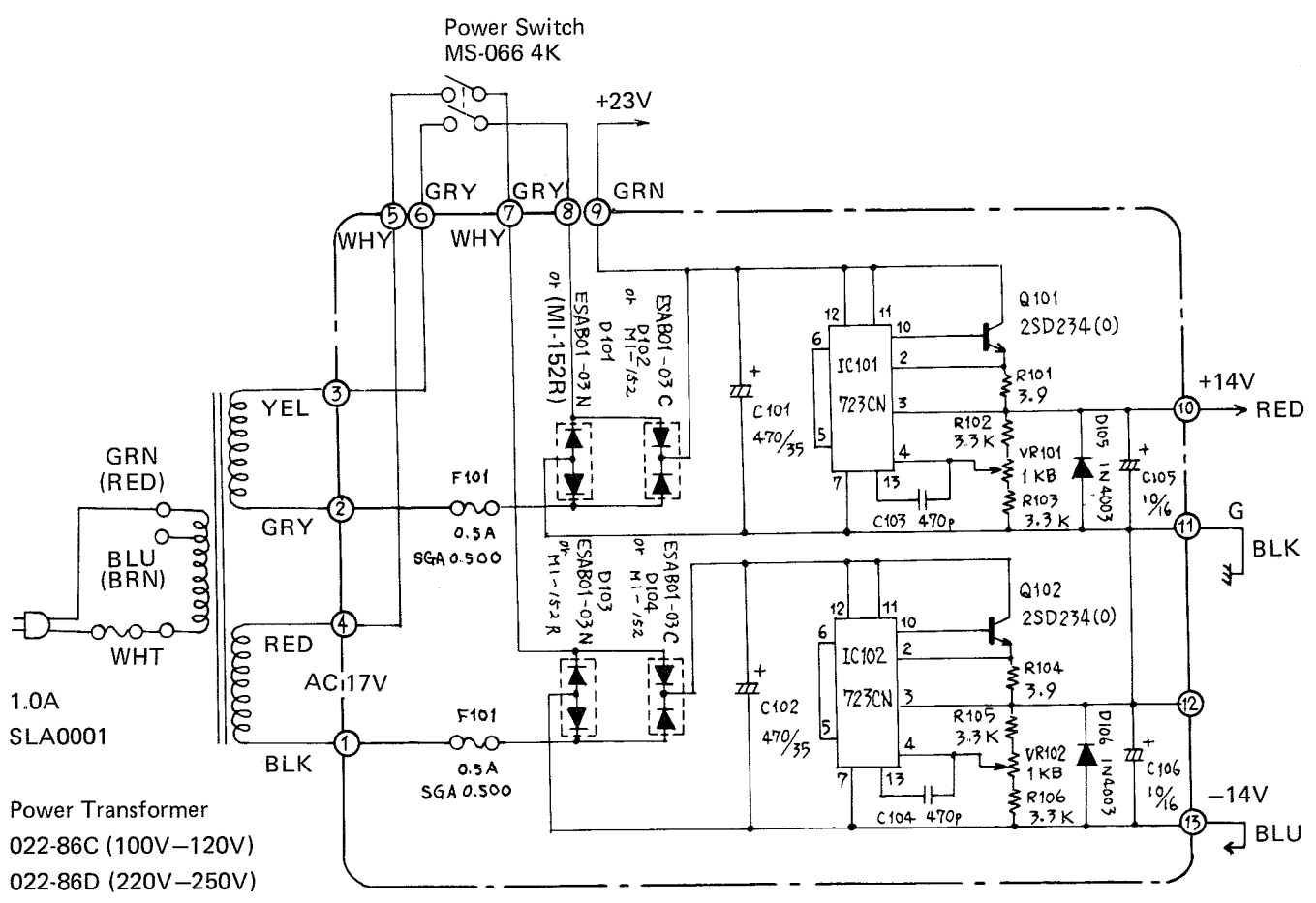
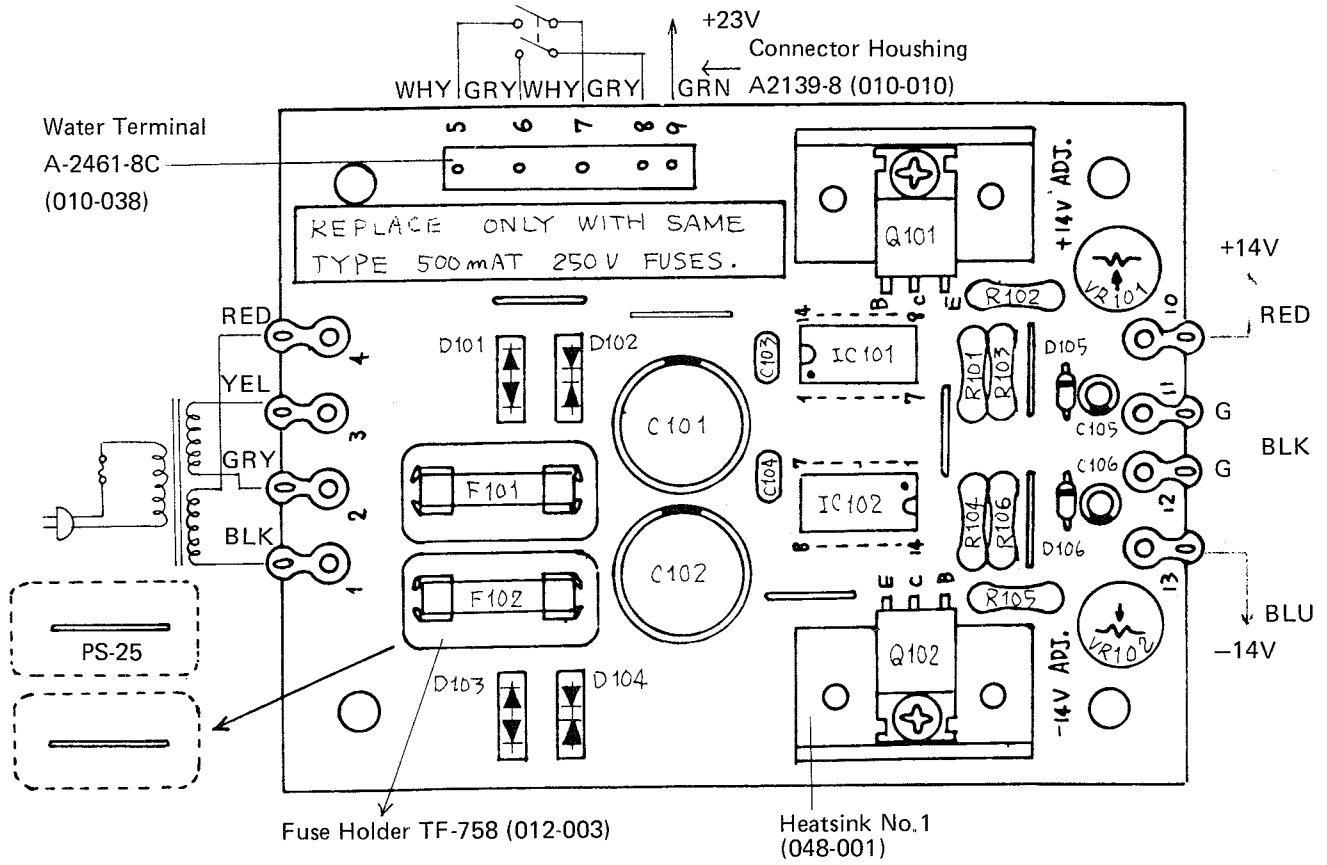


OUTPUT RANGE and CHANNEL SELECT BOARD OP-34 (149-034)



POWER SUPPLY BOARD

- PS-25 (146-025)
(100V-120V)
- PS-26 (146-026)
(220V-250V)



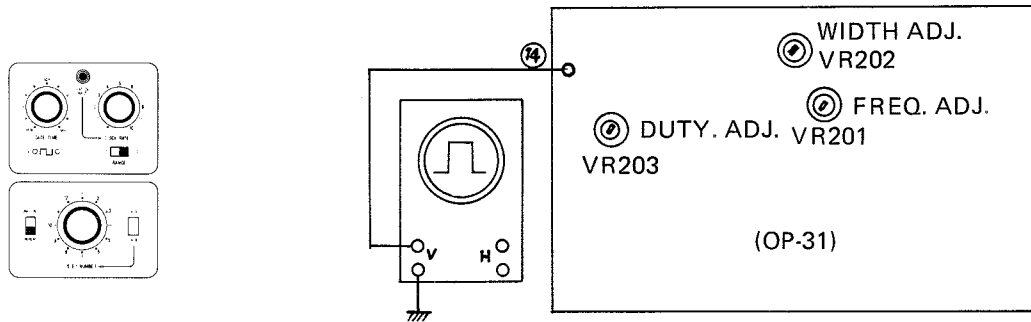
ADJUSTMENT PROCEDURE

1. Power Supply Voltage adjustment

- a. Connect the Digital Voltmeter to terminal "10" of the PCB (PS-25 or PS-26), and adjust VR101 for reading $+14V \pm 100mV$.
- b. In the same manner with connection to terminal "13", adjust VR102 for reading $-14V \pm 100mV$.

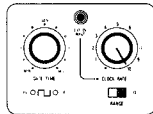
2. CLOCK RATE adjustment

Set the controls as illustrated bellow

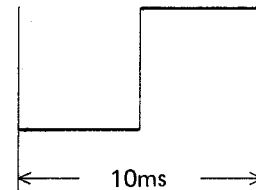


(RANGE: X10. REPEAT)

a



adjust VR201 for

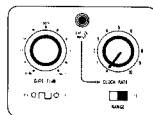
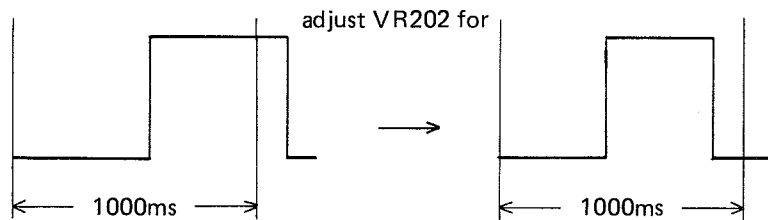


(CLOCK RATE: 10)

b

a little longer than 1000ms

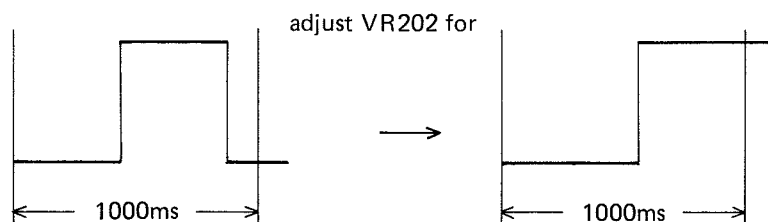
a little shorter than 1000ms



(CLOCK RATE: 0)

a little shorter than 1000ms

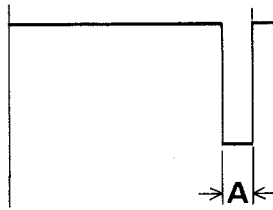
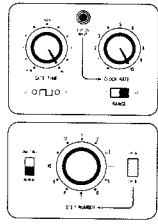
a little longer than 1000ms



- c Step (b) may cause variation on the 10ms width on (a). Repeat, then, the steps (a) and (b) until waveforms are within $10ms \pm 10\%$ and $1000ms \pm 10\%$.

3. GATE TIME adjustment

a

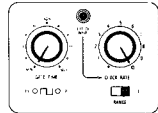


Note width of space (A)

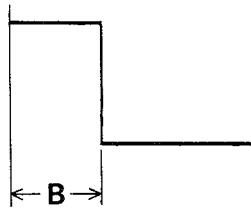
(CLOCK RATE: 10. GATE TIME: MAX)

b

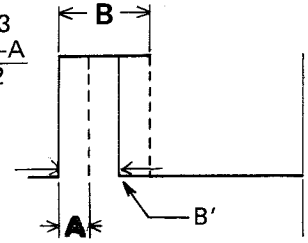
wider than A



(GATE TIME. MIN)

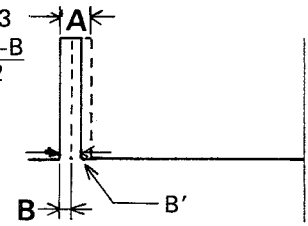


adjust VR203
for $B' = B - \frac{B-A}{2}$

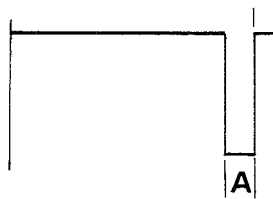


narrower than A

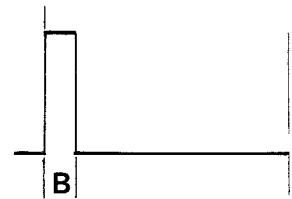
adjust VR203
for $B' = B + \frac{A-B}{2}$



c Repeat the above steps (a) and (b) until A=B



=



PARTS LIST

Sequence Board Assembly OP-31 (149-031)

052-146B	PCB	(less Parts)
020-010	IC	TA7504M (741C)
020-062	IC	μ PC1458C
020-049	IC	LB-1501
020-050	IC	LB-1515
020-055	IC	IT-132 (μ PA41C)
017-013	Transistor	2SC945(Q) (2SC828, 2SC372)
017-012	Transistor	2SA733(Q) (2SA495(Y))
017-072	Transistor	2SD571(L) (2SD414(O))
017-016	FET	2SK30A (GR)
017-014	FET	2SK30A (Y)
018-014	Diode	IS2473 (IS1555)
018-026	Diode	05Z16A
018-015	Thermistor	SDT-1000

Trimmer Potentiometers

028-002	1K (B)	EVT (L) - R4XA00 13B
028-007	100K (B)	EVT (L) - R4XA00 15B

Capacitors

037-007	250pF	50V \pm 10%	Ceramic
032-033	1 μ F	50V	Electrolytic
032-038	10 μ F	16V	Electrolytic
032-050	10 μ F	25V	Electrolytic
032-015	47 μ F	25V	Electrolytic
032-047	220 μ F	16V	Electrolytic

Register Board Assembly

OP-32 (149-032)

OP-33 (149-033)

052-147	PCB (less parts)
017-012	Transistor 2SC945(Q) (2SC828, 2SC372(Y))
030-133	Potentiometer 100K (B) V16L4N 15S-B100K (EVH-BOAS15B15)

Output Range and Channel Select Board Assembly
OP-34 (149-034)

052-148	PCB (less parts)
020-062	IC μ PC1458C
017-016	FET 2SK30A (GR)
001-092	Slide switch S-J0215

Power Supply Board Assembly

PS-25 (100V-120V) (146-025)

PS-26 (220V-250V) (146-026)

052-133B	PCB (less parts)
048-001	Heatsink No.1
020-031	IC 723CN
017-010	Transistor 2SD234(O)

Diodes

018-028	ESA-B01-03C
(018-062)	(MI-152)
018-029	ESA-B01-03N
(018-063)	(MI-152R)
018-022	IN4003

Trimmer Potentiometer

028-002	1K (B) EVL (T) R4XA00B13
---------	--------------------------

Capacitors

037-008	470pF	50V \pm 10%	Ceramic
032-033	10 μ F	16V \pm 10%	Electrolytic
032-068	470 μ F	35V	Electrolytic
010-038	Wafer Terminal A-2461-8C		

PS-26 only

012-003	Fuse Holder TF-758
008-024	Fuse (Midget) 0.5A SGA0.500

* For parts not listed above.

Refer to 2. DISASSEMBLY or 9. PARTS PICTORIAL.

* Carbon film resistors of 1/4W, and mylars are omitted.

PARTS PICTORIAL

