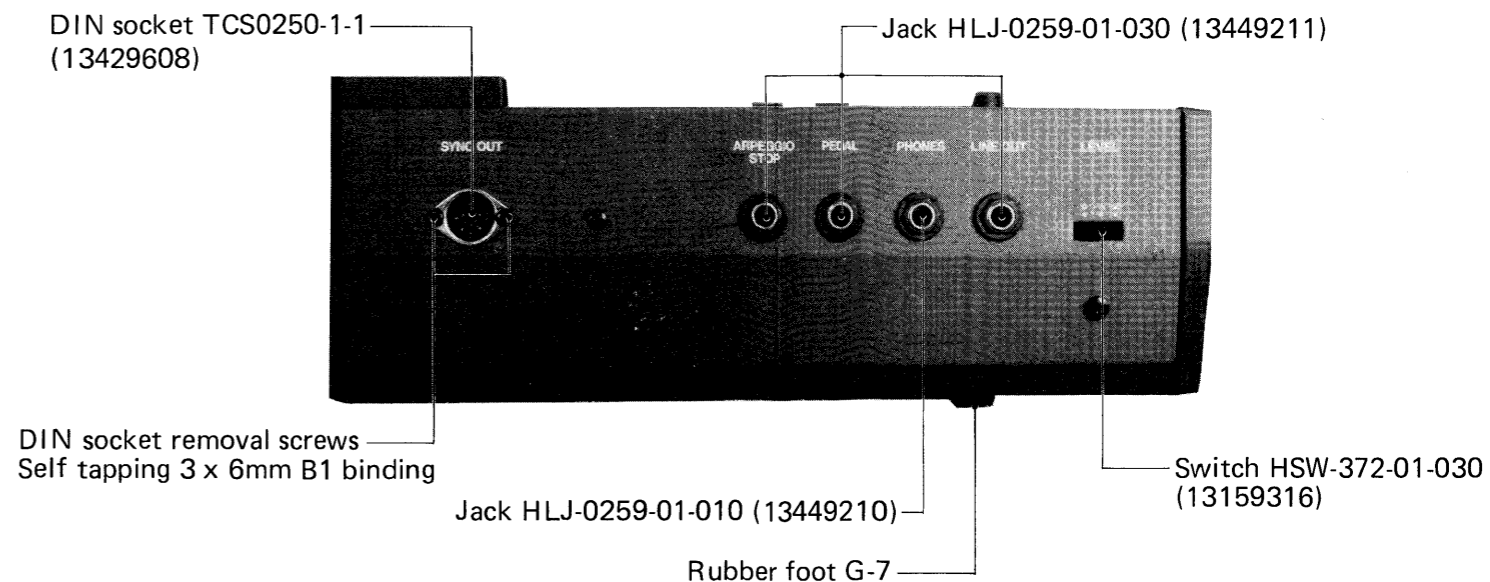
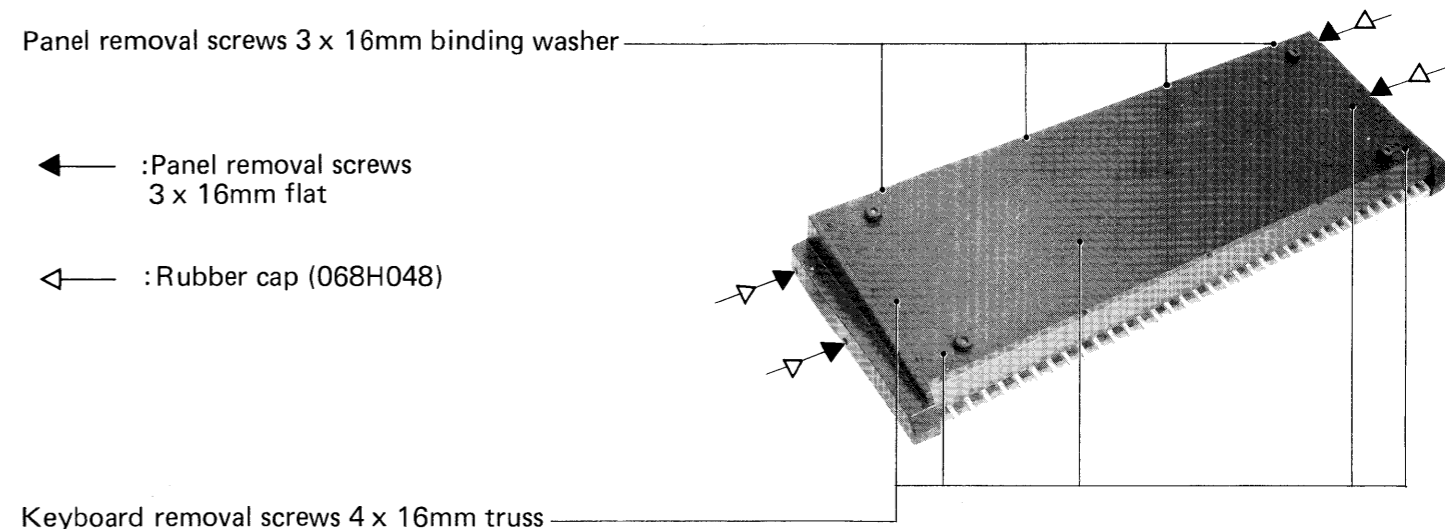
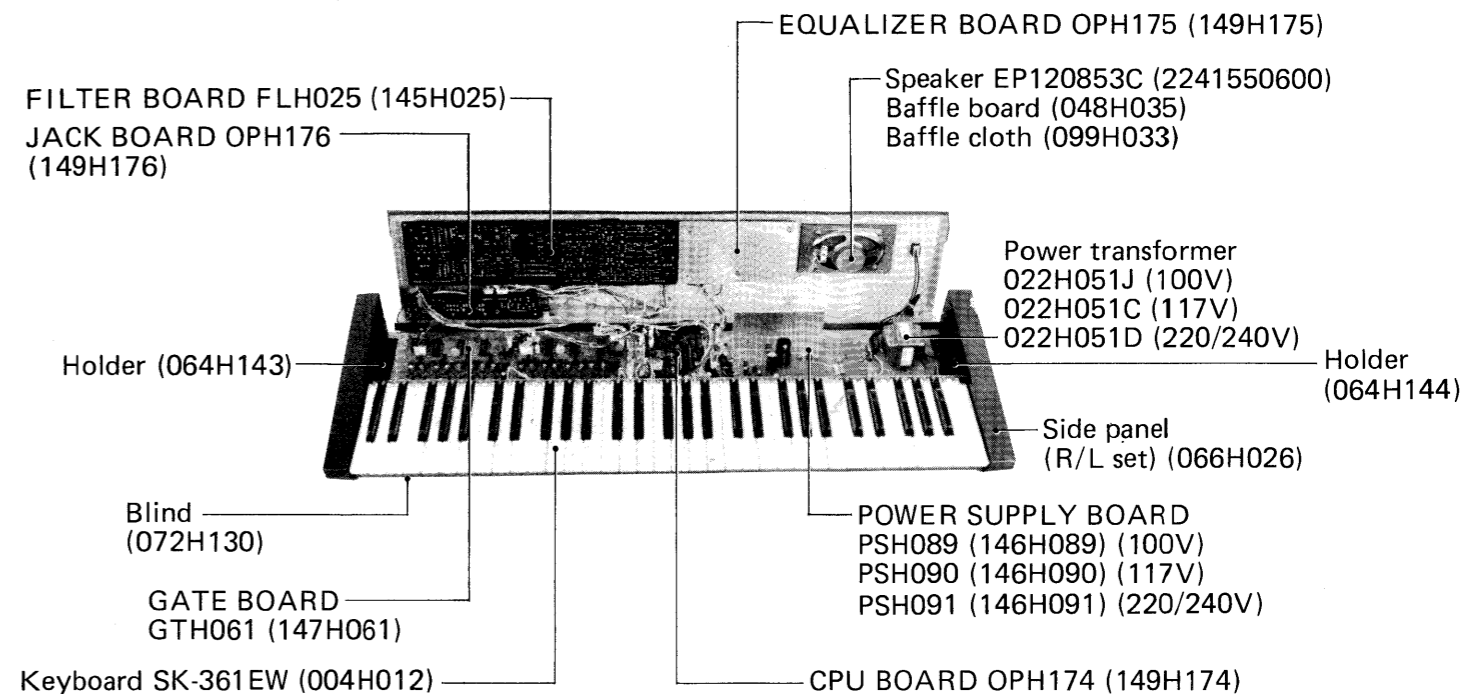
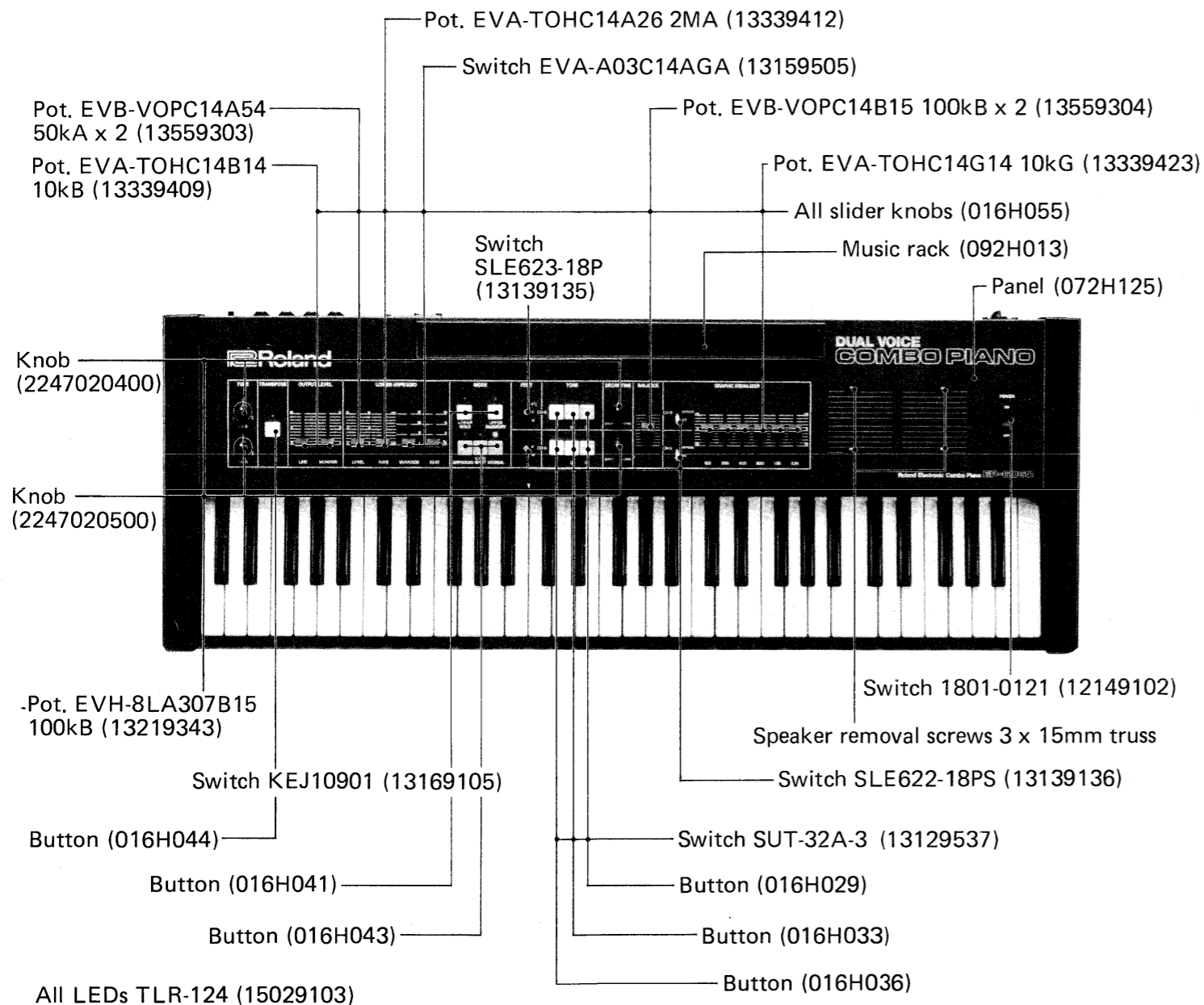


EP-6060 SERVICE NOTES

First Edition

SPECIFICATIONS

Keyboard	61 key 5 octaves (C2-C7, 8')
Pitch	CH-A: 16', 8' CH-B: 16', 8', 5-1/3'
Tunable Range	± 50 cents relative to A4 442 Hz
Tone	I, II, III
Equalizer	100 Hz, 200 Hz, 400 Hz, 800 Hz, 1.6 kHz, 3.2 kHz ± 15 dB
Arpeggio	Variation: I, II, III, IV Beat: 3/4, 4, 8, 12
Line Out	0, 15, -30 dB (+20 dBm max.)
Speaker	12 x 8 cm, 2 W
Power Consumption	18 W
Dimensions	912(W) x 115(H) x 325(D) mm 35-3/4(W) x 4-1/2(H) x 12-3/4(D) in.
Weight	9.5 kg/21 lb.



CIRCUIT DESCRIPTION

TONE GENERATORS

The Tone Generators consist of Master Oscillators Q1–Q3, Q4–Q6 (Gate Board), Footage Selectors IC1–IC3, IC4–IC6 (Filter Board) and Groups of programmable Counters IC1–IC3, IC4–IC6 (Gate Board).

Q1–Q3, Q4–Q6 MASTER OSCILLATORS –GATE BOARD–

Two master oscillators are the same in circuit configuration, but Q4–Q6 oscillates at higher frequency than Q1–Q3 to provide 5-1/3' pitch for CH-B. Both oscillators can be detuned by up to 50 cents high or low with TUNE control. These high frequency signals are routed to sets of programmable counters through Footage Selectors.

IC1–IC6 PROGRAMMABLE COUNTERS –GATE BOARD–

The programmable counters are each capable of dividing input signal (from master oscillator via footage selector) by n (divisor) applied on the D pins. When a key is played on the keyboard, CPU knows the note to be produced, through scanning matrix (DB-Decoder IC5-Key [and TRANSPOSE] contact-Inverters IC2, IC4-Port 1), and outputs divisor data on DB lines. At the same time CPU places address code (programmable counter chip select and counter select) on Port 2. With this code a counter is selected among 18 counters (three on each chip, two of them are not used) and supplies audio signal for that key to a Tone Gate to which Gate Signal is concurrently applied from GATE LATCH IC6 or IC7.

TONE GATES –GATE BOARD–

The following descriptions assume a tone gate in CH-A is to be assigned to a key pressed since all the gates function in the same way.

Upon key pressing one of output pins of Latch IC6 goes low that is routed to base of Q10 which charges C31 with a pulse. During the key press C31 discharges through three paths:

- R28–Q8 Discharging rate in this path greatly depends on conducting period of Q8 which in turn depends on the frequency of audio signal being applied on the base. Higher the frequency, faster is the discharging rate.
- D7–R32–Q12 Amount of discharging current is determined by the setting of DECAY TIME.
- D6–R31–Q11 Since Q11 is biased about half the voltage on Q12 base, Q11 allows C31 to continue discharging after Q12 has been cut off, giving longer fading time to the sound.

Upon key releasing, a fourth path is connected to C31; Q9 is ungrounded by positive going edge at gate off, quickly discharging C31 by grounding R34.

Under the above condition with foot switch plugged into PEDAL jack, pressing foot switch (open circuit) turns Q9 (CPU board) on, which ground biases Q9 (GATE board), making it irrelevant to positive transition of gate signal and giving sustain effect to the sound being produced.

Audio signal from a counter is applied to base of Q7. The signal is also applied to CP pin of divide-by two divider $\frac{1}{2}$ IC9. Sub octave from Q output is coupled with fundamental at Q7 base. When turned on and off by this combined signal, result output at Q7 collector is a continuous pulse (duty cycle 25%, at sub octave frequency) whose amplitude is following discharging envelope of C31.

ARPEGGIO

Although clock oscillator (IC2, Q1 – CPU board) is running once power is turned on, it is inhibited from passing the output to CPU but CLOCK OUT jack. The oscillator is timed by the START/STOP signal in some modes as described below.

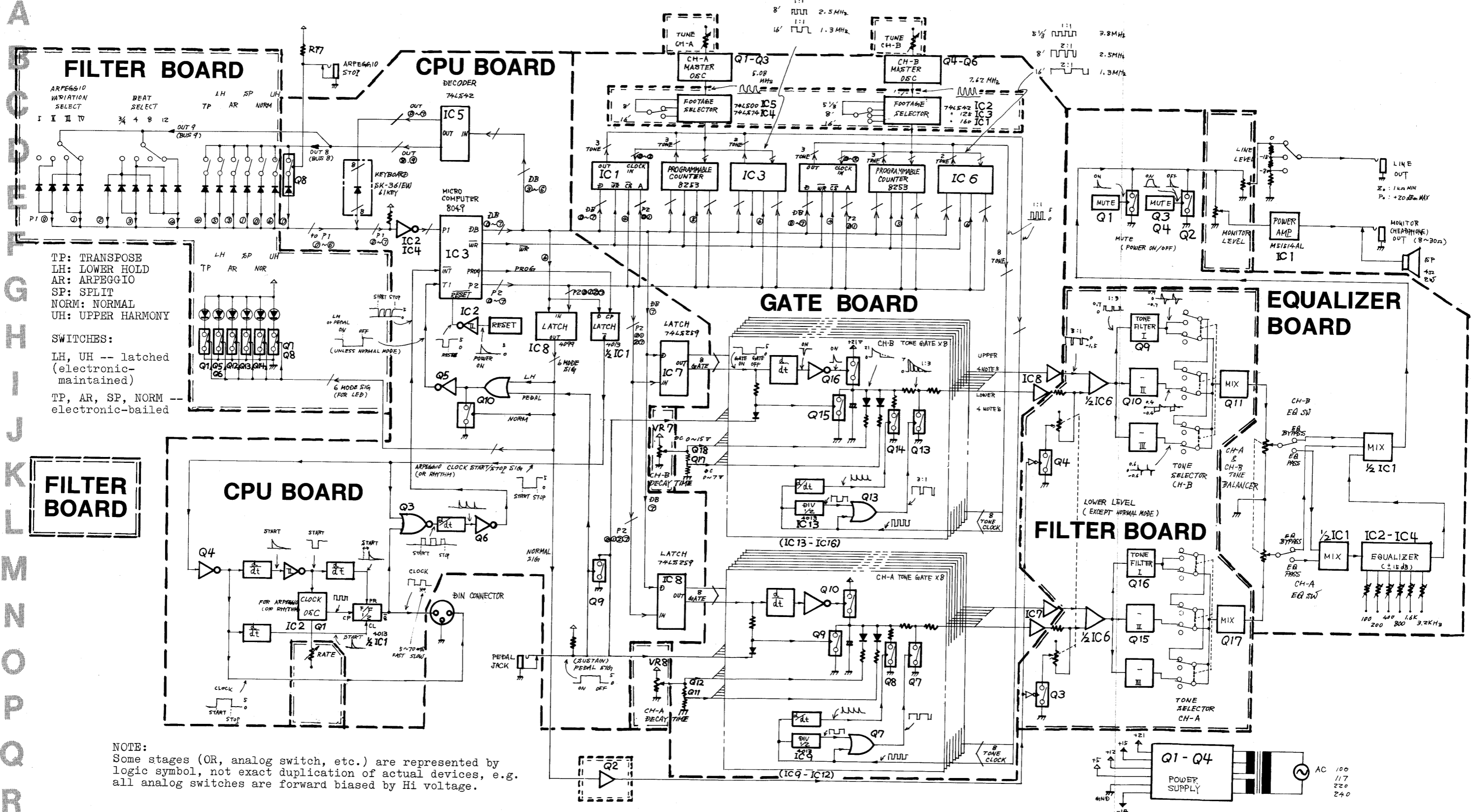
 $\frac{1}{2}$ IC1 START/STOP LATCH –CPU BOARD–

In ARPEGGIO or SPLIT mode, pressing any key on the keyboard causes \bar{Q} (pin 2) of Latch IC1 to go low (START) by the signal from PROG pin. This START signal is routed to base of Q4 here it is inverted and fed to C3–C5 node to reset the oscillator and the flip-flop $\frac{1}{2}$ IC1. Divided-by two clock signal from the flip-flop (pins 12 and 9) is connected to base of Q3 and is \bar{NOR} ed with low START signal. Q6 gates and sends clock signal to \bar{INT} of CPU. (Clock signal at INT pin is accommodated by the CPU only when ARPEGGIO is active.)

When the key is released, pin 2 of IC1 returns to positive, locking Q3 base high enough to saturate its collector, blocking clock signal.

Pressing HOLD switch or opening PEDAL circuit forward biases Q5, removing positive voltage on T1 pin of the CPU. With T1 low PROG will not change when a key now being held is released, clamping START at low.

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

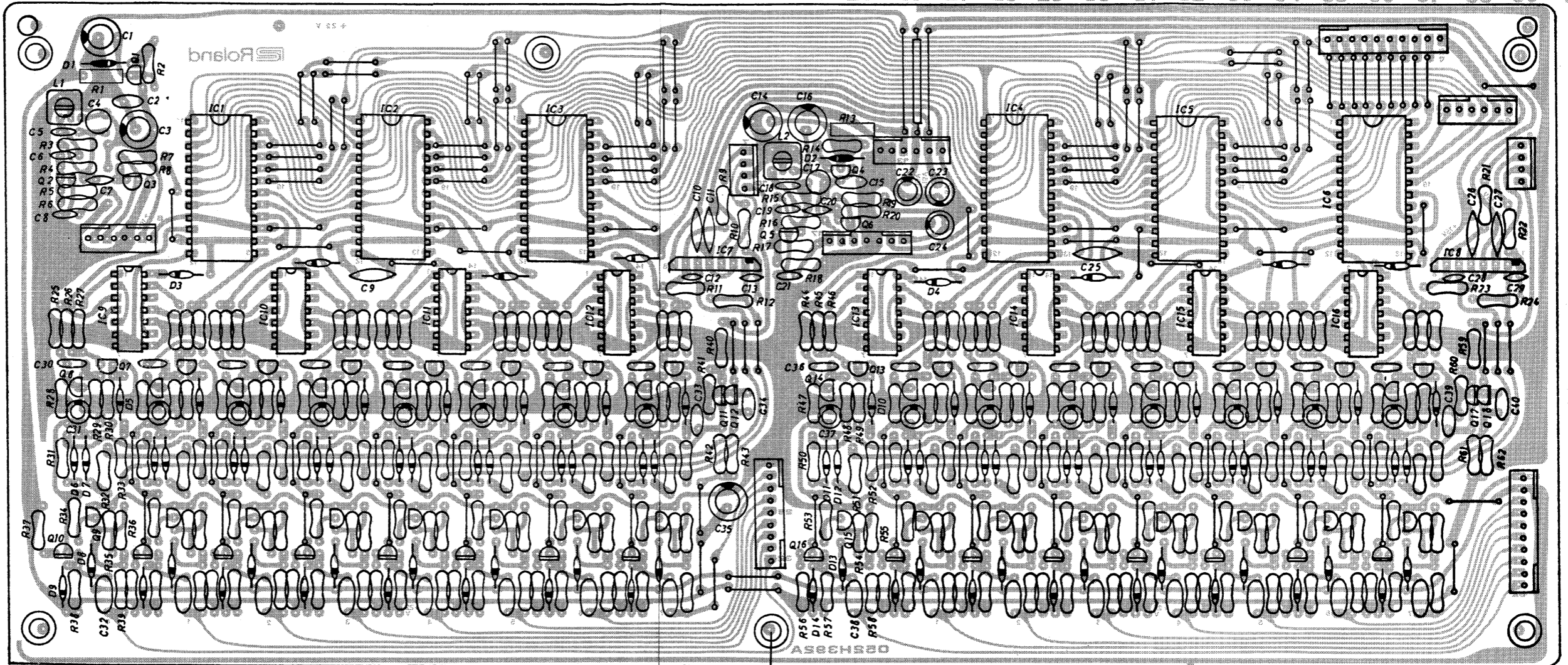


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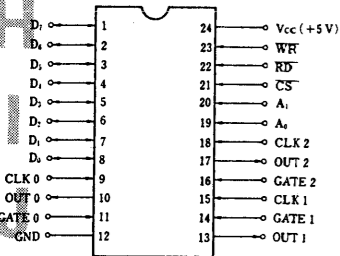
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42

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**GATE BOARD
GTH061
(147H061)
(pcb 052H392A)**



**8253
PROGRAMMABLE INTERVAL TIMER
3 Independent 16-Bit Counters**



CS	RD	WR	A1	A0	
0	1	0	0	0	Load Counter No. 0
0	1	0	0	1	Load Counter No. 1
0	1	0	1	0	Load Counter No. 2
0	1	0	1	1	Write Mode Word
0	0	1	0	0	Read Counter No. 0
0	0	1	0	1	Read Counter No. 1
0	0	1	1	0	Read Counter No. 2
0	0	1	1	1	No-Operation 3-State
1	X	X	X	X	Disable 3-State
0	1	1	X	X	No-Operation 3-State

PIN FUNCTIONS

DB	Scanning Signals to	Keyboard, Mode Switches, Beat Selector, Arpeggio Variation, Arpeggio Stop
	Divisor Data to	Programmable Counters
	Mode LEDs Lighting Signals to	Latch IC8
	Gate On/Off Signals to	Latches IC6 and IC7
PORT 1	Scanning Data Reading	
PORT 2	Chip Select and Counter Select Signals to	Programmable Counters
	Gate Latch Control Signals to (Address, Enable) to	IC6 and IC7
	Switch Data Latch Control Signals (Address, Write Disable) to	IC8
T1	Lower Hold Signal Input	
INT	Arpeggio Clock Input	
WR	Control Signals to	Programmable Counters
PROG	Clock Pulse to	Arpeggio Start/Stop Latch IC1

GATE BOARD

TA-305
TB-300

IC1~IC6 : M5L8253P-5

IC7-IC8 : M5218L

IC9~IC16 : TC4013BP

○ : 05Z-11L

○ : IS2473 or IS1555

D : 2SA1015

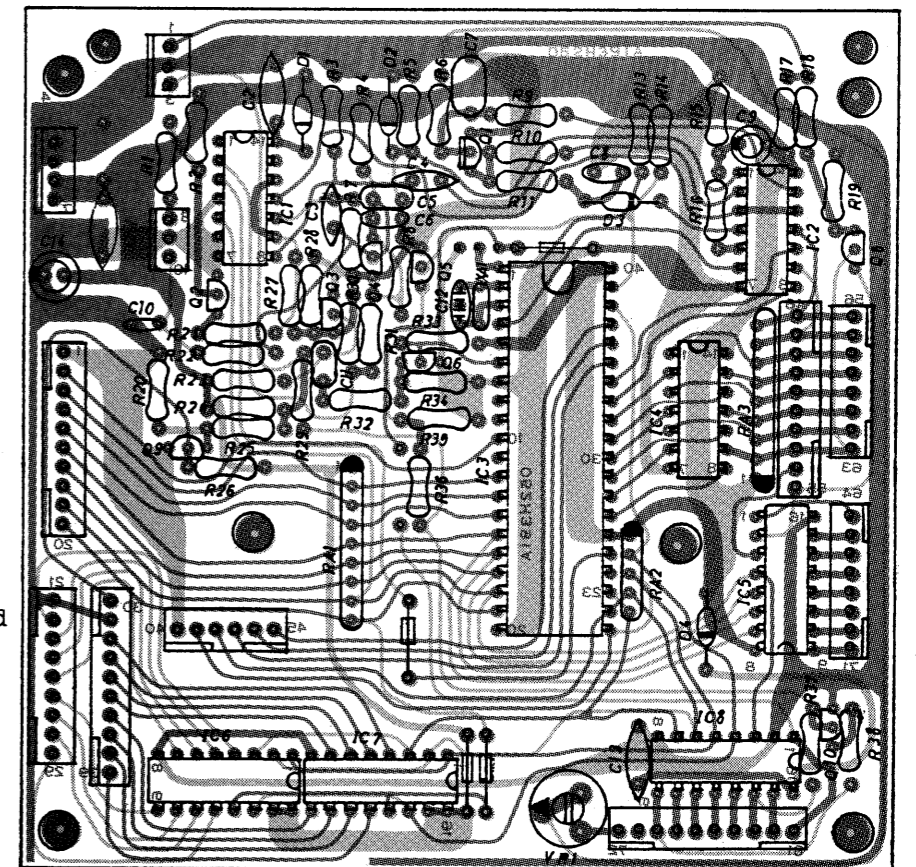
D : 2SC1815

on a PCB,

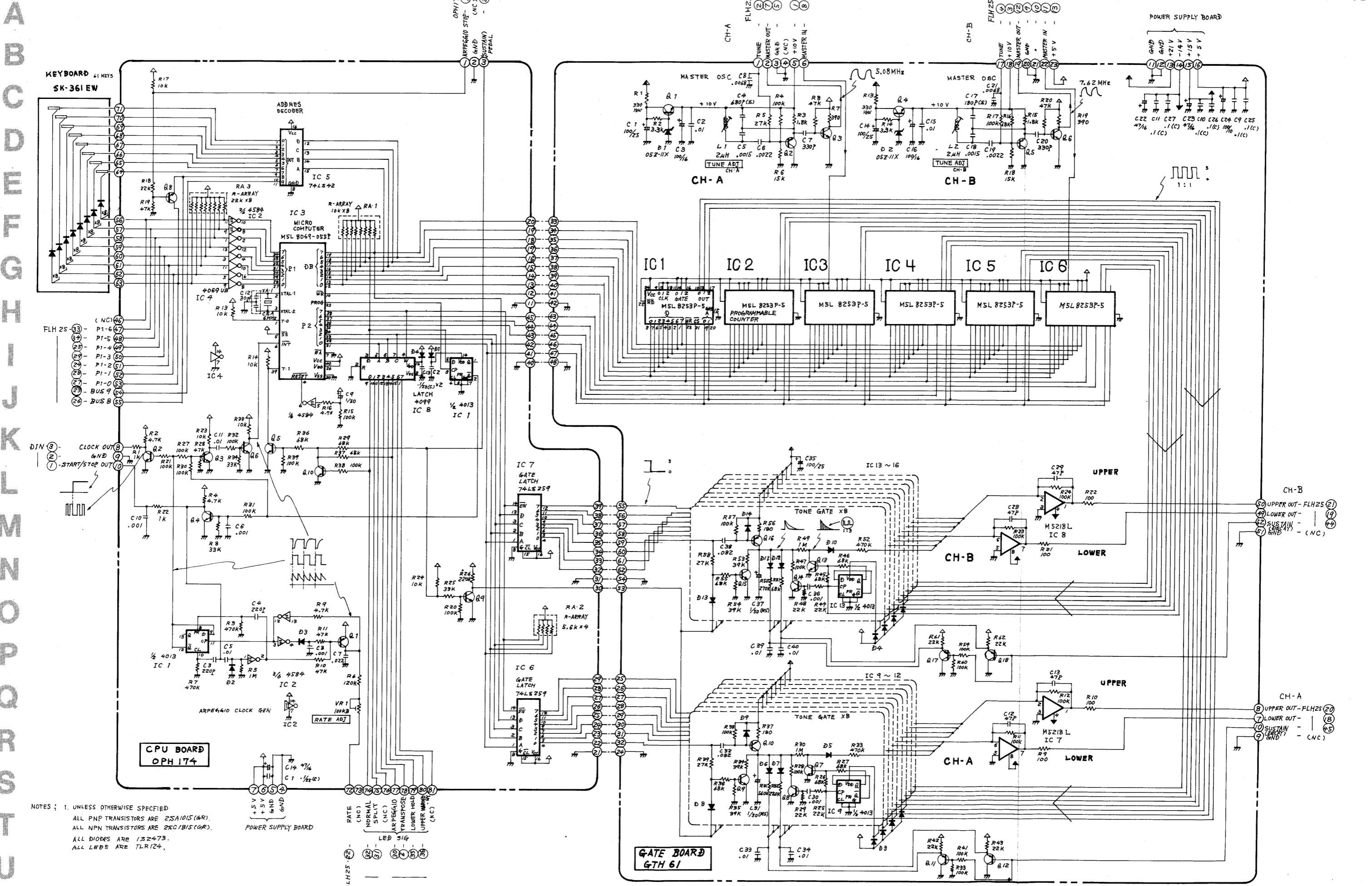
each group must be of the same suffix (Y or GR).

Q2, Q5: cannot be substituted by other brands

**CPU BOARD
OPH174
(149H174)
(pcb 052H391A)**



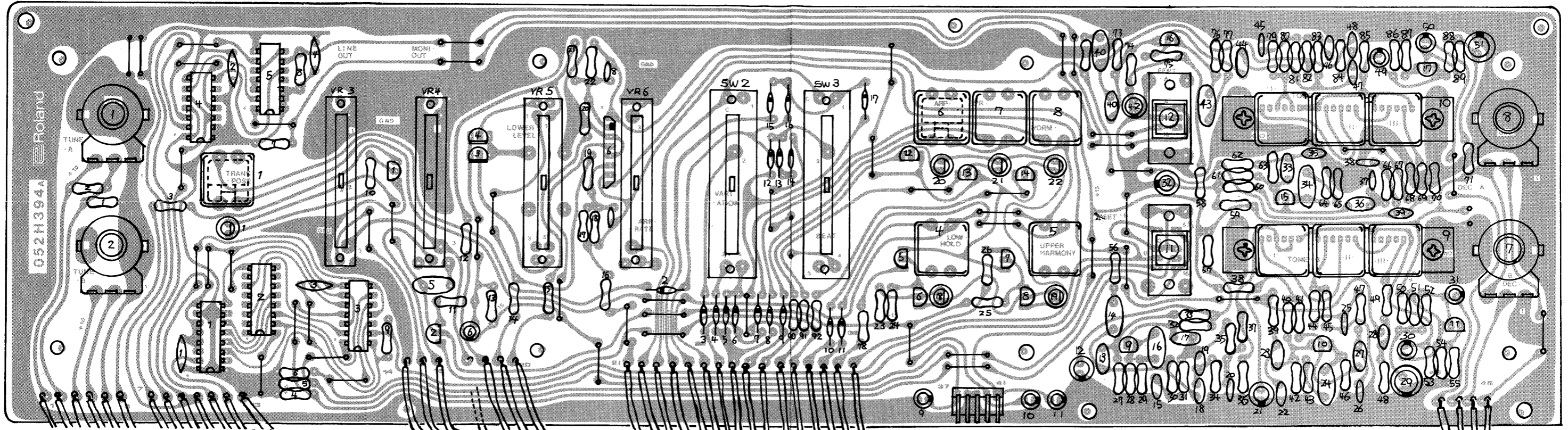
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40



NOTES: 1. UNLESS OTHERWISE SPECIFIED
 ALL PNP TRANSISTORS ARE 2SA1015 (4R).
 ALL NPN TRANSISTORS ARE 2SC1815 (6R).
 ALL DIODES ARE 1S2473.
 ALL LEDs ARE TLR124.

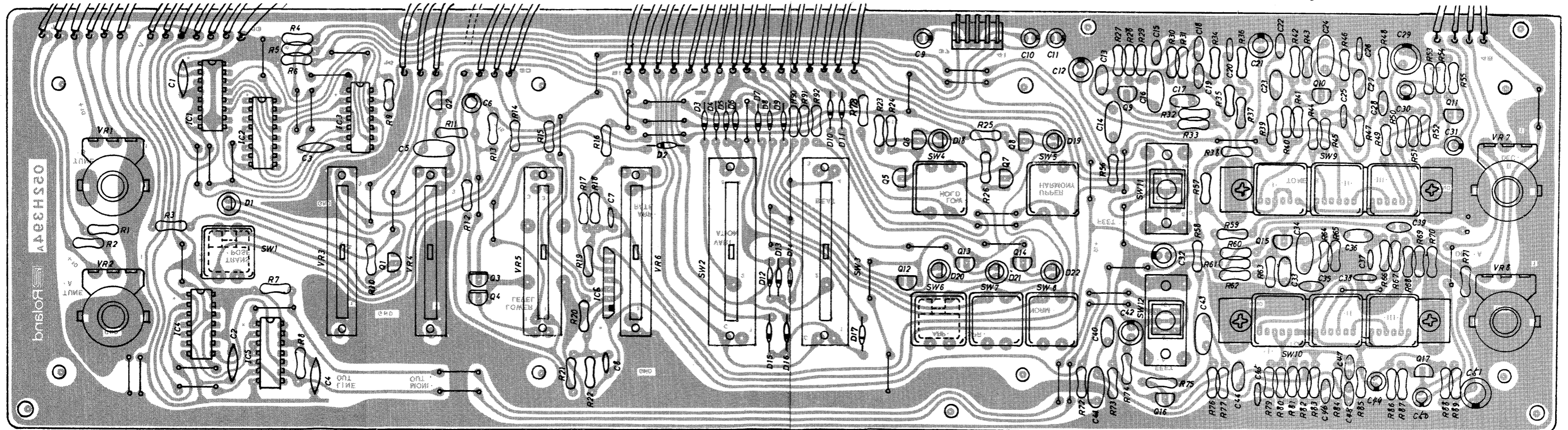
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42

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View from foil side

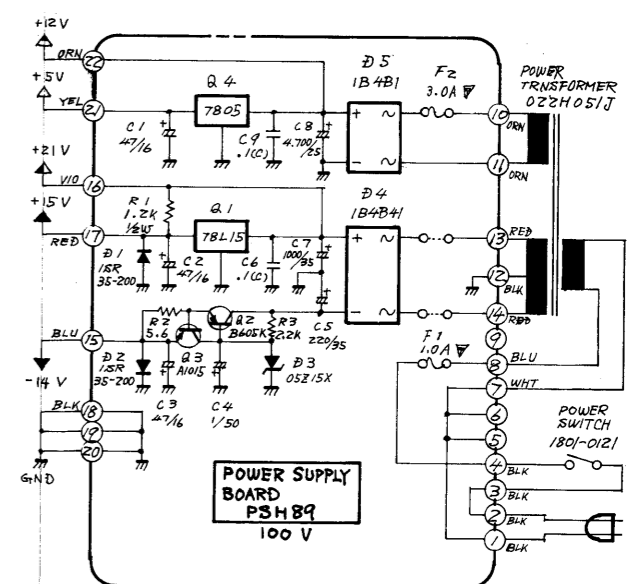
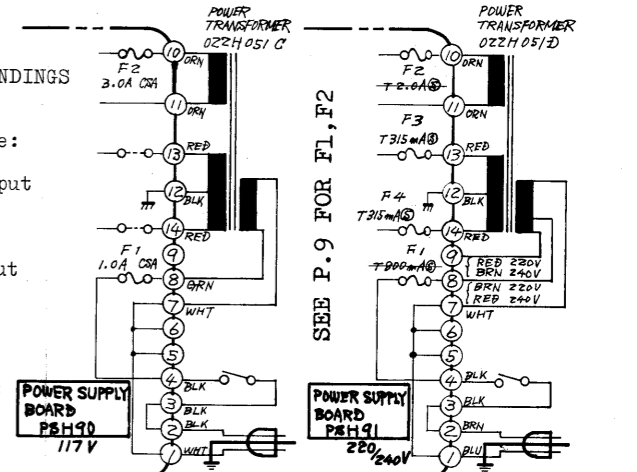
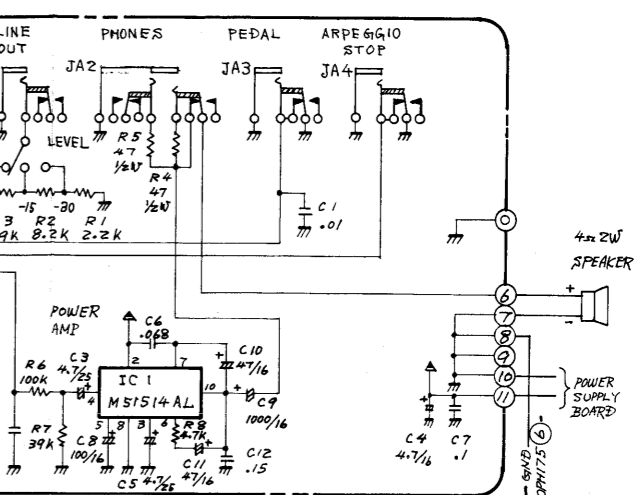
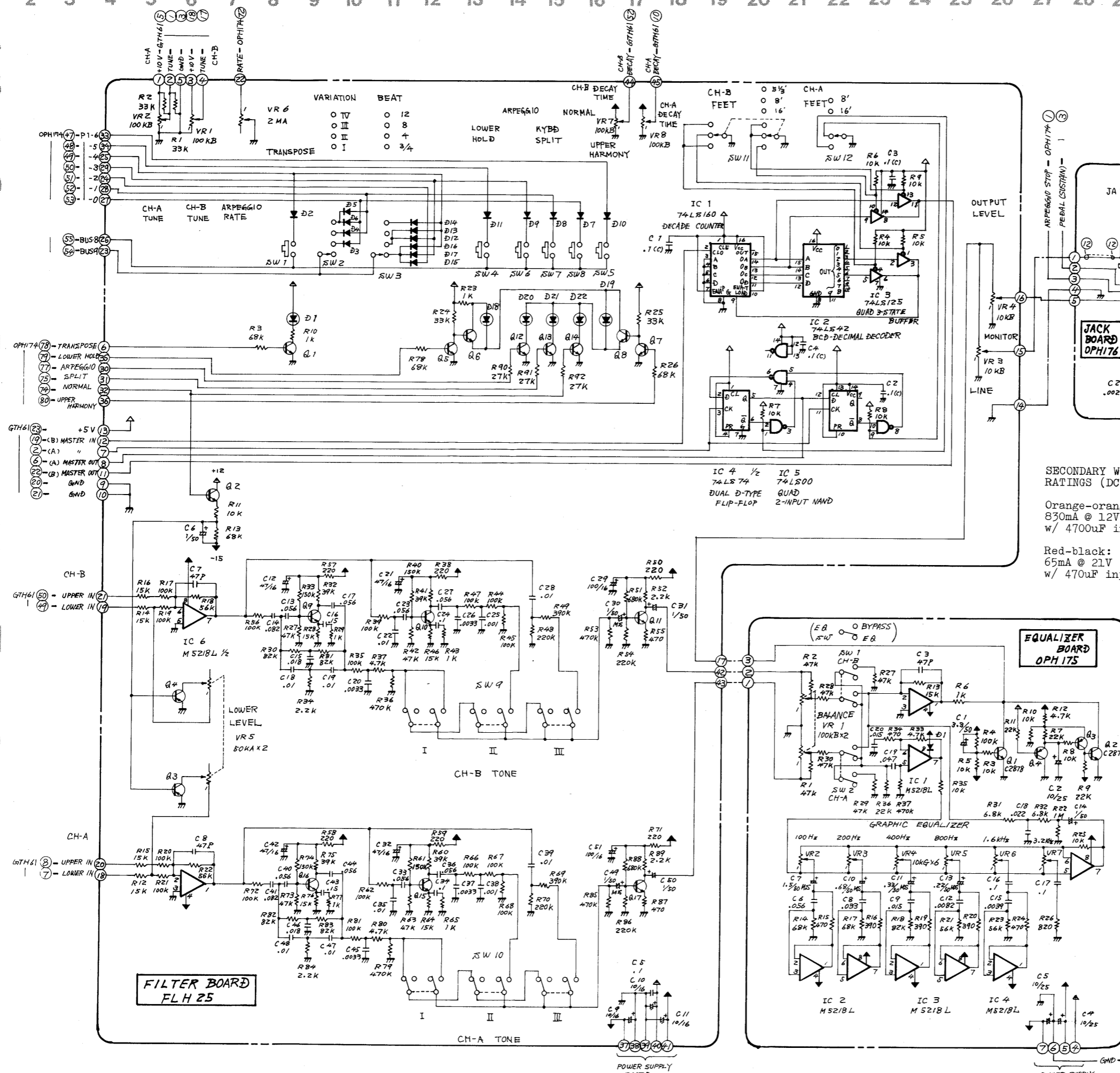
FILTER BOARD FLH025 (145H025)(pcb 052H394A)



View from component side

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

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



SECONDARY WINDINGS RATINGS (DC)

Orange-orange: 830mA @ 12V w/ 4700uF input

Red-black: 65mA @ 21V w/ 470uF input

ADJUSTING & CHECKING

BASIC CONTROL SETTINGS

TUNE: center BYPASS: on
 MODE: NORMAL LEVEL SELECTOR: 0
 TONE: I DECAY TIME: LONG
 FEET: 8' EQ. SLIDERS: center

OUTPUT LEVEL (LINE. MONITOR): 10
 BALANCE: bottom (CH-A) or top (CH-B)

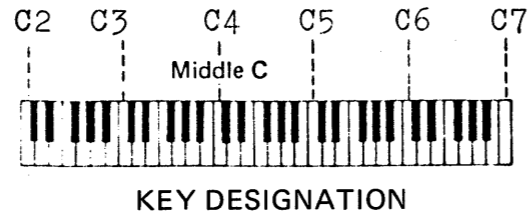
TUNE

Adjust L1 (CH-A) and L2 (CH-B) on GATE board respectively for 442 Hz output with A4 key pressed.

ARPEGGIO CLOCK RATE

Connect scope to pin 3 of DIN socket. Raise RATE knob to top (FAST).

1. Set VR1 of CPU board for a waveform period of 6.0–7.5 ms/cycle.
2. Slide down RATE to bottom (SLOW) and confirm 65–85 ms/cycle.

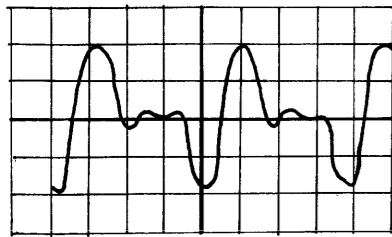


WAVEFORMS

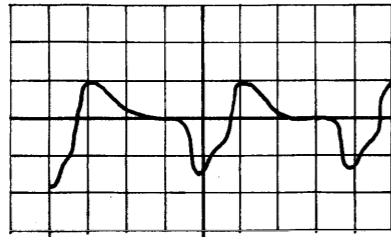
(C4 key, BYPASS ON, OUTPUT jack)

TONE

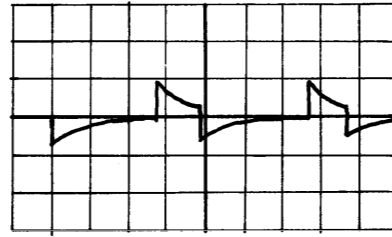
TONE SELECTOR I



II



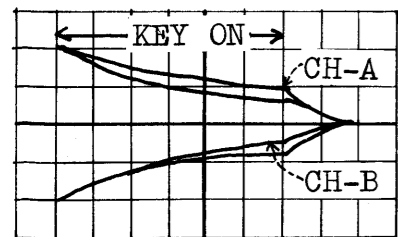
III



(1ms/div, 0.1V/div)

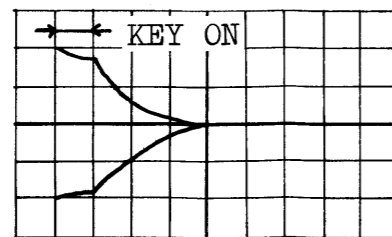
ENVELOPES

DECAY: LONG



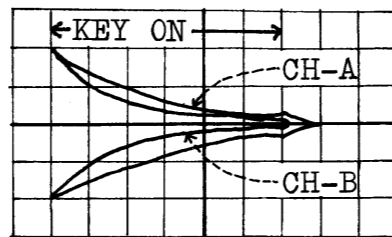
(0.1s/div, 0.1V/div)

DECAY: LONG



(50ms/div, 0.1V/div)

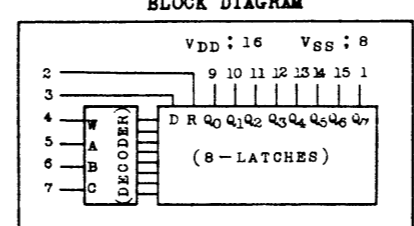
DECAY: SHORT



(50ms/div, 0.1V/div)

TC4099BP

8-Bit Addressable Latch

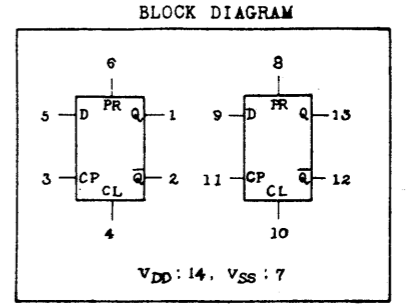


Write Disable	Reset	Addressed Latch	Unaddressed Latch
0	0	Data	Q _n *
0	1	Data	Reset†
1	0	Q _n *	Q _n *
1	1	Reset	Reset

* Q_n is previous state of latch.
 † Reset to zero state.

TC4013BP

Dual "D" Flip-Flop

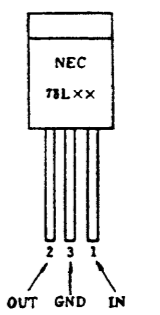


INPUTS				OUTPUTS	
CL	PR	D	CP	Q _{n+1}	\bar{Q}_{n+1}
L	H	*	*	H	L
H	L	*	*	L	H
H	H	*	*	L	H
L	L	L	∫	L	H
L	L	H	∫	H	L
L	L	*	∫	Q _n *	\bar{Q}_n *

*: Don't Care
 ∫: Level Change
 ∙: No-Change

μPC78L

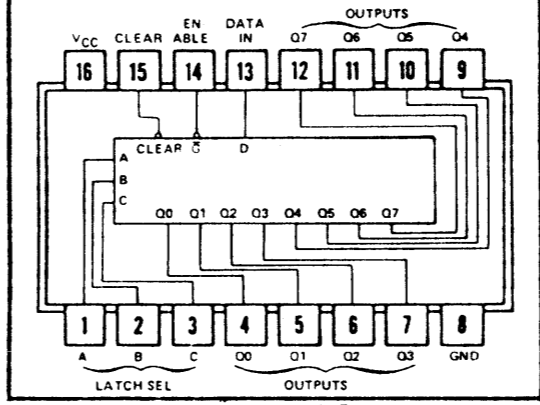
(μPC78L05, μPC78L15)



74LS259

8-BIT ADDRESSABLE LATCH

(TOP VIEW)



INPUTS		OUTPUT OF ADDRESSED LATCH	EACH OTHER OUTPUT	FUNCTION
CLEAR	G			
H	L	D	Q _{i0}	Addressable Latch Memory
H	H	Q _{i0}	Q _{i0}	8-Line Demultiplexer
L	L	D	L	Clear
L	H	L	L	

LATCH SELECTION TABLE

SELECT INPUTS			LATCH ADDRESS
C	B	A	
L	L	L	0
L	L	H	1
L	H	L	2
L	H	H	3
H	L	L	4
H	L	H	5
H	H	L	6
H	H	H	7

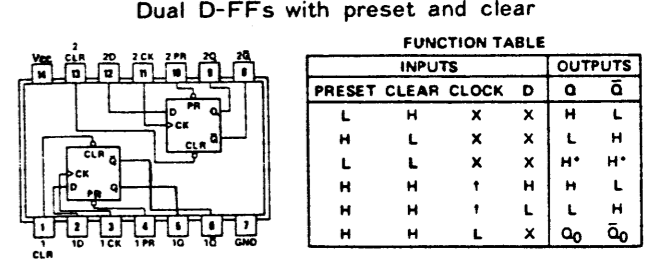
74LS42

ONE-OF-TEN DECODER

A ₀	A ₁	A ₂	A ₃	0	1	2	3	4	5	6	7	8	9
L	L	L	L	L	H	H	H	H	H	H	H	H	H
H	L	L	L	H	L	H	H	H	H	H	H	H	H
L	H	L	L	H	H	L	H	H	H	H	H	H	H
H	H	L	L	H	H	H	L	H	H	H	H	H	H
L	L	H	L	H	H	H	H	L	H	H	H	H	H
H	L	H	L	H	H	H	H	H	L	H	H	H	H
L	H	H	L	H	H	H	H	H	H	L	H	H	H
H	H	L	H	H	H	H	H	H	H	H	L	H	H
L	L	H	H	H	H	H	H	H	H	H	H	L	H
H	L	H	H	H	H	H	H	H	H	H	H	H	L
L	H	H	H	H	H	H	H	H	H	H	H	H	H
H	H	H	H	H	H	H	H	H	H	H	H	H	H

74LS74

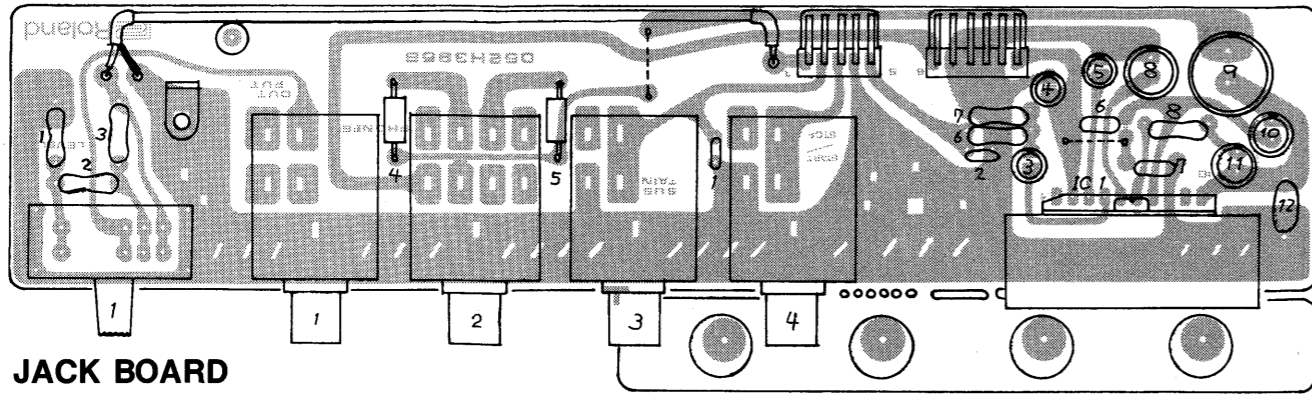
Dual D-FFs with preset and clear



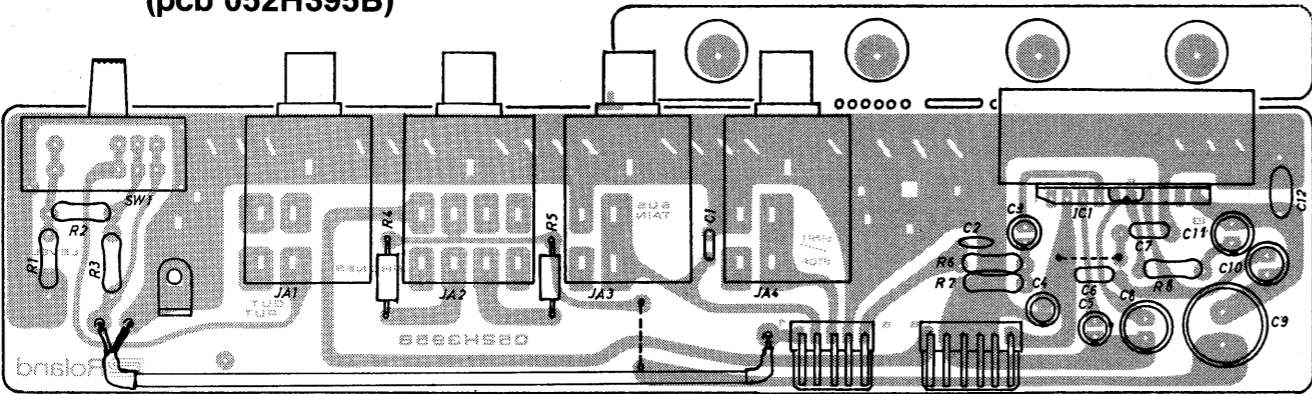
INPUTS				OUTPUTS	
PRESET	CLEAR	CLOCK	D	Q	\bar{Q}
L	H	X	X	H	L
H	L	X	X	L	H
L	L	X	X	H*	H*
H	H	↑	H	H	L
H	H	↑	L	L	H
H	H	L	X	Q ₀	\bar{Q}_0

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

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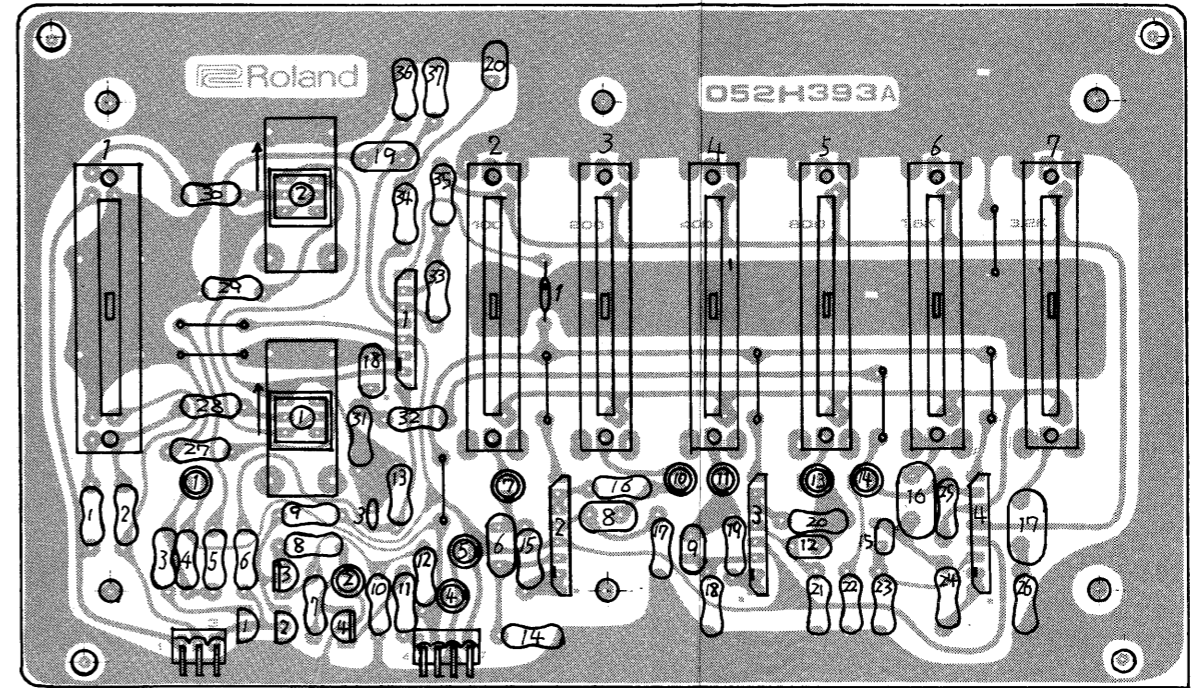
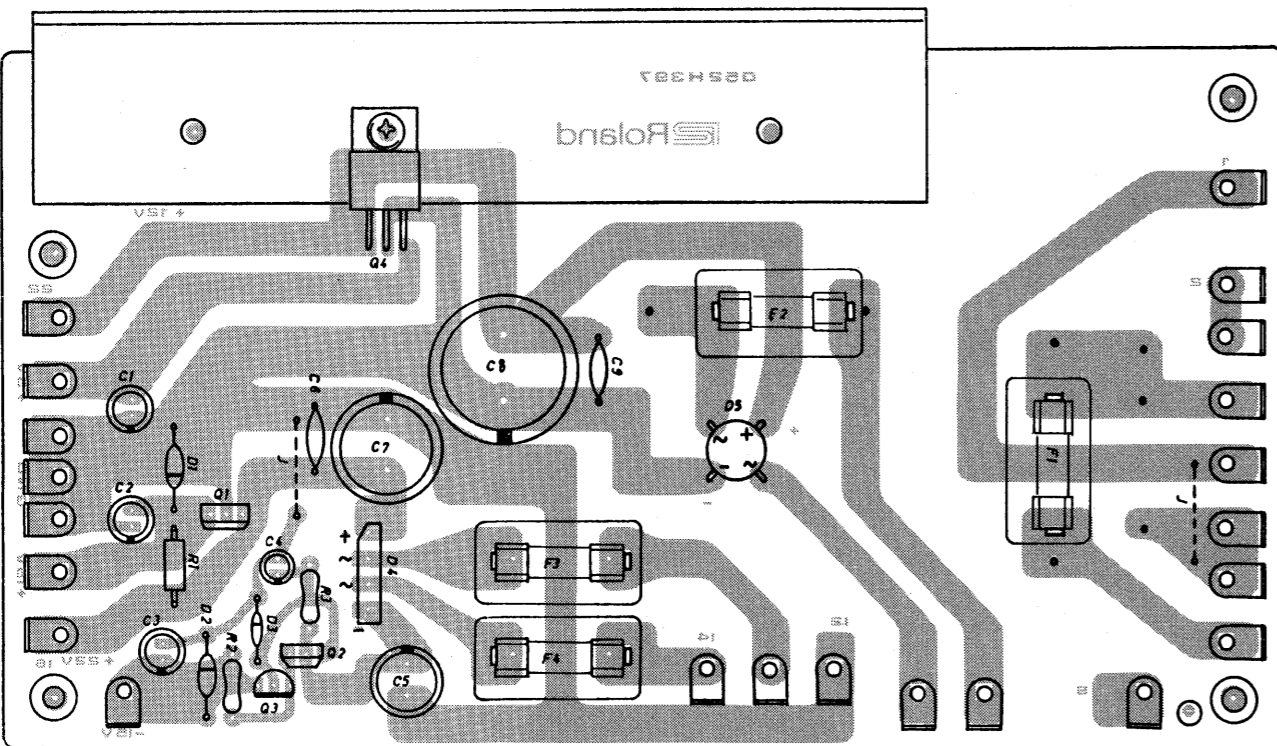
JACK BOARD
OPH176 (149H176)
(pcb 052H395B)



POWER SUPPLY BOARD
PSH089 (146H089) 100V
PSH090 (146H090) 117V
PSH091 (146H091) 220/240V
(pcb 052H397)

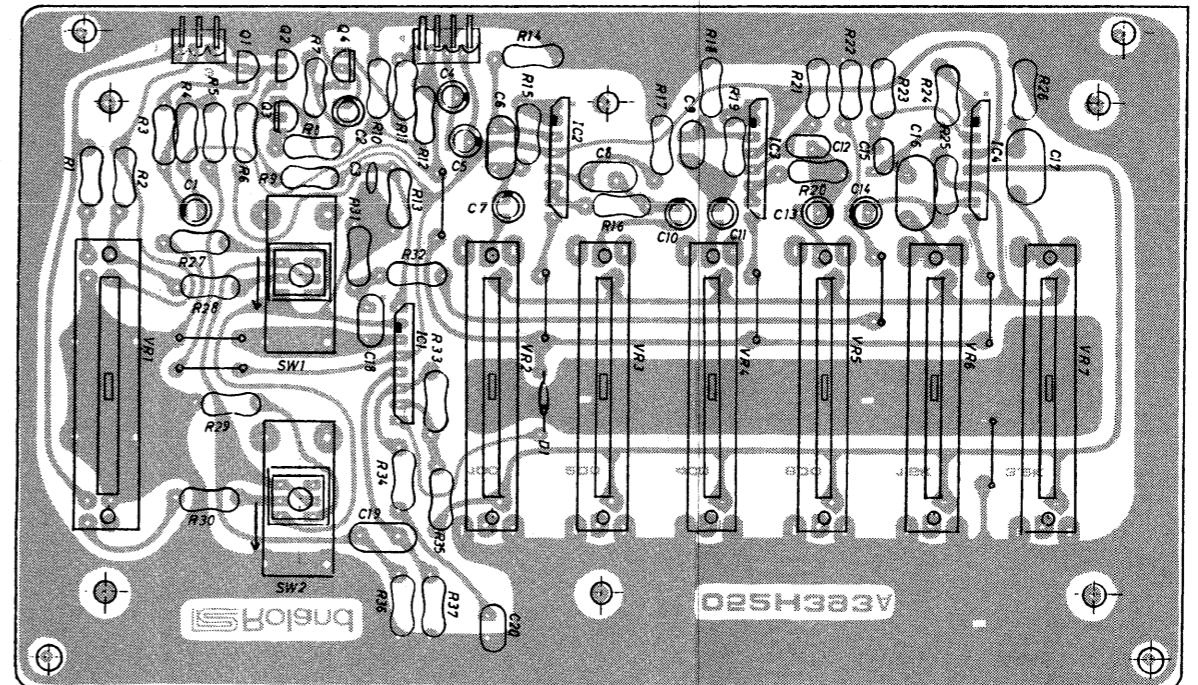
	100V	117V	220/240V
F1	MGP 1A	MGP 1A CSA	SEMKO T200mA (SEMKO T800mA)
F2	MGP 3A	MGP 3A CSA	SEMKO T1.6A (SEMKO T2A)
F3			SEMKO T315mA
F4			

Parentthesized: on early EP-6060's



View from foil side

EQUALIZER BOARD
OPH175 (149H175) (pcb 052H393A)



PARTS LIST

KEYBOARD

004H012 SK-361EW w/weight in keys

CASE

087H018 Cabinet
 072H125 Panel
 072H130 Blind
 066H026 Side panel R/L set
 068H048 Rubber cap
 064H143 Holder left
 064H144 Holder right
 092H013 Music rack
 2241550600 Speaker EP120853C

KNOB. BUTTON

016H055 Knob
 016H041 Button ivory
 016H043 Button gray

SWITCH

12149102 1801-0121 POWER
 13169105 KEJ10901 push TRANSPOSE MODE
 13129537 SUT-32A-3 push TONE
 13159505 EVA-A03C14AGA slide LOWER ARPEGGIO
 13139135 SLE623-18P lever CH-B FEET
 13139136 SLE622-18PS lever CH-A FEET, G. EQ
 13159316 HSW-372-01-030 slide LEVEL

JACK

13449211 HLJ-0259-01-030 mono
 13449210 HLJ-0259-01-010 stereo
 13429608 DIN socket TLCS0250

POWER TRANSFORMER

022H051J 100V
 022H051C 117V
 022H051D 220/240V

COIL

12449223 S-167-1066 2μH

PCB ASSEMBLY

149H174 CPU BOARD
 OPH174 (pcb 052H391A)
 147H061 GATE BOARD
 GTH061 (pcb 052H392A)
 145H025 FILTER BOARD
 FLH025 (pcb 052H394A)
 149H175 EQUALIZER BOARD
 OPH175 (pcb 052H393A)
 149H176 JACK BOARD
 OPH176 (pcb 052H395B)
 146H089 POWER SUPPLY BOARD
 PSH089 (pcb 052H397) 100V
 146H090 POWER SUPPLY BOARD
 PSH090 (pcb 052H397) 117V
 146H091 POWER SUPPLY BOARD
 PSH091 (pcb 052H397) 220/240V

IC

15179121B0 M5L8049-055P Single-Chip 8-Bit Microcomputer
 15179109 M5L8253P-5 Programmable Counter
 15169301X0 SN74LS00 Quad 2-Input NAND Gate
 15169310X0 SN74LS42 One-Of-Ten Decoder
 15169311X0 SN74LS74 Dual D-Flip Flop
 15169316X0 SN74LS125 Quad 3-State Buffers
 15169351X0 SN74LS160 BCD Decade Counters
 15169330X0 SN74LS259 8-Bit Addressable Latch
 15159105T0 TC4013BP Dual D-Flip Flop
 15159116T0 TC4069UBP Hex Inverter
 15159120T0 TC4099BP 8-Bit Addressable Latch
 15159303T0 TC4584 Hex Schmitt Trigger
 15159106 μPC7805H Three Terminal Voltage Regulator
 15199114 TA78L15 Three Terminal Voltage Regulator
 15189136B0 M5218L OP Amp.
 15199507 M51514AL Power Amp.

TRANSISTOR

15110113 2SA1015-GR
 15129114 2SC1815-GR
 15129136 2SC2878-A

DIODE

15029103 TLR-124 LED
 15019245 1B4B41 rectifier stack
 15019243 1B4B1 rectifier stack
 15019208 1SR35-200
 15019103 1S-2473
 15019619 05Z-15X (L) zener
 15019617 05Z-11X (L) zener

POTENTIOMETER

13219343 EVH8LA307B15 100kB DECAY TIME
 (Slide)
 13339409 EVATOH14B14 10kB OUTPUT LEVEL
 13339412 EVATOH14A26 2MA LOWER ARP. RATE
 13559303 EVBVOP14A54 50kA x 2 LOWER ARP. LEVEL
 13339423 EVATOH14G14 10kB EQUALIZER
 13559304 EVBVOP14B15 100kB x 2 BALANCE
 (Trimmer)
 13299102 EVTR4SA00B15 100kB

CAPACITOR

(Electrolytic, low leak)
 13639261M0 ECEA50M010 1/50MS
 13639282M0 ECEA50MR22 R22/50MS
 13639283M0 ECEA50MR33 R33/50MS
 13639284M0 ECEA50MR68 R68/50MS
 13639285M0 ECEA50M1R5 1R5/50MS
 (Polystyrene)
 13569155 CQ09S1H 180J05 180P
 13569156 CQ09S1H 680J05 680P

RESISTOR

13910115 RM4-562 5.6k x 4 array
 13829821 RM8-103 10k x 8 array
 13910105 RM8-223 22k x 8 array

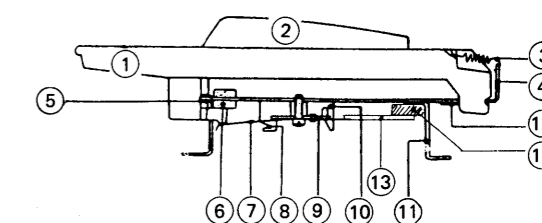
FUSE

12559133 MGP 1A pri. 100V

12559311 MGP 1A CSA pri. 117V
 12559137 MGP 3A sec. 100V
 12559314 MGP 3A CSA sec. 117V
 12559507 SEMKO T200mA pri. 220/240V (800mA, early units)
 12559509 SEMKO T315mA sec. 220/240V
 12559521 SEMKO T1.6A sec. 220/240V (2.0A, early units)

OTHERS

12559519 Fuse holder TF-758 220/240V only
 065H113 Cover slide pot.
 048H021A Heat sink JACK BOARD
 048H031 Heat sink POWER SUPPLY
 12389800 Ceramic resonator CSA6MHz and paired CSC30pF



KEYBOARD PARTS
 SK-361EW (004H012)

NO	PART NO	DESCRIPTION
1	106H026W	Natural key C F
1	106H027W	Natural key D
1	106H028W	Natural key E B
1	106H029W	Natural key G
1	106H030W	Natural key A
1	106H031W	Natural key C' F'
2	106H032W	Sharp key black
3	070H029	Key spring H29
4	061H086A	Chassis H86A
5	068H004	Guide bushing H4
6	101H141	Level felt H141
7	071H044	Contact leaf H44
8	071H051	Busbar 8P H51
	071H054	Busbar 5P H54
9	043H007	Switch unit 12P H7
	043H008	Switch unit 13P H8
10	104H093	Busbar holder H93
11	062H024	Chassis bracket H24
12	098H006	Key stopper H6
13	052H283-5	Matrix board H283-5
14	107H059	Cushion H59

All keys: weight loaded

NOTE:
 Although Roland has employed 8-10 digit coding, old ones (6 digit and 6 digit with H) are still applied to some parts.