JP-4 SERVICE NOTES

Second Edittion

SPECIFICATIONS

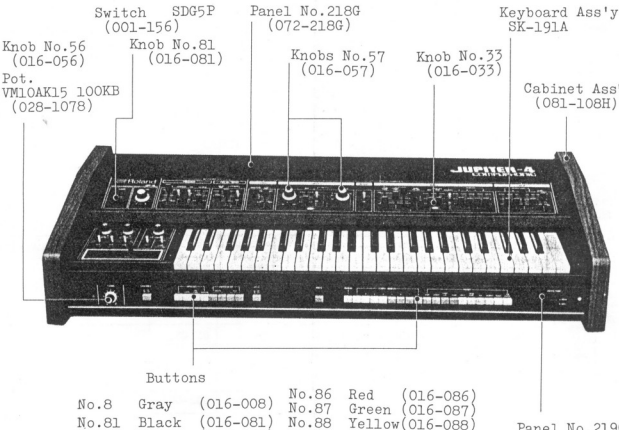
- **KEYBOARD**
  (49-keys, 4 octaves, C scale)
- **SYNTHESIZER MODULES** 4
- **VC O(VOLTAGE CONTROLLED OSCILLATOR)**
  VCO RANGE (16', 8', 4') 1
  PULSE WIDTH (50%, 40%, 20%, 10%)
- **VCF (VOLTAGE CONTROLLED FILTER)**
  HPF CUT OFF (40Hz - 5KHz) 1
  KYBD FOLLOW (10%, 40%, 70%, 100%)
- **LFO (LOW FREQUENCY OSCILLATOR)**
  LFO RATE (OVER 0.1 Hz - 80Hz) 1
- **ENVELOPE GENERATOR**
  (ENVELOPE GENERATOR) for the VCF, VCA 2
  ATTACK TIME (0.6 ms - 3 Sec)
  DECAY TIME (14 ms - 10 Sec)
  SUSTAIN LEVEL (0 - 100%)
  RELEASE TIME (14 ms - 10 Sec)
- **TRIGGER**
  TRIGGER RATE (1Hz - 25 Hz) 1
- **DELAY / BEND**
  DELAY TIME (0 - 10 Sec) 1

FIRST READ
PP. 12-2 &
16-2
INFORMATION
ON
DESIGN CHANGES

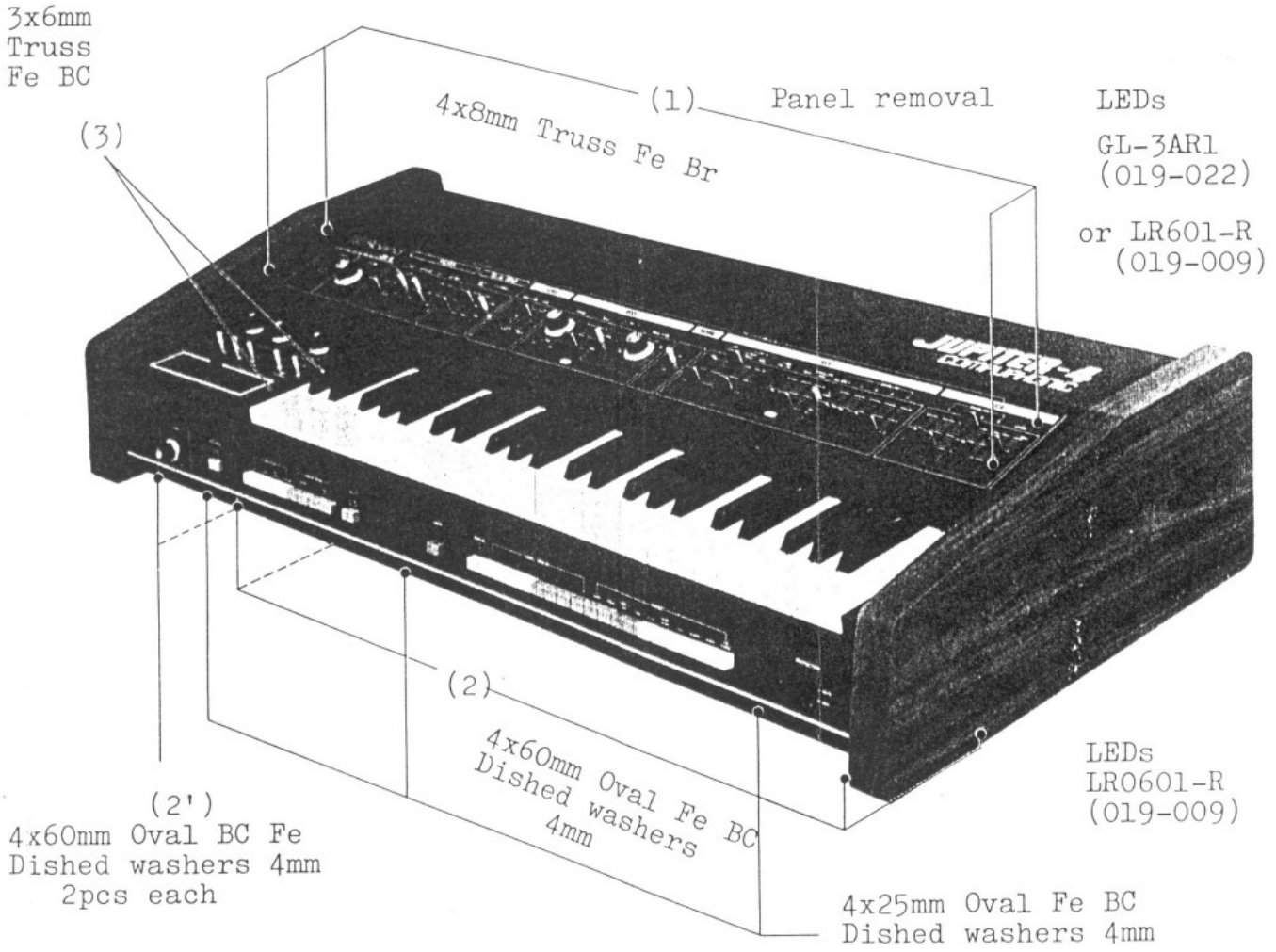
- **CONTROLLER**
  PORTAMENTO (1 sec/8va.) 1
  TRANSPOSE (NORMAL - 1 Oct. DOWN) 1
  VCO : over ± 1 Oct.
  VCF over ± 2 Oct. (RESONANCE PITCH)
  VCA : over ± 12 dB
- **TUNING (± 50 cent. ± 1%)** 1
- **CONNECTION JACKS**
  OUTPUT JACK
  (MONO, STEREO) 2
  OUTPUT LEVEL SELECTION SWITCH
  (AVERAGE 0 dB at position H) 1
  HEADPHONE JACK
  (stereo) 1

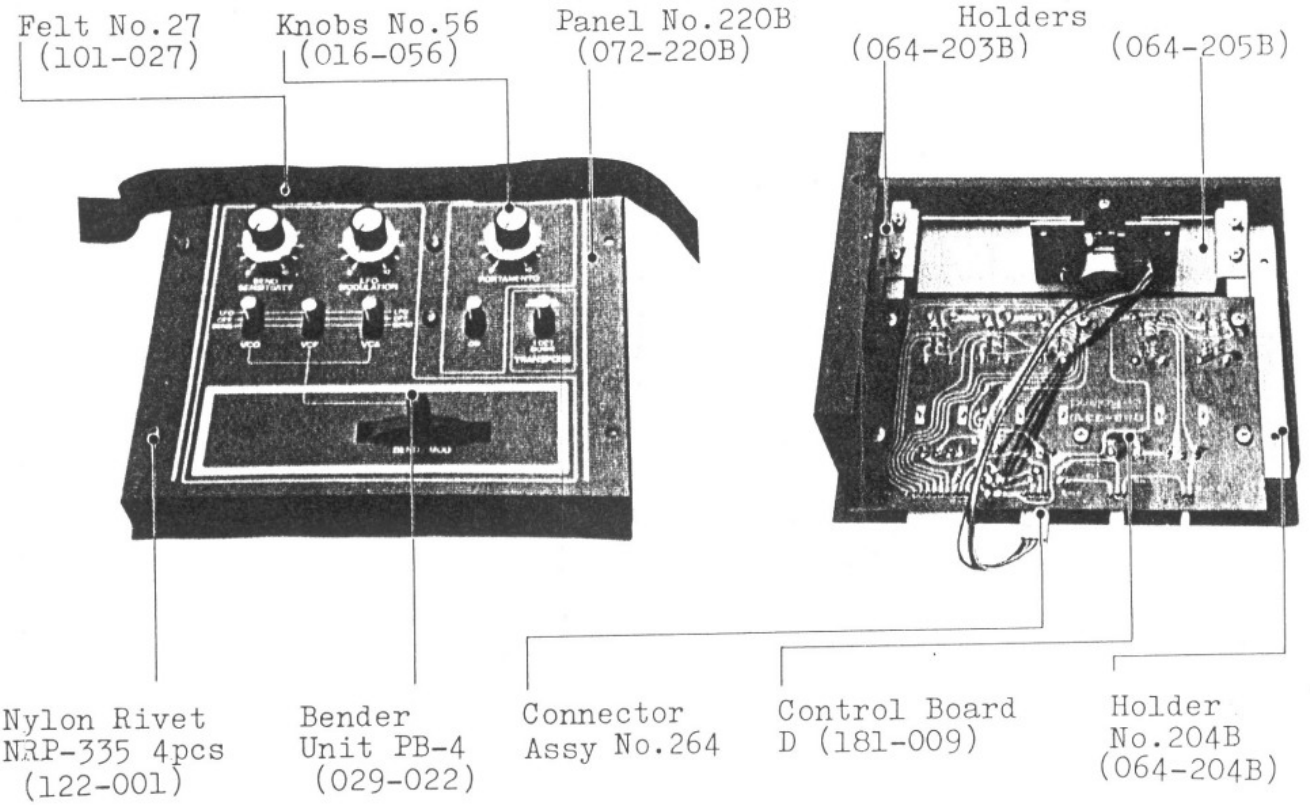
EXTERNAL CONTROL JACK 4
DAMPER (DP-1), VCF, (FV-2)
EXP. (FV-2: 0 ~ -30 dB)
EXTERNAL CLOCK (OFF: ov/on : min. + 1 V pulse)

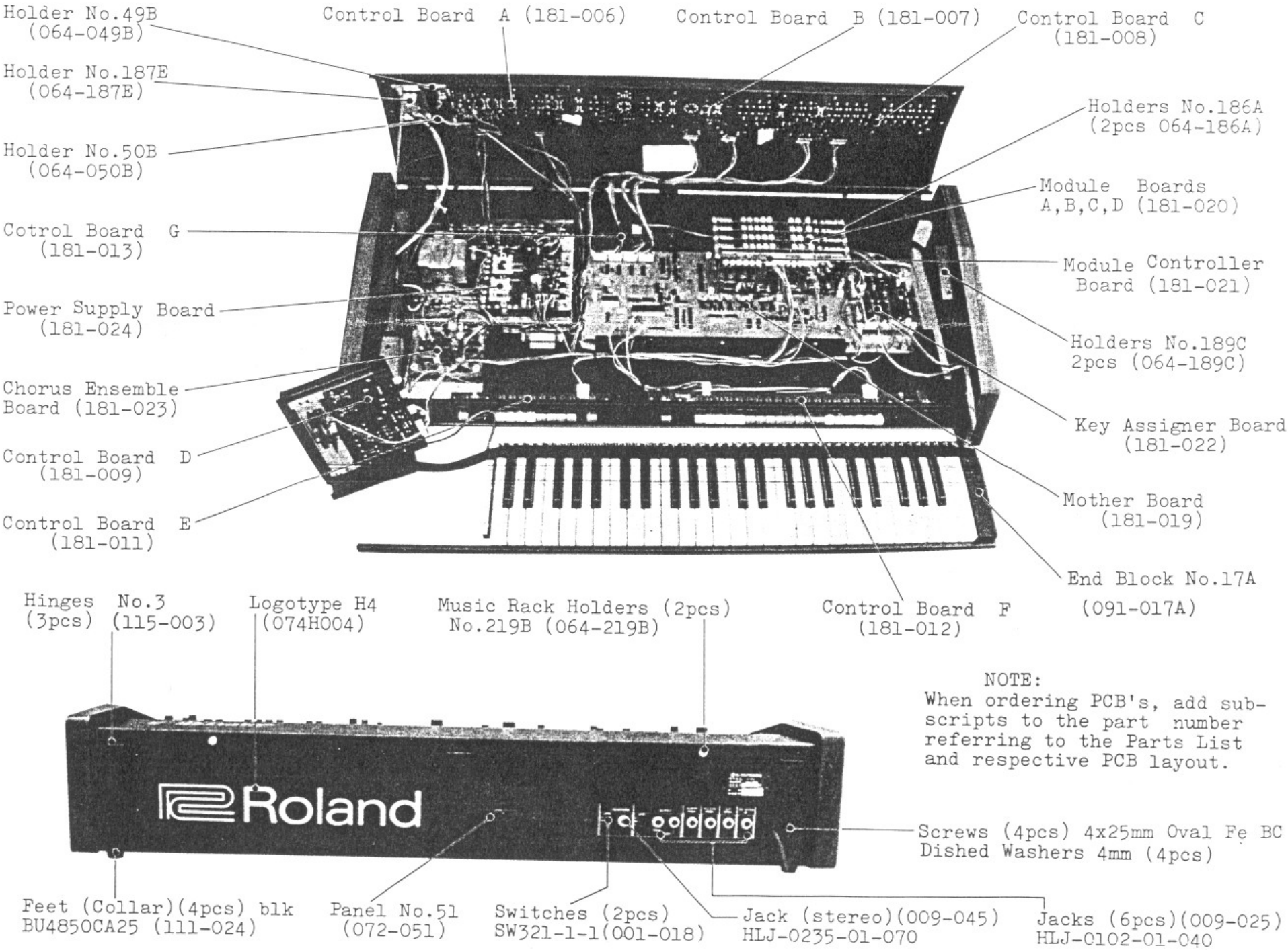
POWER REQUIREMENTS 30W
OVERALL SIZE ..... 946 (W) ×410 (D) ×179 (H) mm
NET WEIGHT 19kg
ACCESSORIES. 2.5m hookup cords : 2



Screws (2), (2'): Keyboard and Left control unit removal
For only Left control unit removal: Screws (2'), (3)

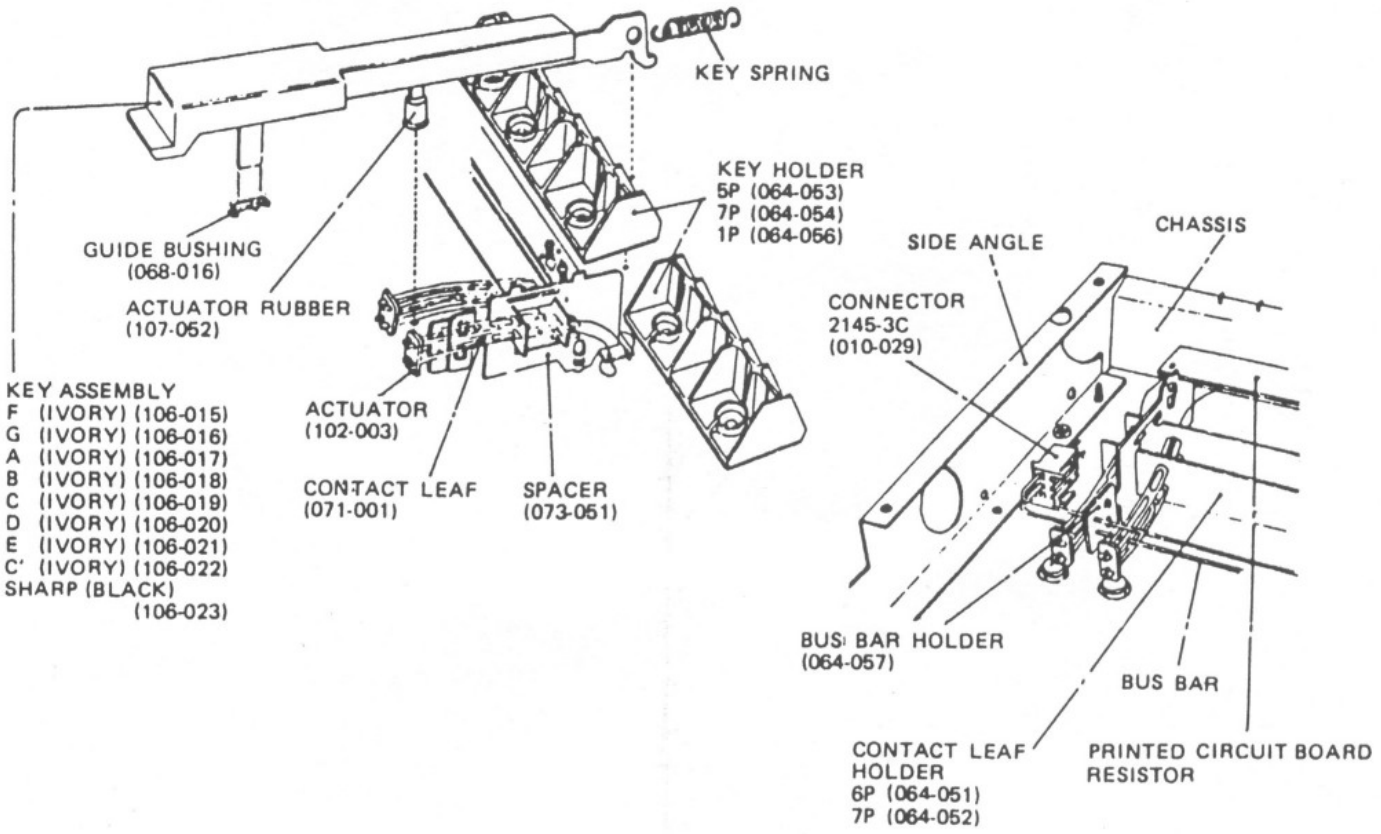






NOTE:
When ordering PCB's, add sub-scripts to the part number referring to the Parts List and respective PCB layout.

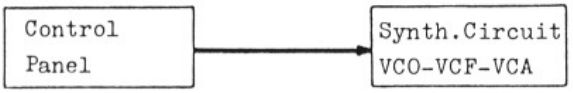
KEYBOARD PARTS



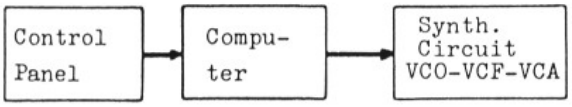
INSTRUMENT MODEL	NO. OF KEYS	KEYBOARD MODEL	KEY SPRING	BUS BAR	PCB		RESISTOR
					6P	7P	
SH-1	32	SK-132-D	070-052	071H034	052-066	052-067	100 1/4W ±1% CRB1/4FX
SH-3A	44	SK-142-A	070-052	071-008	052-066	052-067	100 1/4W ±1% CRB1/4FX
SH-5	44	SK-142-B	070-052	071-008	052-066	052-067	100 1/4W ±1% CRB1/4FX
SH-7	44	SK-142-C	070-052	071-008	052-066	052-067	100 1/4W ±1% CRB1/4FX
JP-4	44	SK-191A	070-052	1P 072H042 8P 072H036A	1P H112	8P H117	Diodes 1S1588
SYSTEM-100	37	SK-132-C	070-052	071-006	052-066	052-067	100 1/4W ±1% CRB1/4FX
SYSTEM-700	61	SK-162-C	070-058	071-007	052-066	052-067	100 1/4W ±1% CRA1/4FX
RS-09	44	SK-141-A	070-058	071-007	052-081	052-082	
RS-101	61	SK-161-A	070-058	071-007	052-081	052-082	
RS-202	61	SK-161-A	070-058	071-007	052-081	052-082	
RS-505	49	SK-192-A	070-058	071H043	052-081	052-082	
EP-10	61	SK-162-A	070-058	071-007			
EP-20	61	SK-162-A	070-058	071-007			
EP-30	61	SK-162B	070-058	071-007	052-081	052-082	

CIRCUIT DESCRIPTION

What is Compu-Phonic Synthesizer ?
(Features of Compu-Phonic Synthesizer)



Conventional Synthesizer



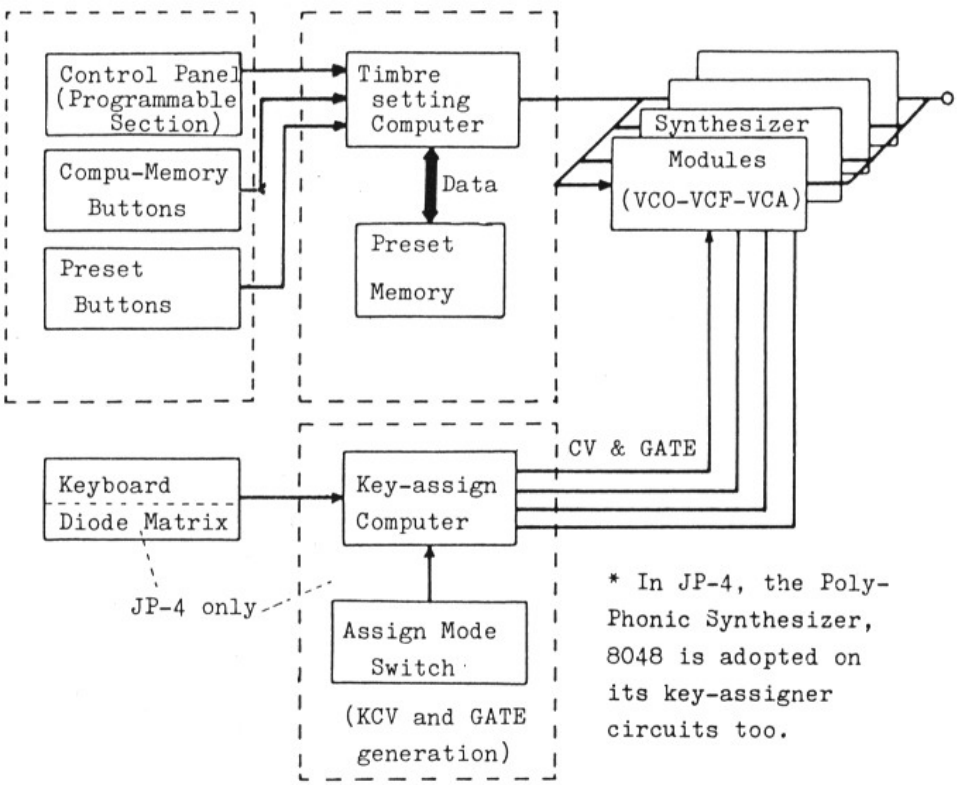
Compu-phonic Synthesizer

1. Operational Principle:

In the conventional synthesizer, the circuits (VCO, VCF, VCA, etc.) are directly controlled from the control panel.
In the compu-phonic synthesizer, it is the computer that comes in between and provides control voltages suitable to those VCO, VCF, VCA, ENV GEN, etc.

2. Hardware:

Compu-Phonic Synthesizer is composed of the "Synthesizer Control Circuits" with μPD8048 as its central point and the "synthesizer circuits" which are fully controlled by voltage.



* In JP-4, the Poly-Phonic Synthesizer, 8048 is adopted on its key-assigner circuits too.

2-1. Control Section:
- Switches and Sliders -

Sliders and switches on the control panel are now not for the production of the synthesizer control signals directly, such as the production of the time constants, ON/OFF switching, etc. They now serve only to letting the computer know of their positions or the states as they are put on the Control Panel.

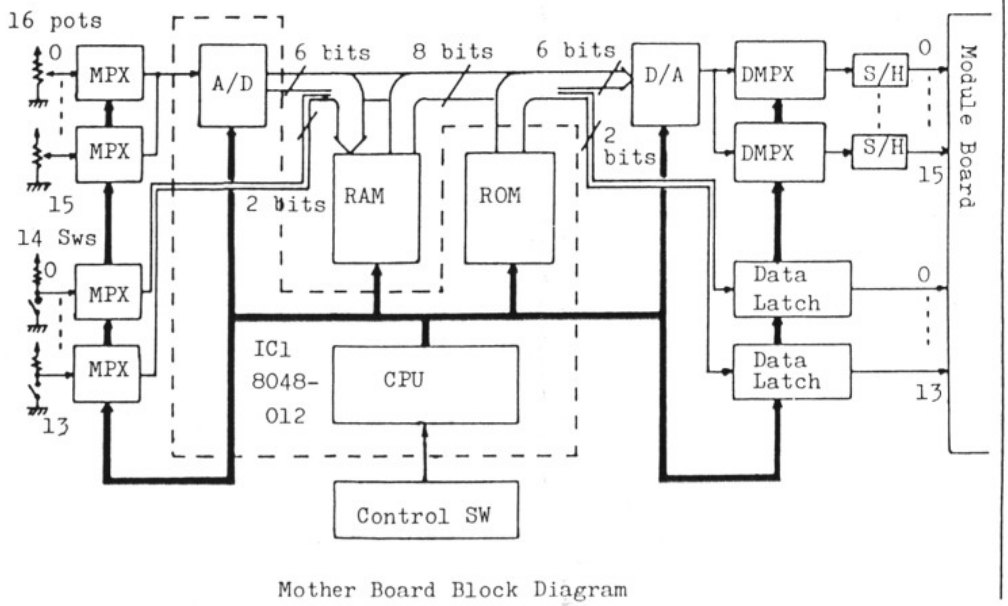
2-2. Voltage Controlled Synthesizer Circuits:

Such parameters as the time constant, ON/OFF switching, or their signal levels, etc. have so far been produced on the control panel there are sliders and switches to obtain directly of such.

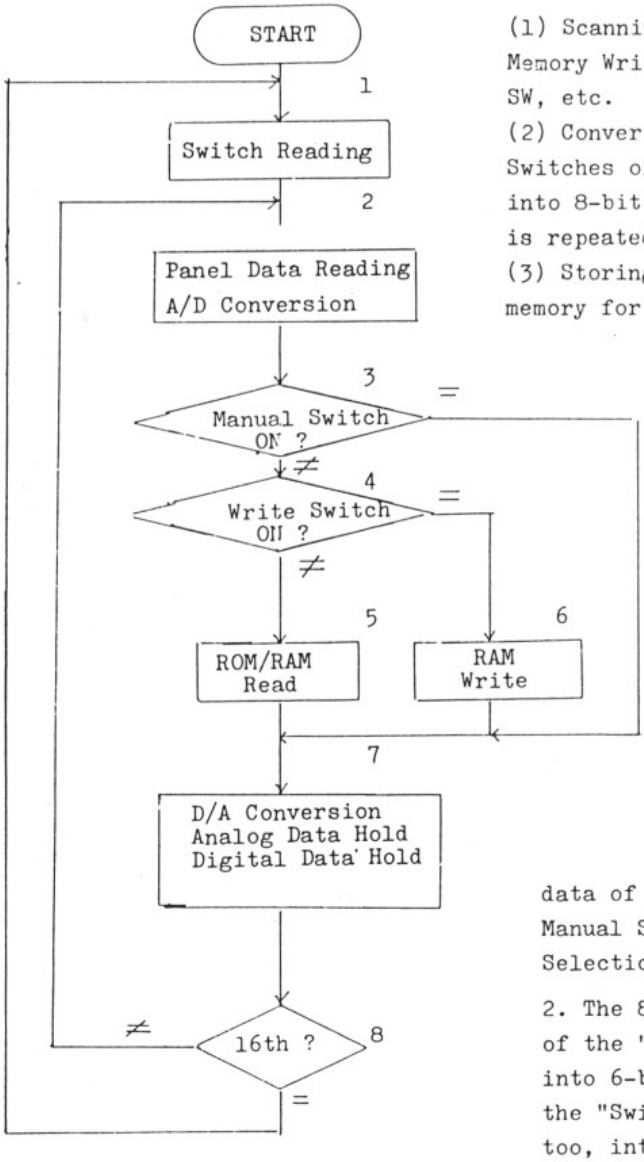
These are, however, now produced by the computer's internal circuits, and the synthesizer circuits are under fully voltage controlled, programed and/or given by the computer, with self-contained transconductance amps or analog switches, etc. However, the circuit and function themselves of VCO, VCF, VCA etc. of the synthesizer's main circuits are just as the same as before with those on the conventional synthesizer.

Function of Mother Board

In the Mother Board included are the microcomputer 8048-012 and its perpheral circuits. (refer to the General Block Diagram when reading the following)



Mother Board Block Diagram



8048-012 Flow Chart

(JP-4, PROMARS)

(1) Scanning of all the switches on the Control Panle such as Memory Write SW, Manual SW, Compu-Memory SW, Pre-Set Selection SW, etc.

(2) Converting the Analog signals obtanined from Sliders and Switches of the Programmable Section on the Control Panel, into 8-bit digital data (A/D conversion). (This data reading is repeated 16 divided times to complete them all).

(3) Storing these A/D converted data of the POTs and SWs into memory for use afterward upon retrieval.

(4) Converting back again these digital data into analog voltage (D/A conversion) to send them out into Synthesizer Modules.

All these functions stated above are performed under the control of 8048-012.

-Functions of 8048-012-
(Tone color setting controller)

These operations of 8048-012 are shown in the flow chart. The 8048-012 repeats such flow chart cycle.
The following numbers refer to those in flow-chart.

1. When the power is turned on, 8048-012 starts its reading and puts into memory the data of the positions it reads of Memory Write Switch, Manual Switch, Compu-Memory Selection Switch and Preset Selection Switch.

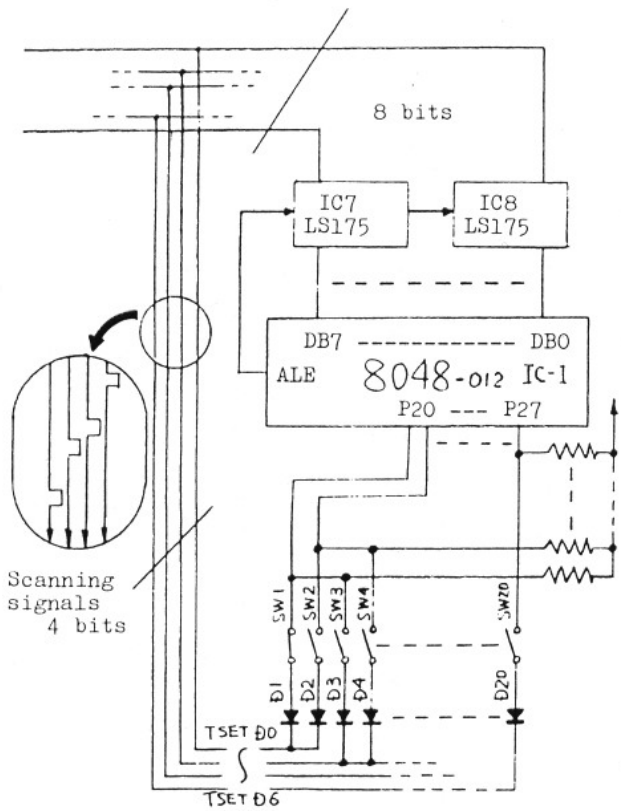
2. The 8048-012 takes in at first the voltage data of one of the "Slider pots" on the Control Panel and converts it into 6-bit digital data. At the same time, it reads out the "Switch Position" on the Control Panel and converts it, too, into 2-bit digital data. The two data thus obtained are combined to make a total 8-bit data. These are held there for a while.

3. If the MANUAL Switch was OFF at step 1, the program proceeds to step 4, or if ON, to 7. During this process, the data obtained in step 2 is maintained.

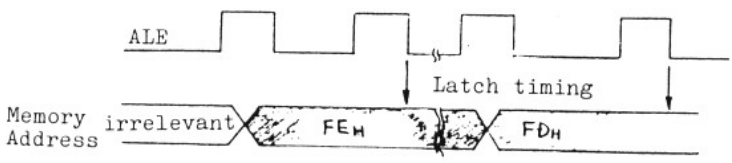
4. When the Memory Write Switch was OFF at step 1, the program goes to step 5, if ON, to to 6. The step 2 data is still maintained.

5. Based on the data being held in step 2, the 8048-012 accesses to either RAM (Random Access Memory) when a switch in Compu-Memory was pushed in, or ROM (Read Only Memory) when one of Preset Switches was in. It then reads out from the address corresponding to the switch depressed, the data to give control to the Synthesizer Modules.

6. Based on the data in step 1, it writes the data held in step 2 to RAM, selecting the address over there which is corresponding to the switch position on the COMPU-MEMORY SWs.



Switch Scanning Signal Flows



DB Data Latch Timing

7. The 8048 divides the 8-bit data (data in step 2 or data retrieved in step 5) into two formats: 2-bit switch data and 6-bit slider data. The 6-bit data then proceeds to D/A conversion. Those two signals of analog converted voltage and of switches are fed to the Module Boards.

8. The 8048 checks to see whether it completed all 16 cycles to read out all data divided into 16 at the previous stage. If all are completed it goes back to step 1. If not, to 2.

-Switch Reading-

The 8048-012 scans the matrix made of the diodes and switches on the Control Board F to find out which switch is depressed among those of WRITE through MEMORY PROTECT.

1. Diode-Switch Matrix

On the Control Board F, Switches (each accompanying diode) are grouped into 4 blocks consisting of 2 to 8 switches. These blocks are then connected through the data bus to DB0, DB3, DB4, DB6 on 8048-012. The blocks are also routed through to the pins of P20-P27 on Port 2 of 8048-012. They are then making a matrix. (refer to the Circuit Diagram, Control Board F)

2. To Scan the Switches

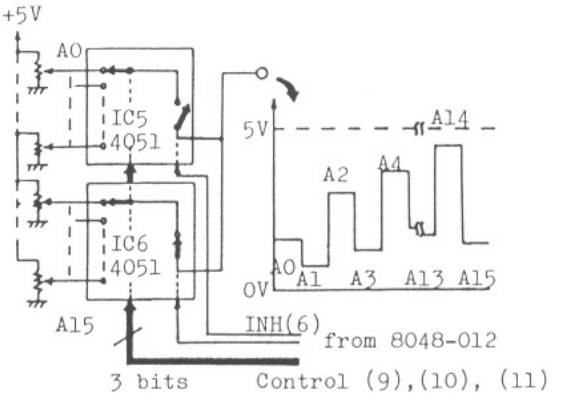
The 8048-012 outputs "L" onto DB0 alone and "H" on all other DB1-DB7. They are out on the data bus and latched on IC7, IC8, 74LS175 by the pulses from pin ALE (Address Latch Enable) to be out put onto D0-D6 of TSET. Next, 8048-012 reads the Port 2 (P20-P27). If it finds here that the P20 alone "L" while all otheres on "H", then it can know that the SW1 is on. The above process is repeated to go over all of DB0 to DB7, but four of them are connected to switches. MEMORY WRITE Switch (SW1) is so wired that it is only enabled when Compu-Memory selection switch is ON with the PROTECTION switch (SW21) being depressed at the same time.

(see circuit diagram, CONTROL BOARD F)

- Reading of CONTROL PANEL -
The PROGRAMMABLE SECTION

The 8048-012 reads the patching on the Control Panel and converts them into digital data of 16 bytes. (1byte = 8 bits)

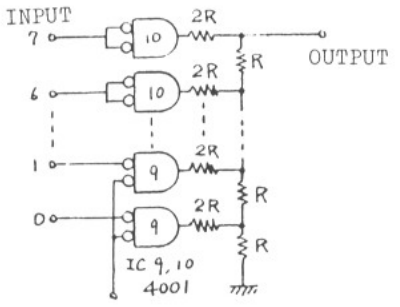
Of the Control Panel, the section named "PROGRAMMABLE" consists of 16 pots and 14 switches, these 16 pots produce 16 different kinds of analog voltage varying between OV to 5V. The 14 SWs, on the other hand, produce binary digital data of "H" or "L", given by +5V or OV, respectively. The 16 analog voltages that come in parallel to each other are re-arranged thru the analog multiplexer(MPX) IC5, IC6 4051, to be put on a single line in time sequence.
These outputs of the MPX go into the A/D converter (will be described later) to become 6-bit data of 16 kinds.
The 14 binary data of the switches are also re-arranged into 2 groups of 7 kinds (total 14) with each group entering each respective MPX IC3, IC4 where they are made to 2-bit data and be output fron there in time sequence as above. These 6-bit and 2-bit data are combined to become an 8-bit data. That is to say, that, the patching first made on the Control Panel are become to be represented by all digital data of 16 bytes in all. (refer to Memory Map on page 13)



Multiplexer

IC5, IC6, 4051 can be regarded as the same to a rotary switch provided with one more switch on itself as shown above.
Port 1 of 8048 outputs both the Address signal (Control A, B, C, Pins 9, 10, 11), which also serves as switch for 4051 itself for INPUT/OUTPUT Address data, and Chip Enable Signal (INH, Pin 6).
(There are 4 of 4051. Pins 9, 10, 11 of all four are connected through the same lines)

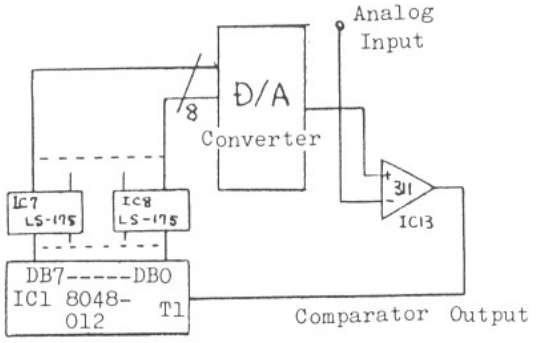
- D/A and A/D Conversion -



D/A Converter

1. D/A Converter

The D/A Converter used on the Mother Board is the one called "R-2R type". The converter here is only making use of higher significant 6 bits among those of 8 bits given here, leaving the least significant 2 bits unused.

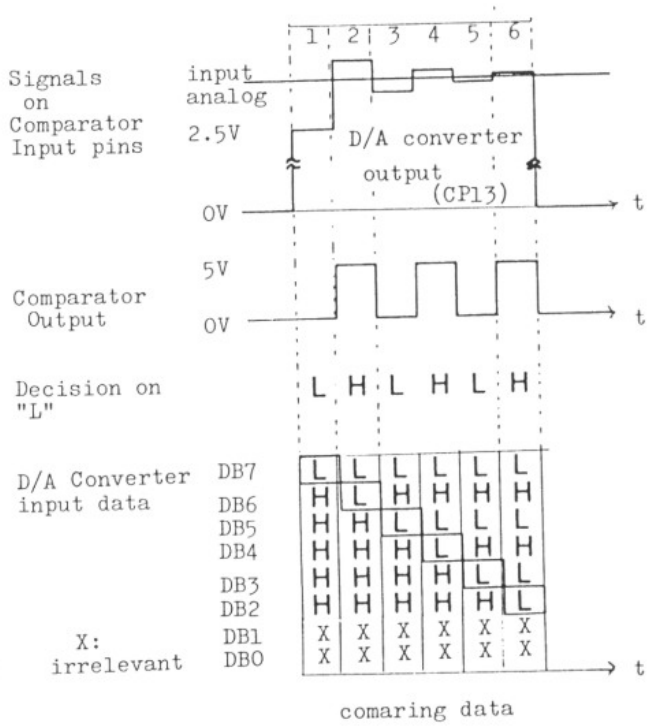


A/D Converter

2. A/D Converter

The A/D Converter on the Mother Board is referred to as " Successive Approximation Type Converter" which make use of the D/A converter and a comparator.
To proceed on with conversion, 8048-012 starts deciding the data at first for the most significant bit, then down to those lesser significant bits.
IC9, IC10 serve as an inverter, making the input to follow negative logic. The output is +5V maximum, therefore, when it receives the input LLLLLLXX, or OV minimum when HHHHHHXX.
(XX are for those least significant bits that are made nil.)

(Numbers 1-6 below in this section refer to those at top in figure right)
The 8048-012 tries at first putting DB7 to "L", thus making the digital data at first to LHHHHHHXX, tentatively. These are latched on LS175 by the pulse from ALE pin, then out onto the D/A converter. On the one hand, 8048-012 reads the output level of the comparator, IC13 311, through T1 pin.
It makes comparison between these two, of the A/D input and of D/A converted output to LHHHHHHXX (= 2.5V). If the A/D input is to be as shown in figure (a straight line a little over 2.5V), the comparator finds that the D/A converted output LHHHHHHXX(2.5V) is less than that of A/D input. It is to instruct 8048 to decide that the "L" previously put on tentative base can be firm so that "L" is to remain on DB7 hereafter. Now, 8048 turns to DB6 in putting here again "L" tentatively, to output LLHHHHHXX. With this data, the D/A output becomes higher than the A/D input as in step 2 on figure. It makes the output of the comparator 311 turn to "H". That means, that 8048 has now to decide that DB6 in "L" is too large, so it must be reset back to H again. The same process continues through the lesser significant bits, as on step 3-6 on figure.

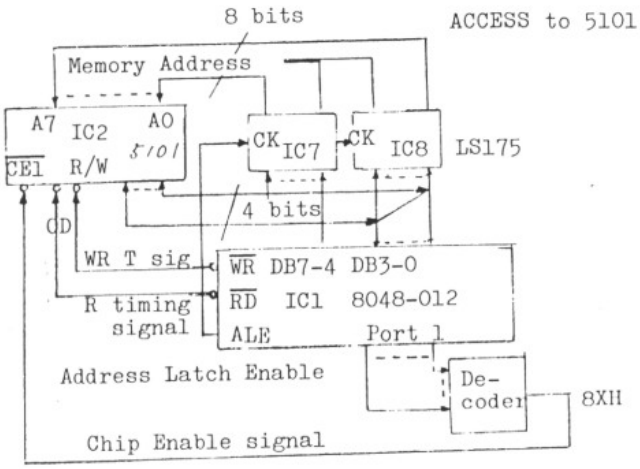


Input:Data Comparison

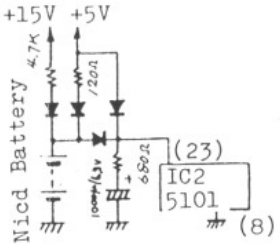
Each time, the D/A output approaches successively nearest to the A/D input voltage. And finaly, when 8048 completes them all for DB7 to DB2 for bits, it has decided the data on the nearest approximation to be equal to that of input of the A/D converter.

- Memory -

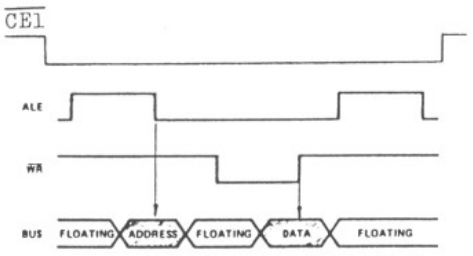
Here provided on this Compu-Phonic Synthesizer are "CMOS RAM", IC2, 5101 for memory of the tone color (timbre) data to be used on Compu-Memory and ROM which resides in 8048-012 for use on PRESET mode.



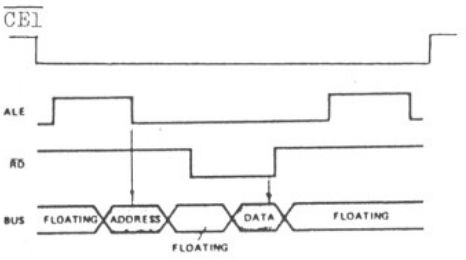
8048-012 outputs from Port 1 the address data to turn the Chip Enable (CE1) to "L" on 5101. Then, 8048-012 outputs the pulses from ALE pin to make LS175 (IC7, IC8) latch the data and define the memory address upon 5101. While the memory address being defined by LS175, 8048-012 outputs onto DB0 to DB3 the data to be written. These data are then written onto 5101 by turning $\overline{WR}$ to "L", and are read by 8048 through DB0 to DB4 when $\overline{RD}$ is "L". The digital data on the Control panel are 8 bits format.
However, when made access to 5101, they are divided into 2 by 8048-012. (Because 5101 handles 4-bit quantities.)
5101 is backed up by the NiCd battery for protection of its memory. The NiCd battery will be fully recharged for more than 48 hours.
The memory on 5101 are also protected for an hour by the electrolytic capacitor (1000mfd 6.3V) just in case when the battery is removed for replacement or other.



DC Supply for 5101



WRITE TO EXTERNAL DATA MEMORY



READ FROM EXTERNAL DATA MEMORY

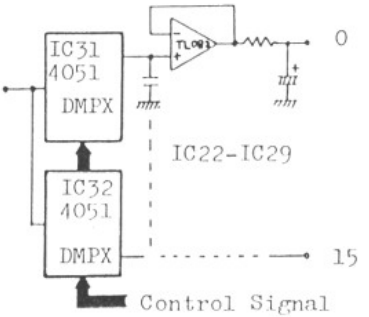
5101 READ/WRITE CYCLE

-- GENERATION of CONTROL SIGNALS to MODULE BOARD(S) --

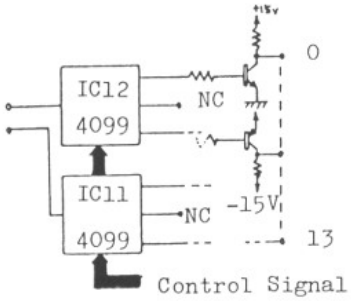
The control data that were A/D converted to 8-bit digital data are re-converted to 16 kinds of analog voltages and 14 kinds of binary signals before they are sent to the Module Board(s).

1. The 8048-012 reads out these digital data of 16 bytes successively from RAM or ROM. Upper 6 bits (DB7 to DB2) among them are made to analog voltage thru D/A converter and are put on a single line in time sequence and are sent to 16-output analog demultiplexer, DMPX IC31, IC32, 4051.

DMPX here is to separate the input data into 16 at the control signals from 8048-012 (IC31, 32, pins 6, 9, 10, 11). They are held at TL082, IC22 through IC29 to be sent out to the Module Controller and the Module Board.



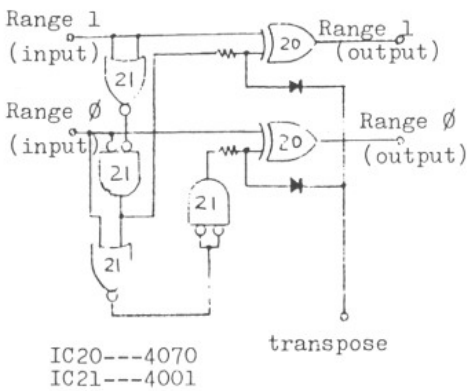
DMPX & HOLD circuits



Level Shift Circuits

2. The lower 2 bits data, DB1, DB0 are fed in time sequence to the input pin of each respective address data latch 4099, IC11, IC12. The two 4099s latch them in separate 7 groups under the control signals from 8048-012 (to pins 4, 5, 6, 7).
The outputs of 14 kinds go into the level shift circuit following 4099 where they are shifted into levels each suitable for the purpose to each. (Section surrounding Q3-Q14.)

3. Of the 14, those of VCO-WAVE 1, Ø and LFO-WAVE 1, Ø are fed to the Wave form selector, IC19, IC20 and LFO Select Decoder, IC33, IC34 to receive each respective decoding. VCO-RANGE 1, Ø go into Transpose Subtractor where the contents of the 2-bit data of RANGE 1, Ø are converted when the Transpose Input is turned to "L" Refer to Table for what conversion is meant on this transpose. In effect, it is to go down by 1 octave on VCO range as shown by arrows. Thus, the Switch control signals in 14 kinds become to control the Module Boards after passing through these circuits as above.



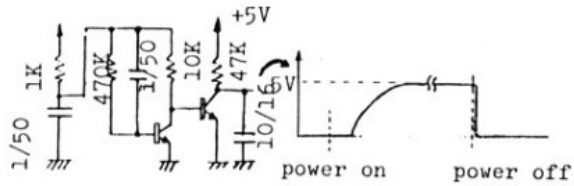
Transpose Subtractor

Transpose by the Subtractor

TRANSPOSE	H ⟷ L			
	RANGE 1	RANGE Ø	RANGE 1	RANGE Ø
32'			L	L
16'	L	H	L	H
8'	H	L	H	L
4'	H	H		

- OTHERS - Reset Circuit

The circuit is to protect 8048-012 from running program inadvertently. When RESET pin 4 is turned to "L", it makes 8048-012 to reset back to the initial state. This is also connected to 8048-011 through the common line. (8048-011, JP-4 only)



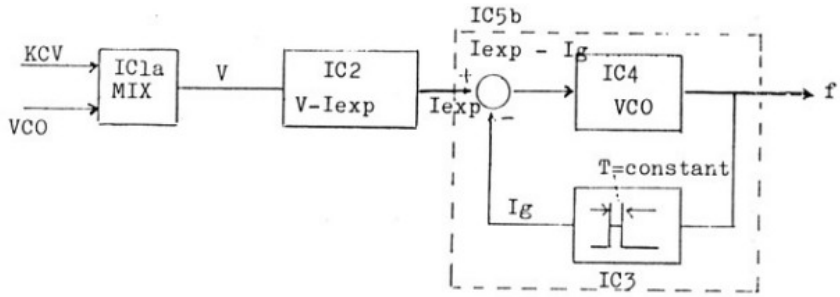
Reset Circuit

- MODULE BOARDS -

Included here are VCO, VCF, VCA and 2 ENV GENERATORS.

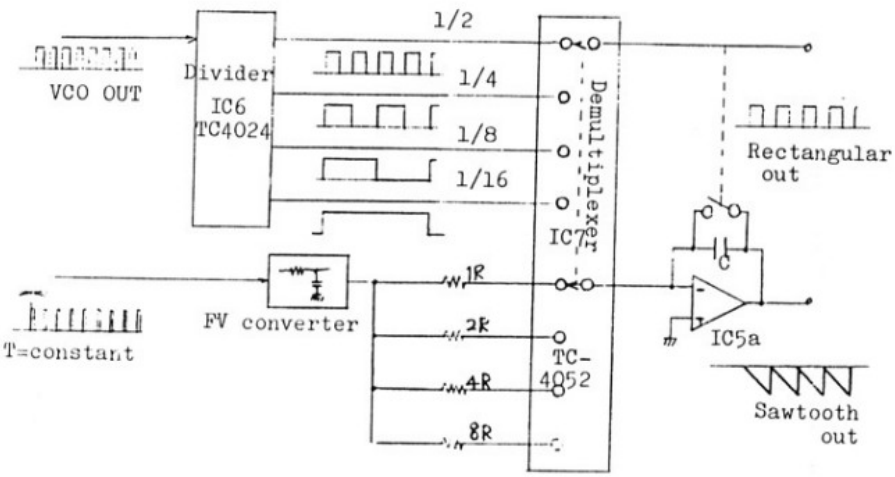
1. VCO and its Peripherals

IC1a(pin 1,2 and 3)makes the vibrato voltage VCO CONT and keyboard key voltage KCV mixed and sends them out onto the antilog transistor IC2 which outputs antilog current from pin 9. This antilog current is then compared at the Comparator IC5b(pin 5,6, 7) with the current flowing in from pin 6 of IC4 thru R118.



f-I: feedback loop

The output of the comparator IC5b is made to control the VCO generator oscillation frequency produced from IC4, Gate IC. Here, however, the VCO has to make the oscillation in such frequency that it always keeps the difference at zero in values between the current Ig from pin 6 of IC4 and the antilog current I-exp from the antilog IC2.



The VCO outputs are in the pulse form of the constant width converted by the one shot multivibrator IC3(555). It is therefore necessary to double the number of pulses if the antilog current is doubled. IC5b watches this to keep the balance at this pin 6. And, if losing the balance, it sends an additional voltage onto VCO to make it regain the balance. These are the process how to output the frequency which is antilog-proportional to the input voltage. The pulse output here is of so narrow width as yet. It is necessary therefore to provide further wave conversion.

IC6 is a frequency divider. IC7 is a multiplexer to make selection from those divided frequency,

IC5a generates sawtooth waveform synchronized to that of the selected frequency. The amplitude of the sawtooth waveform is kept constant by choosing either of R18-R24 by the multiplexer IC7 regardless of any change made at the tone feet.

On PROMARS, it has a VCO 9 Board for its 2nd VCO. This Board is in effect just as the same that the VCO section is only taken out from the Module Board stated herein.

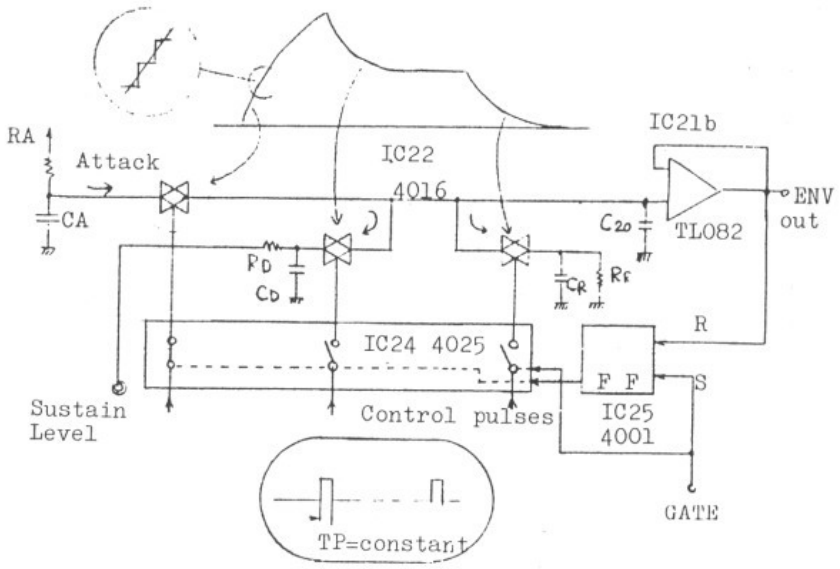
2. VCF and its Peripherals

VCF here is not much different from those on the conventional synthesizer. IC11 is the high-pass filter. IC12-IC15 are the low-pass filters. IC17 is the circuit for setting Q for the low-pass filters.

IC18 is the electronic potentiometer to control the depth of the cutoff frequency modulation. IC19 (pins 5,6,7) is the cutoff frequency control mixer. Q8 and Q9 are the antilog current generation circuit.

3. Envelope Generator

There are two Envelope Generators, one each for VCF and VCA.
They are basically the circuits to voltage-control the time or the level of A, D, S, R. Since the signals are now in the pulse form, being voltage-pulse converted on the Module Control Board, the A,D and R controls are to be achieved by controlling the number of pulses in a given time. Note that, these pulses here are of so narrow width that it may easily be lost of sight from screen on the oscilloscope if the pulse intervals were extended a little long.



IC25 is the flip-flop which inverts itself on arriving at the attack level. IC24 is the gate selecting the pulse for each of A, D, and R by the timing of the flip flop. IC22 is the analog switch which turns on only when there is a pulse arrival, thus making C20 to charge-discharge, accordingly.
On such charge/discharge, envelopes are developed. The envelopes from C20 are fed through buffer IC21 to obtaine low output impedance.

- MODULE CONTROLLER -

Module Controller Board is to control those on Module Board as follows:

- VCO modulation
- VCF modulation
- VCA modulation
- Generation of the clock signals to control ENV GEN.
- Cutoff frequency of HPF
- Pulse width modulation of VCO

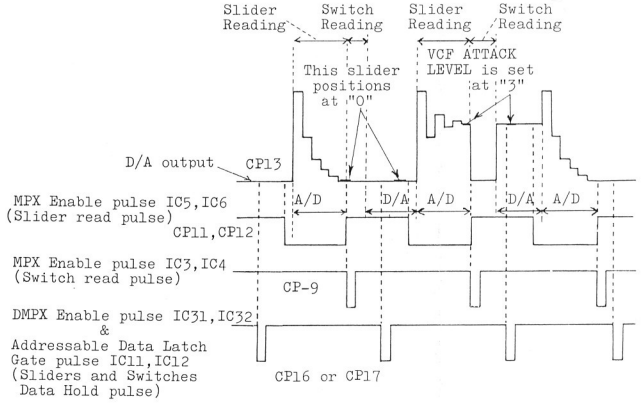
The Module Controller performs these functions by converting the control signals fed from the Mother Board or those fed from the Bender Board into such signals to suit for controlling the modules.
Here also included are the Noise Generator and LFO Delay Circuit.

RANGE 1
VCO WAVE 1
PW 1
NC
LFO WAVE 1
SUB
KF 1
VCF POL
RANGE 1
VCO WAVE 1
PW 1
NC
RANGE Ø
VCO WAVE Ø
PW Ø
NOISE
LFO WAVE Ø
NC
KF Ø
PW/PWM
RANGE Ø
VCO WAVE Ø
PW Ø
NOISE
CP9
MPX Enable pulse
(IC3,IC4 pin 6)
H 5v
CP7
MPX output
(IC3 pin 3)
NC
NC
L 0v
14 Switches
H 5v
CP8
MPX output
(IC4 pin 3)
NC
L 0v
All sliders on the PROGRAMMABLE are
set at "0" except VCF ATTACK (at "3")
MAX 5v
CP10
MPX output (IC5, IC6 pin 3)
CP11
CP12
MPX (IC6) Enable pulse
MPX(IC5) Enable pulse
(pin 6)
16 Sliders
CP13
MAX 5V
D/A Converter
output
(IC14 pin 1)
CP16
CP17
VCO MOD
VCF LFO MOD
VCF ENV A
VCF ENV D
VCF ENV R
VCA ENV A
VCA ENV D
VCA ENV R
VCF ENV MOD
LEVEL
LFO RATE
HPF COF
VCF ENV S
VCA ENV S
VCF COF
REXONANCE

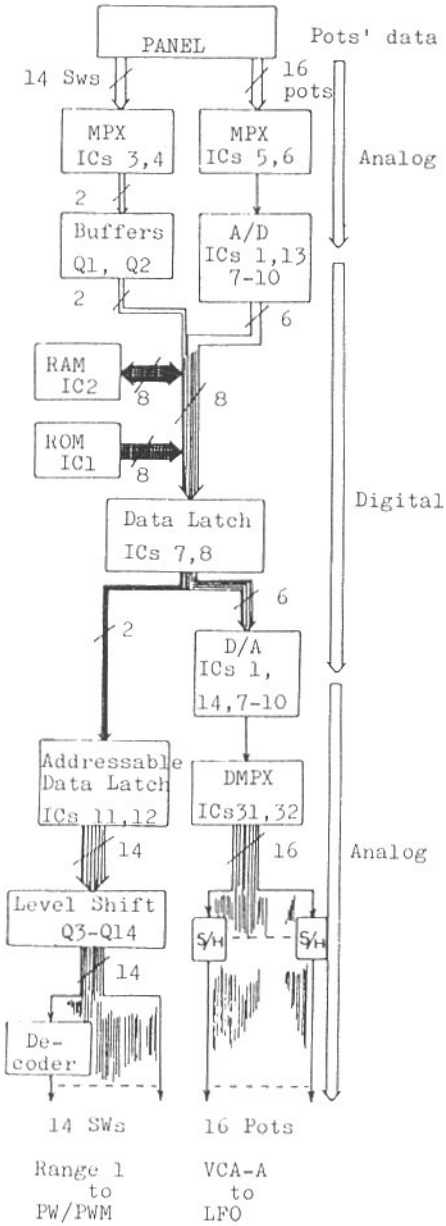
MOTHER BOARD TIMING DIAGRAM in MANUAL MODE (SLIDER/SWITCH READ/HOLD, A/D & D/A CONVERSIONS, MPX and DMPX)

Figure below is part of CP9, 11, 12, 17 and 13 at the left showing functions and timings of A/D, D/A conversions and the Switch reading.
Studing D/A conversion theory on the Mother Board by observing the converter output waveform is very helpful in understanding the operation of microcomputer 8048-012.

1. The computer 8048-012 reads Sliders set positions through A/D conversion.
2. The computer reads, between A/D and D/A conversions, Panel switches status.
3. In Manual Mode, at CP13, final of A/D and D/A outputs are equal in level. This means that Panel Data are fed into Synthesizer Modules as they are. However, in other modes, A/D and D/A show different values because they are out of relation to each other, D/A converter transforms digital data from the memory.
4. During D/A conversion, sliders data being D/A converted from 6-bit format and switch data from 2-bit format are held (latched) and output to the synthesizer modules.



Signals Flow Diagram on the Mother Board

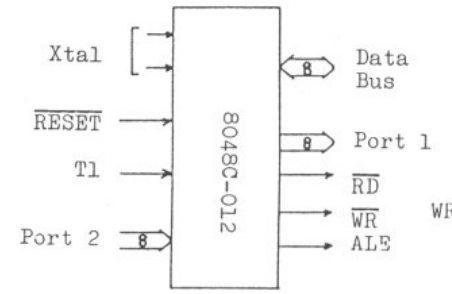


Indicate Data Flows from the Control Panel. Will be output to the Synthesizer Modules only in Manual Mode.

Show Data to/from the Memories in Compu-Memory and Preset Modes.
Will not be output to the Synthesizer Modules in Manual Mode.

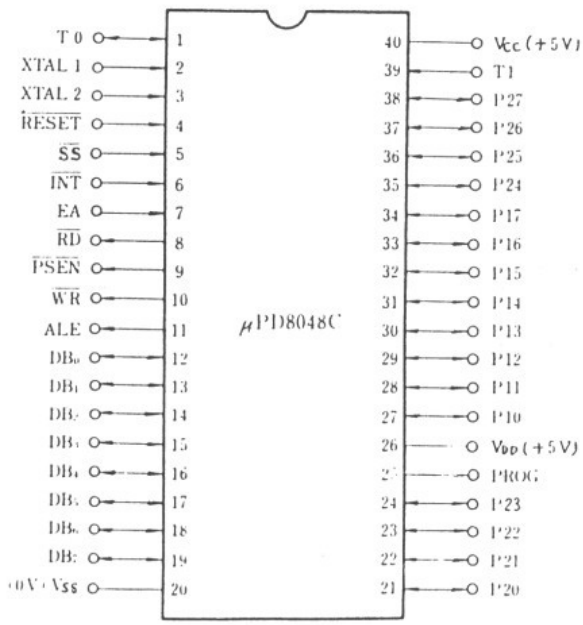
Common lines for the data from the Control Panel and the Memories.

DESIGNATION		PIN NO.	FUNCTION
DB (Data Bus)	DB0	12	Panel Switches Data / Panel Sliders Data → Push Switches Scanning → RAM address → Sliders and Switches Data during RAM address
	1	13	
	2	14	
	3	15	
	4	16	
	5	17	
	6	18	
	7	19	
PORT 1	P10	27	I/O address 4051: IC3-IC6, IC31-IC32 4099: IC11, IC12 5101: IC2 $\overline{CE}$ 1 select
	11	28	
	12	29	
	13	30	
	14	31	
	15	32	
	16	33	
	17	34	
PORT 2	P20	21	Switch Scan Reading Data
	21	22	
	22	23	
	23	24	
	24	35	
	25	36	
	26	37	
	27	38	
XTAL 1		2	Inputs for internal Clock Oscillator
XTAL 2		3	
RESET		4	Reset pulse input
T 1		39	Comparator output signal input during A/D conversion
$\overline{RD}$		8	Memory read timing signal output
$\overline{WR}$		10	Memory/Write timing signal output
ALE		11	DB Data latch pulse output



8048-012 Logical Symbol

(Top View)

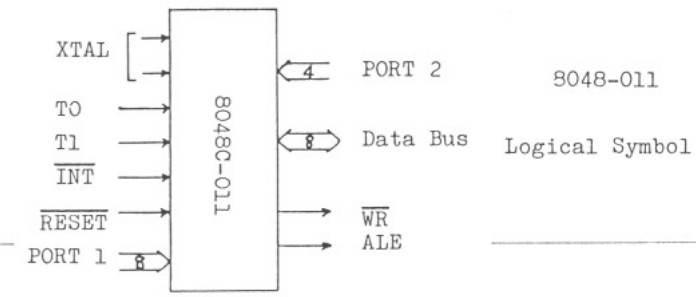


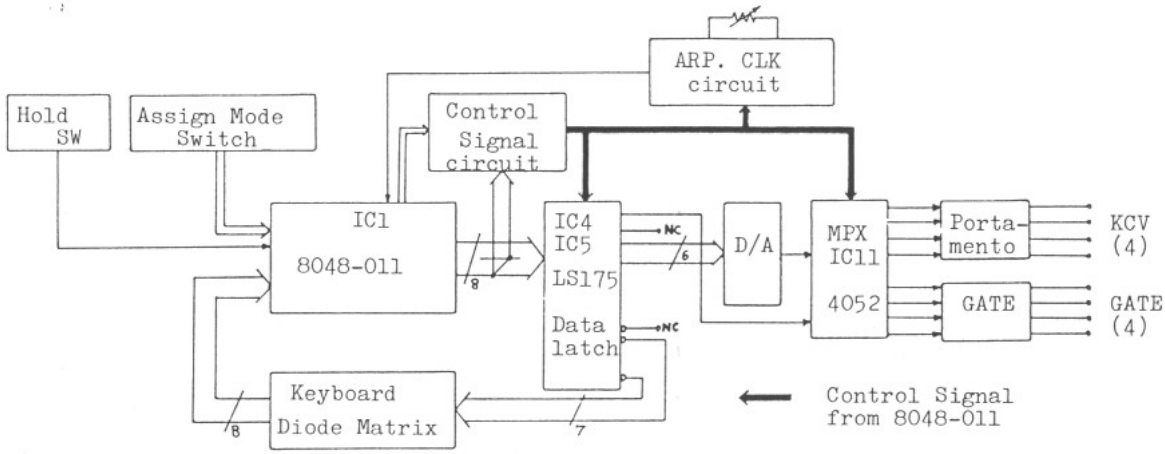
μPD8048

The μPD8048 is an 8-bit parallel computer fabricated on a single silicon chip. The 8048 contains a 1K x 8 ROM program memory, 27 I/O lines, an 8-bit timer/counter and clock circuits.

Used in the Compu-Phonic Synthesizers are μPD8048-012 and μPD-8048-011 (JP-4 only) versions in which programs and data dedicated to the Compu-Phonics are stored in the program memories.

DESIGNATION		PIN NO.	FUNCTION
DB (Data Bus)	DB0	12	Keyboard scanning data; Control data (KCV & GATE address); KCV data (during KCV & GATE address); TOTAL GATE data (during total gate address); Control data (Total GATE address); GATE data
	1	13	
	2	14	
	3	15	
	4	16	
	5	17	
	6	18	
	7	19	
PORT 1	P10	27	Keyboard scan reading data
	11	28	
	12	29	
	13	30	
	14	31	
	15	32	
	16	33	
	17	34	
PORT 2	P20	21	--------
	21	22	--------
	22	23	--------
	23	24	Key assign mode select signal input
	24	35	Arpeggio mode signal input
	25	36	Arpeggio mode signal input
	26	37	----------
	27	38	Key assign mode signal input
XTAL 1		2	Inputs for internal Clock Oscillator
XTAL 2		3	
$\overline{\text{RESET}}$		4	Reset pulse input
TO		1	Arpeggio mode select signal input
T1		39	Arpeggio CLK input
$\overline{\text{INT}}$		6	GATE Hold signal input
$\overline{\text{WR}}$		10	DB Data latch pulse output
ALE		11	Control data latch pulse output (Address)





Key assigner Board Block Diagram

- FUNCTIONS of KEY ASSIGNER BOARD -

The microcomputer 8048-011 (IC1) is a central point of the Key Assigner Circuit.

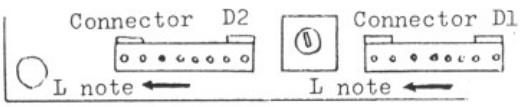
1. Main Functions of Key Assigner Board

Followings are its main functions:
(1) Scanning of the keyboard
(2) Generation of KCV and GATE signals, and assigning them to four Voice Synthesizers
(3) Generation of KCV, GATE signals for use in Arpeggio

All of those are performed under the control of 8048-011.

2. Scanning of Keyboard Data:

The 8048-011 finds out what key is depressed by scanning the keyboard. Scanning of the keyboard is done in the same manner as with the scanning of Switches by 8048-012 on the Mother Board. The latch pulses, in this case, is output from WR pin of 8048-011 to LS175.



The keyboard bus is divided into 7 sections with 8 keys per bus section except the rightmost - only one for the highest note.
Every key contacts in all of the sections are connected to Port 1. The lowest key in each section and the section which consists of only one key are connected to P10; the second keys are connected to P11, etc.
The signal flows are in the sequence to start at the connector D1 (Bus Bar) then go to D2 (key contact). Arrangements on D1 and D2 are that to go left is toward lower notes.

3. Generation of KCV and GATE Signals, and Assigning to four Voice Synthesizers:

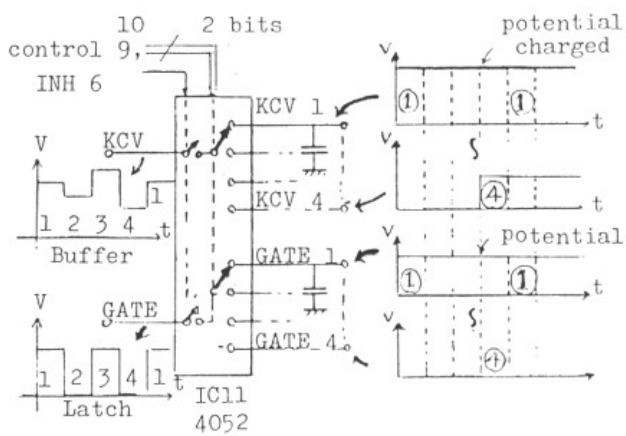
After detecting the depression on the keyboard, 8048-011 proceeds with generating KCV and GATE signals in accordance with the Assign Mode selected among the four modes provided.

8048-011 comes to know of the position of Key Assignment Mode Selector by checking whether the levels of P23 and P27 are on "H" or "L".
These 4 assign modes made by the combination ways with P23 and P27 are listed below.

		P23	P27
UNISON	1	H	L
UNISON	2	H	H
POLY	1	L	L
POLY	2	L	H

According to the turns of the key depressions, the situation of the key depressed at such particular time, and the position of the key Assignment Mode Selector, 8048-011 makes assignment of KCV and GATE signals to the 4 Module Boards.
8048-011 makes use of the 6 bits of DB0 to DB5 for KCV out and 1 bit of DB7 for GATE out. It puts them together into 1 byte format and sends it out, group by group, to the Modules, A,B,C and D in time sequence.

These digital data in 6-bit that come out of 8048-011 become analog signal voltage after D/A conversion (IC8, IC9).
The GATE signal and its associated KCV which is now analog voltage enter DMPX, IC11 4052 on the same timing. There, they are separated into four KCVs and four GATEs. Then, they are held at the capacitors connected next to the DMPX's outputs.
The capacitors are to become charged/discharged through the DMPX's internal resistance if KCV and GATE signals for the same module change.
It is because that the capacitors are in connection to the signal sources through the D/A converter's buffer and through the data latch LS175.



4. ARPEGGIO MODE:

When TO pin is turned to "L", 8048-011 becomes to Arpeggio Mode and it starts reading the levels of P24 and P25 to see whether these are on "H" or "L".

	TO	P24	P25	P23	P27
Arpeggio UP	L	L	L	L	H
Arpeggio DOWN	L	H	L	L	H
UP & DOWN	L	L	H	L	H
RANDOM	L	H	H	L	H

Arpeggio ON

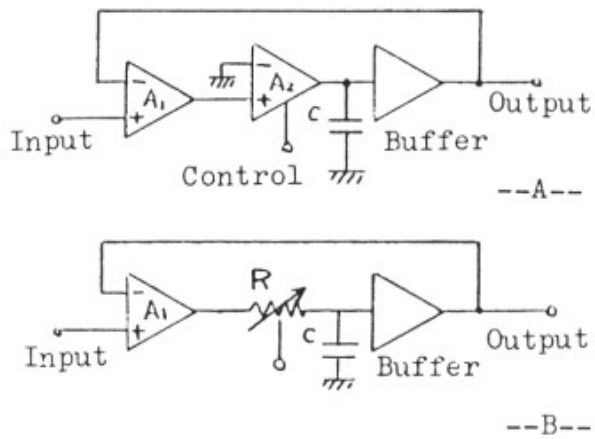
Arpeggio MODE

Key assign MODE = POLY II

When Arpeggio Selector Switch is depressed, Key Assign Mode is turned to POLY 2, too, because qf the Selector's contacts wiring (refer to Control Board F circuit diagram)

Under Arpeggio Mode, 8048-011 sends out KCV and GATE signals following the Arpeggio pattern with one note each at the rise time of the clock pulse on T1 pin.
When the mode is UP mode, KCV is output with addition of 1 volt each. Or on DOWN mode, it subtracts 1 volt each. Or with UP DOWN mode, it is with the combination of these addition and subtraction of 1 volt each. Still the other way such as that there are either the addition of 1 volt and the subtraction by 2 volts is called RANDOM mode.
(See the Owner's Manual, "Arpeggio")
The clock signals that enter T1 are generated from IC6(pin 1-6) of TC4013. These clock signals are reset by the Total Gate Signal from reset circuit of IC6 to start when a keyboard is depressed.

5. PORTAMENTO CIRCUIT:



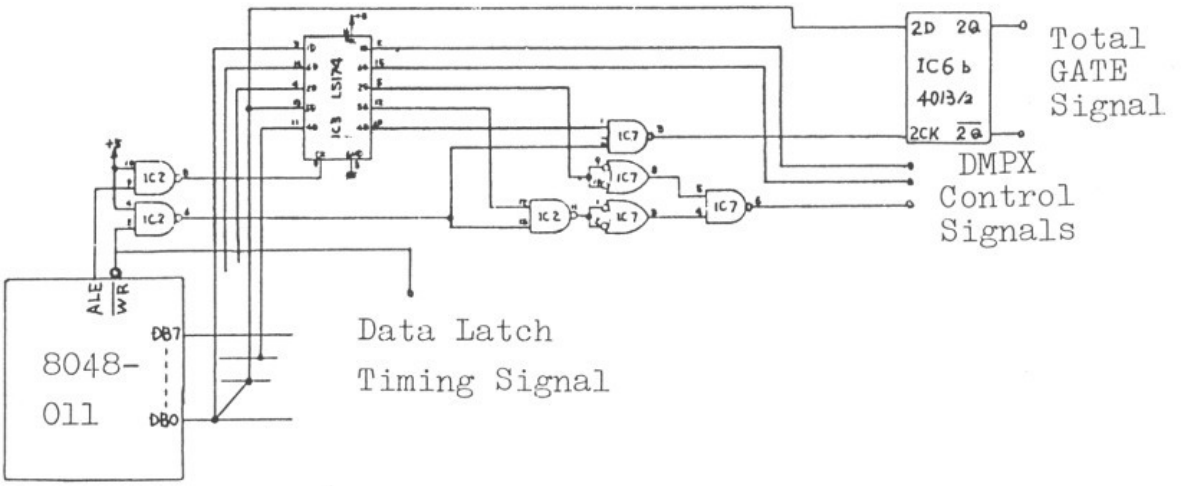
Output from the D/A converter goes through DMPX, is held at the capacitor, then applied to the portamento circuit, IC13-IC18.

Figure above represents simplified Portamento circuit.
In the figure, A2 is the transconductance amp. It can be regarded as equivalent to a variable resistor whose resistivity changes according to amout of current flow coming to control terminal.
The portamento time is decided upon the time constant consists of C and internal resistance R of A2.

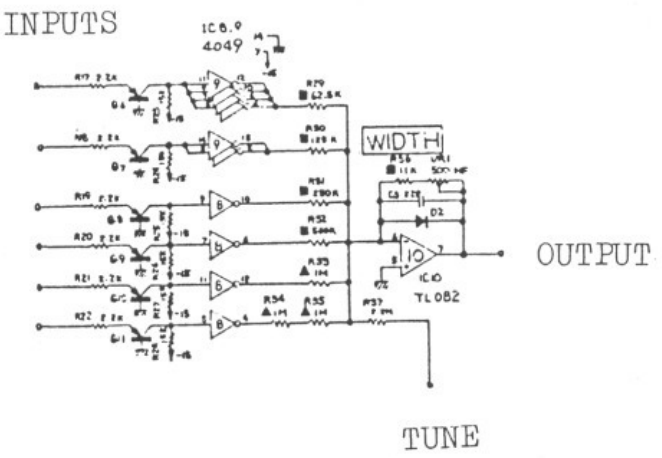
6. OTHER CIRCUITS

(1) Control Signal Circuit

This is the circuit through which the control signals to DMPX, IC11 4052 and Total Gate signals are drown out from Data Bus (DB7-DB0) as instructed by the pulses from ALE and WR pins.



(2) D/A Converter



On the Key Assigner, there is also the 6-bit D/A Converter of the type called " The current summing type".
The D/A Converter, IC8, IC9 4049 is enabled by either OV or -15V. But, the signals are either OV or +5V when they come out from the Latch output.
It therefore become necessary to have a means here of a voltage shift to make +5V and OV down to OV, -15V, respectively.
The circuits for this task are Q6 to Q11.
Also, here needs, inversely, a shift from OV, -15V to be back again to +5V, OV.
On the output buffer TL-082, IC10 this is done together with the adjustment of tuning and width.

(3) Hold Switch

To depress the Hold Switch on the JP-4 control panel is to turn the INT pin to "L". When this is done, 8048-011 is made to hold the outputs from GATE 1-4.

JP-4 ADJUSTMENT

The last page of this ADJUSTMENT has a foldout which shows location of test points.

Numbers in circle on the figures in this adjustment refer to trimmer potentiometers used for adjusting, whose designations are independent of those on circuit diagrams and PCB layouts.

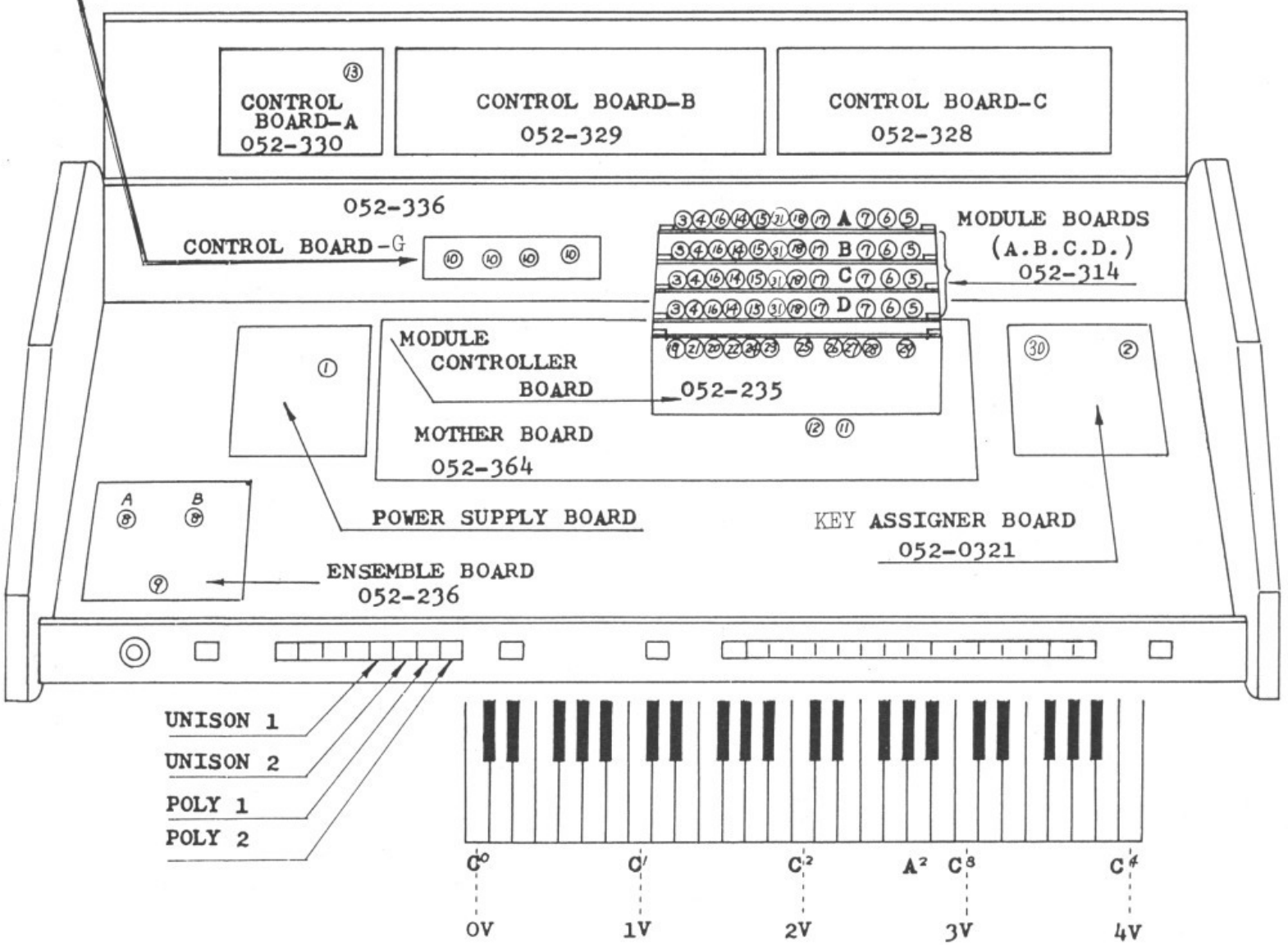
In some PCBs, exact trimmer location may differ from representaion shown below. Some PCBs have fewer preset potentiometers.

CAUTION

- Four Trimmers, CONTROL BOARD G -

Always set these trimmers at midpoint before starting adjustment of VCO.

Readjust them for fine tuning the VCOs - about an hour after the calibrated and completely reassembled unit is kept power on - to compensate for drifts in temperature surrounding IC uA726 (Module Board).

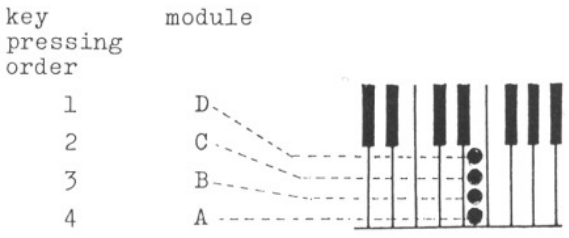


KEY DESIGNATION

KEY ASSIGN LOGIC

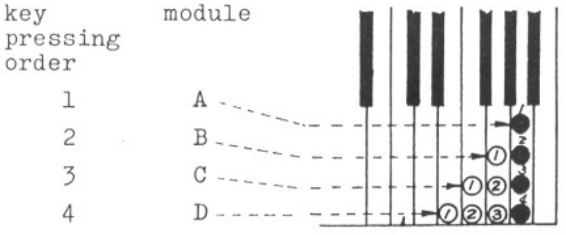
In adjusting JP-4, it is important to know which module is being activiated when a given key is pressed.

POLY-1



If one key is depressed repeatedly:
Module is changed to the next one in sequence.
After pushing ASSIGN MODE to another mode and back to POLY-1, the key first pressed will be for Module D.

POLY-2



Tapping one key never changes modules.
Plural keys must be pressed in the order of number indicated at the left before desired module is triggered(except A).

IN MODE POLY-2 PROCEED FOLLOWING ADJUSTMENTS

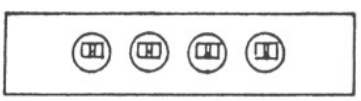
TO GET AT A TARGET MODULE Press keys to the number referring to above illustration.

MODULE A ---- press ● key
MODULE B ---- press and hold ① and ●, then release ①
MODULE C ---- press and hold ①, ②, and ●, release ① and ②
MODULE D ---- press and hold ①, ②, ③, and ●, release ①, ②, ③

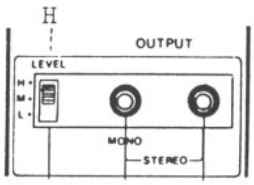
BASIC CONTROLS SETTINGS

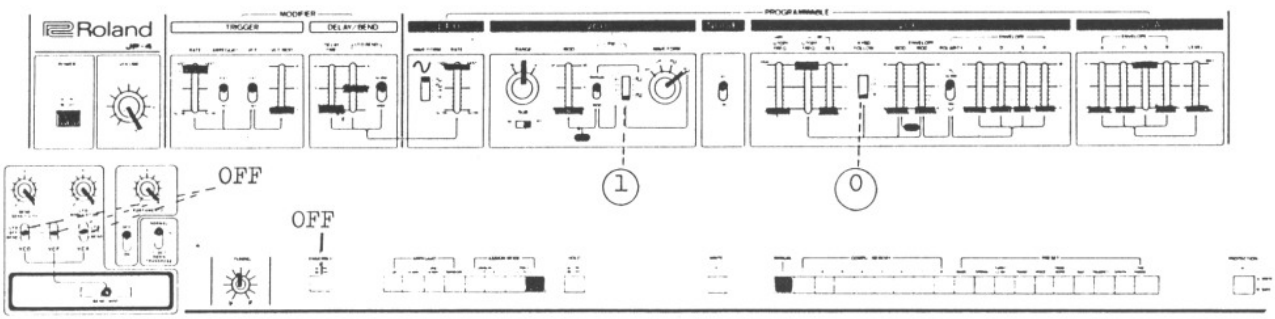
*Trimmer 31(F. INV) of Module Board 052-314E (later version,S/N xx4100-) All midpoint.

These settings allow each adjustment step to be made with minimum reset.



CONTROL BOARD-G (052-236) all pots at midpoint





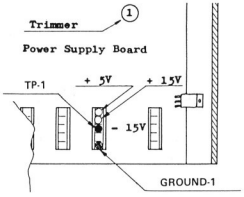
1. DC VOLTAGE (−15 Volt)

POWER SUPPLY BOARD

IMPORTANT

Checking the DC voltages is the must before attempting any adjustment.

Allow five minutes warm up for circuits stabilization



Connect Digital Voltmeter to TP-1.

1. Adjust Trimmer 1 for -15.000 ±10mV.

The remaining voltages should be:

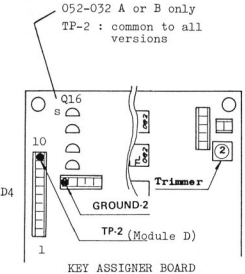
+5.000±250mV
+15.000±750mV

2. KEY ASSIGNER (CV and WIDTH)

KEY ASSIGNER BOARD

IMPORTANT!

ASSIGN MODE --- UNISON-1
PORTAMENTO ---- OFF



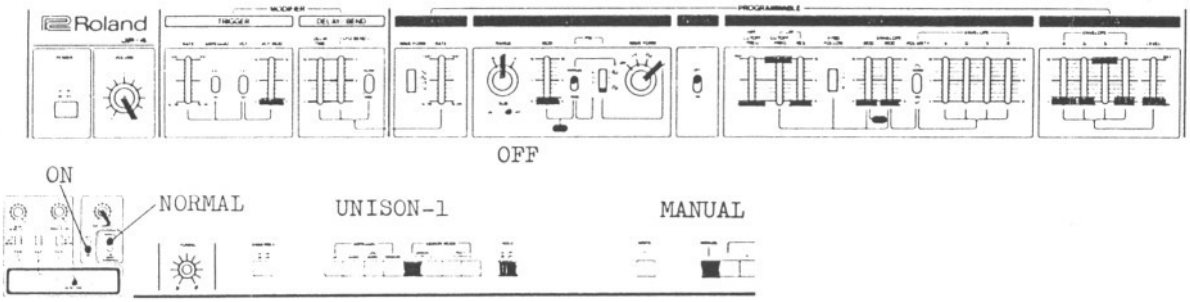
Connect digital voltmeter to TP-2 or Q16 source (A or B version).

1. Press C0 key and set TUNING on front panel for 0.000V.
2. Press C4 key. Set Trimmer 2 for 4.000±2mV.
3. Confirm:
   C1 ---- 1V
   C2 ---- 2V
   C3 ---- 3V

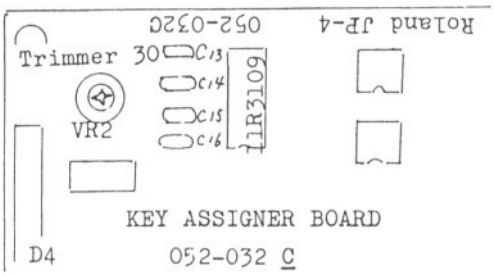
3. PORTAMENTO

Applicable to Serial Numbers 952750-952799
952850-
or PCB 052-032 C

KEY ASSIGNER BOARD



IMPORTANT! Replacement of 052-032 A or B with C necessiates change of VR3 2MA on Control Board D to 50KB to retain the time constant by compensating for difference between circuit configurations.
See p. 12-2.



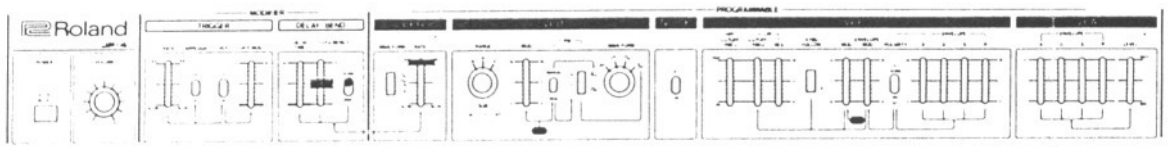
Connect amplifier/speaker to JP-4 Out jack.

1. Hold down C0 key until every note reaches the same pitch.
2. Hold down C4 key. The time required of 4 notes to become steady pitch is 4-5 sec.
3. Set trimmer 30 for spec.

If there are variations in time lapse, juggle C13-C16 respectively for synchronization.

4. LFO WAVEFORM

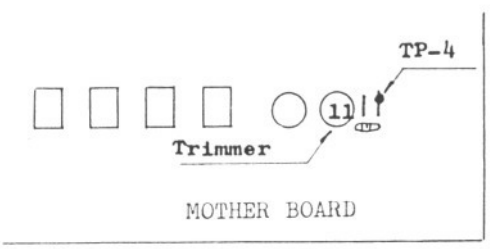
MOTHER BOARD

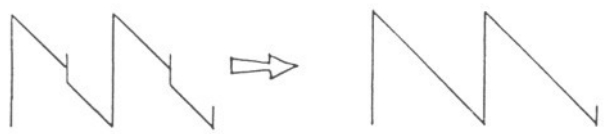


MANUAL

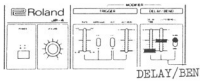
Connect oscilloscope to TP-4.

1. Adjust trimmer 11 for straightness.





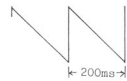
5. LFO RATE MOTHER BOARD



PRESET "VOICE"

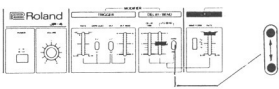
Connect scope to TP-4 on MOTHER BOARD.

1. Set trimpot 12 (Mother Bd) for 5Hz or 200ms sawtooth waveform.



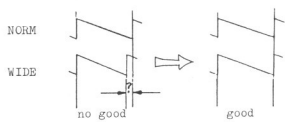
6. LFO OFFSET CONTROL BOARD A

Applicable to S/N up to 790799



Test point: TP-4 (MOTHER BOARD)

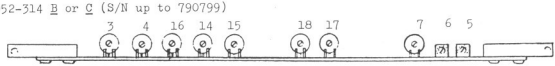
1. Set trimpot 13 on CONTROL BRD A (052-330) so that NORM-WIDE switching produces no frequency change.



TRIMPOT LOCATIONS ON MODULE BOARDS OF DIFFERENT VERSIONS

Although trimmer potentiometers on every module are arranged in the same order (except 31 on later E version), spacings are different. This difference will help when distinguish versions.

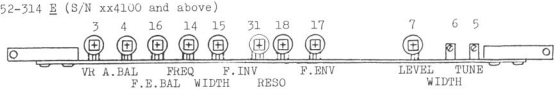
052-314 B or C (S/N up to 790799)



052-314 D (S/N 800800-942749)

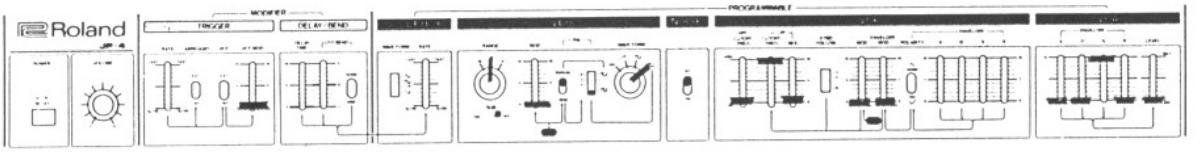
052-314 E (S/N 952750-xx4099)

052-314 E (S/N xx4100 and above)

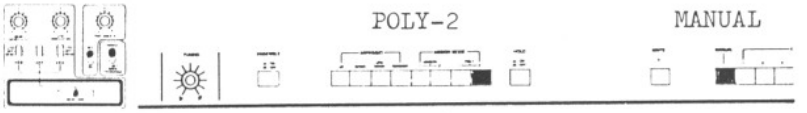


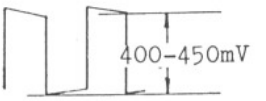
7. VCA LEVEL MOTHER BOARD

FOR TP-3 LOCATION, SEE ILLUSTRATION ABOVE SECTION 18.



OFF NORMAL

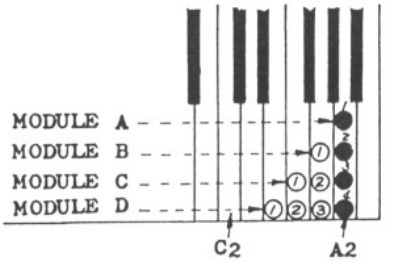




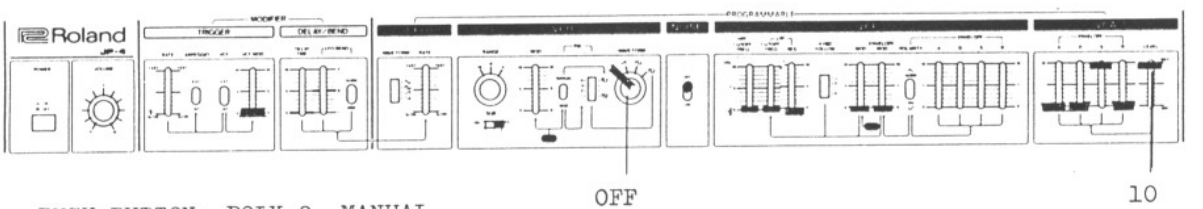
TEST POINT: TP-3 (MOTHER BOARD)

VCA LEVEL is to be determined by amplitude margin at the subsequent stages, which can be examined by playing cord with ENSEMBLE on.
Set trimmer 3 on each MODULE BOARD(A,B,C,D) for 400-450mV. Press keys as follows.

A: Press A2 key.
B: Press and hold G2 and A2, then release G2 key.
C: Press and hold F2,G2,A2, release F2 and G2.
D: E2,F2,G2 and A2, release all but A2 key.



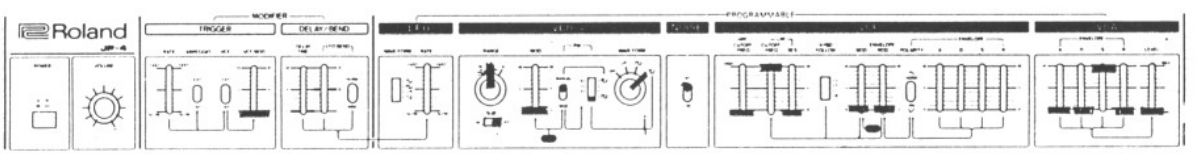
8. VCA BALANCE MOTHER BOARD

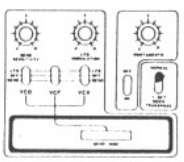


PUSH BUTTON: POLY-2, MANUAL
TEST POINT: TP-3 (MOTHER BOARD)

Use above key pressing order.
Minimize click noise from individual Module Board (A,B,C,D) in the following way.
While holding down ○key(s), tap ● key repeatedly and turn trimpot 4.

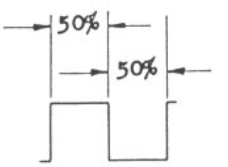
9. VCO WAVEFORM (Pulse width 50%) MODULE BOARD



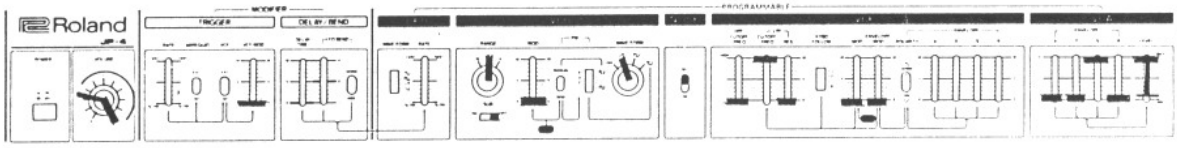


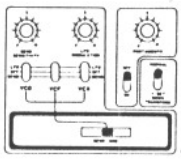
PUSH BUTTON: POLY-2, MANUAL
TEST POINT: TP-3 (MOTHER BOARD)

With key pressing order used in Section 7, set trimmer 7 for duty 50%.



10. VCO FREQUENCY and WIDTH





PUSH BUTTONS: POLY-2, MANUAL

CENTER OFF

MODULE A
MODULE B
MODULE C
MODULE D

C1 A1 A2 C3 A3 C4

440Hz 880Hz 1760Hz

trimmer 6 trimmer 5

VCO can be calibrated in different manners: scope, tuning meter, Lissajous, zero beat, etc. Below as an example using scope for coarse adjustment and zero beat for fine tune.

MID-POINT

CONTROL BOARD-G (052-336)

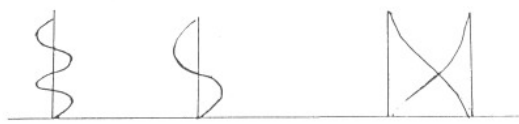


Fig. A

Set up instruments as shown in Fig.B.

Set four trimmers of Control Board G to midpoint.

Use key arrangement shown in Section 7, reading the key designation as a one suitable for adjusting step.

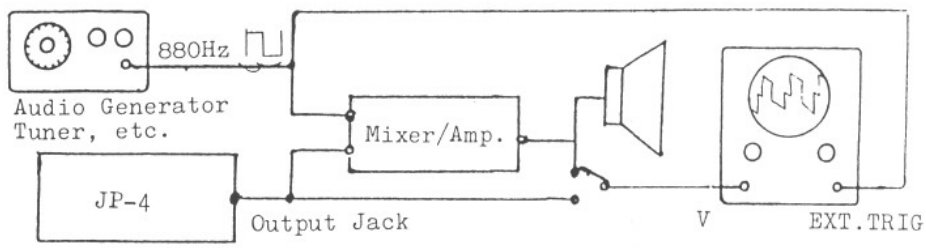


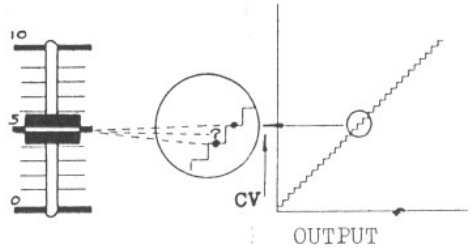
Fig. B

1. While playing two keys alternately, set trimmers of Module Board A for stationary waveforms; A3 key - trimmer 5, A1 key - trimmer 6.
2. Repeat trimmings and finish with zero beat method.
3. In the same way, calibrate the remaining Modules B, C and D.

Figure A shows Lissajous figures for reference. When using this method, change the set-up in figure B as follows: standard 880Hz into sine wave, scope EXT TRIG to HOR VAR (External Sweep, X-Y).
Fine tune by ear, listening to zero beat.

EFFECTS OF DIGITAL VOLTAGE ON ADJUSTMENTS

Moving of slider on the panel delivers control voltage in series of steps to the subsequent stage which in turn varies its parameter in digital steps. When the slider is set between steps, result is jolting or jittering output since control voltage jumps up and down between these two steps.
Significant effects may be seen on adjustment sections are: VCF- RESONANCE FREQ., WIDTH, MODULATION DEPTH, etc. in which slider is to be set midway travel range. In such a case, set knob at a point where waveform locks positively.
Some divergences from the value specified by adjustment steps may be negligible or may be compensated for by other manners.



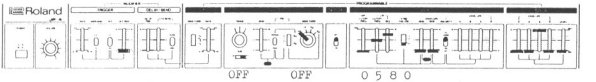
11. VCF RESONANCE

MODULE BOARD

APPLICABLE SUBSECTIONS

11-A S/N up to 790799 or PCB 052-314 A/B/C

11-B S/N 800800 and above or PCB 052-314 D/E



PUSH BUTTONS: POLY-2, MANUAL

TEST POINT: TP-3 (MOTHER BOARD) or Output jack

CAUTION!

Proceed Sections 11 thru 14 in the order numbered.

The purpose of this adjustment is to have the four modules begin resonating at a point and produce equal amount.

NOTES:

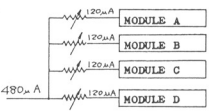
1. Panel setting and test point are common to all versions.
2. Use key pressing arrangement shown in KEY ASSIGN LOGIC or Section 7.

IMPORTANT

1. Before starting actual adjustment, read through the steps in a subsection to have the conception of an adjustment.
2. Since this is a relative adjustment, first try to coarse, then fine tune.
3. Amplitude in resonance depends greatly on RES knob position. Resetting of the knob is sometimes required to keep VCF resonating and delivering output within a range 200-300mVp-p at which accurate adjustment can be established.
4. If waveshape jitters on a screen, shift corresponding knob slightly referring to "EFFECTS of DIGITAL---" on the preceding page.

11-A. Serial Number up to 790799 or PCB 052-314 A/B/C

Unlike D or E version, this adjustment is to divide constant current source into four to duplicate circuit condition. Turning one trimmer to out of balance will increase or decrease currents flowing into other three modules. These trimmings are touchy and would have to be repeated quite a few times for accurate setting.



1. Check each module and determine which voice is highest amplitude.
2. With trimmer 18, lower the highest. This will increase other modules' level, then lower the new highest, then to next until four modules are equal in amplitude. Keep amplitudes close 200mVp-p with RES knob; if one module mis-resonates, up the knob a little. Repeat trimmings until none is outsized.
3. Make sure that all modules begin resonating simultaneously when RES is raised to 7-8.

11-B. Serial Number with 800800 or PCB 052-314 D or E

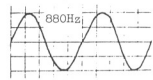
1. With trimmer 18, find a module least accessible to 200mVp-p. Set other modules for that value with trimmer 18.
2. Set RES for 200mVp-p. Check all modules for mis-resonance, if any, readjust trimmer 18 of missing module for resonance. If this module won't resonate, slightly up RES to 200mVp-p (can be read as 300mV if convenient) then readjust other modules to 200mV or 300mVp-p.
3. Make sure that all modules begin to resonate at the same RES position and show equal output in amplitude.

12. VCF FREQUENCY and WIDTH MODULE BOARD

TEST POINT:
INITIAL SETTING: same as for Section 11 but RES knob at "10"

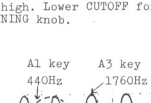
NOTE:
1. Use key pressing arrangement shown in KEY ASSIGN LOGIC or Section 7.
2. Panel setting and test point are common to all versions.

Scaling of resonating VCF can be done by different methods. Below describes procedure using scope's graticule as a measure. Lissajous method shown in Section 10 can also be adoptted.



Apply reference sinewave of 880Hz to scope V.IN and adjust time base (H) for 2 cycles across graticule. Disconnect reference note from, and connect TP-3 or JP-4 output jack to V.IN.

1. Press A2 key. Adjust trimmer 14 of Module A for figure right. If waveform is jolty because of reason explained on the preceding page below Section 10, slightly move CUTOFF knob for stable figure. Adjust trimmer 14 for exact 880Hz.
2. Set KYBD FOLLOW switch to 3. The frequency will shift high. Lower CUTOFF for 880Hz. Avoid waveform from joggling, fine tune with TUNING knob.
3. While playing A3 and A1 keys alternately, adjust trimmers 14 and 15 respectively for fig. right.

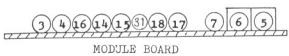


NOTE:
Trimmers corresponding to two keys are completely reversal between version groups.

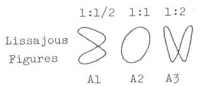
	A1 key	A3 key
S/N up to 942749 or PCB 052-314 B/C/D	trimmer 15	trimmer 14
S/N 952750 and up or PCB 052-314 E	trimmer 14	trimmer 15

4. Repeat step 3 for the remaining modules using A module's as a reference.

Note that the filters will never track as well as the oscillators. Beate notes counting up to 10/second are considered within tolerance. As for the beats in excess of 10, they can be reduced by fine tuning trimmer 14 of those pcbs.



MODULE BOARD



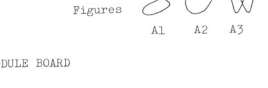
13. VCF ENVELOPE BALANCE MODULE BOARD

TEST POINT:
INITIAL SETTING: same as for Section 11. NOTE: POLARITY - NORM

Use key pressing arrangement shown in Section 7.

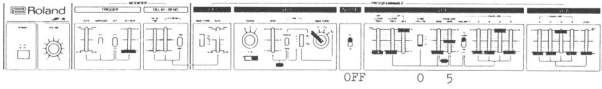
To let your left hand free from key play,

1. while pressing A2 key for module A, push HOLD into ON.
2. While moving ENVELOPE MOD slider 0 to/from 10, adjust trimmer 16 of A module for no frequency change.
3. Release HOLD to OFF.
4. Duplicate steps 1-3 for other three modules.



14. VCF ENVELOPE MODULATION DEPTH

MODULE BOARD

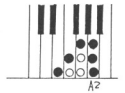


TEST POINT: TP-3 (MOTHER BOARD) PUSH BUTTONS: POLY-2, MANUAL

1. Press A2 key, set trimmer 17 of Module board A for 500Hz.
2. Adjust remaining modules B, C and D to 500Hz using module A's output as a reference signal. This can be done by displaying two waveforms at a time in the following key plays.

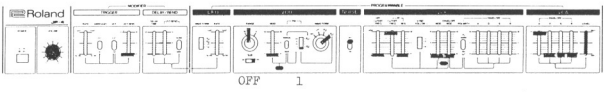
MODULE B: Press and hold G2 key, then A2 key.
MODULE C: Press and hold keys in this order; F2, G2, A2, release G2 only.
MODULE D: Press and hold; E2,F2, G2, A2, release F2, G2.

These frequencies may not have to be set at exact 500Hz, but as close to each other as possible.



15. VCA ENVELOPE ATTACK

MODULE CONTROL BOARD



PUSH BUTTONS: ENSEMBLE & HOLD - OFF, POLY-2 & MANUAL - ON

Adjustment can be done either by observing screen on scope connected to TP-3 (MOTHER BOARD) or by listening to one note through speaker. Use stopwatch for timing.

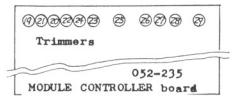
In the following key pressing order, find the shortest Attack time. Note that key(s) once pressed should be kept hold down until 4th module is measured.

1. Press and hold A1 key for Module A.
2. Press and hold B1 key for Module B.
3. Press and hold C2 key for Module C.
4. Press and hold D2 key for Module D.

Adjust trimmer 19 so that the shortest attack time becomes 3 seconds. The same key for that module may be pressed any number of times provided key(s) for preceeding module(s) is being held down.

Check remaining modules for attack time.

Acceptable variations 0 to +40%.



16. VCA ENVELOPE DECAY

Change panel setting in Section 15: ATTACK to 0; DECAY to 10.

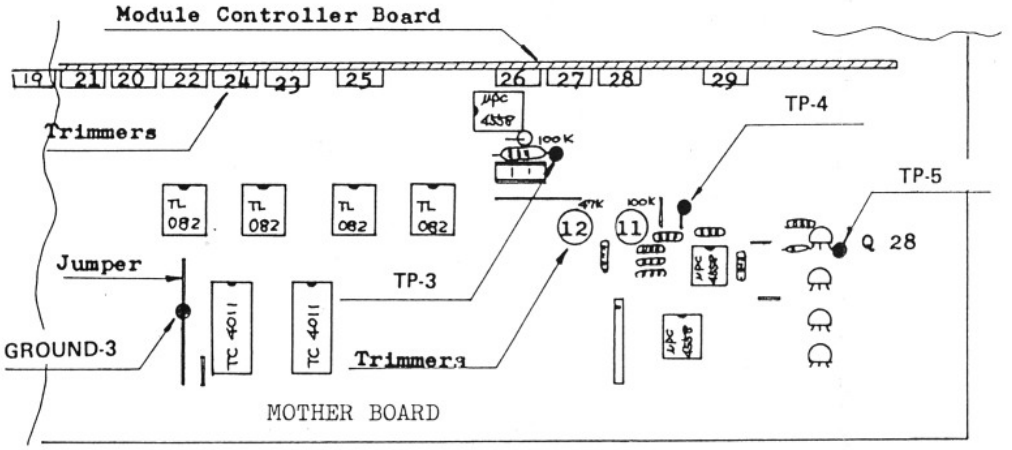
Use the same procedure as in Section 15 VCA ATTACK, but adjust trimmer 20 so that shortest decay time is 4s. Acceptable variations: 0 to +40%.

17. VCA ENVELOPE RELEASE

(Four seconds in Sections 16 & 17 means the time required for the envelope to decrease in amplitude 1/10 of its maximum value.)

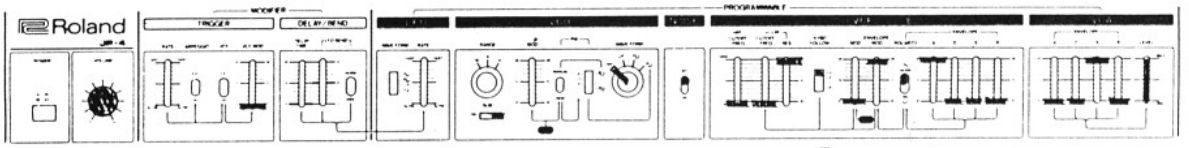
Change panel setting in Section 15: ATTACK to 0; SUSTAIN, RELEASE to 10.

Use the same procedure as in Section 15, but adjust trimmer 21 to set the shortest release time for 4 seconds. Acceptable variations: 0 to +40%.



18. VCF ENVELOPE ATTACK

MODULE CONTROL BOARD



3

PUSH BUTTONS: ENSEMBLE & HOLD- OFF
POLY-2 & MANUAL- ON

TEST POINT: TP-3 (MOTHER BOARD)

Use the key pressing arrangement given in Section 15 VCA ATTACK but the last key pressed should always be C2. Note the attack time for 4 VCFs.
Attack time is defined as the time from pressing the key to the time when the increasing frequency drops suddenly.

Using the same key pressing method, adjust trimmer 22 so that the shortest attack time noted becomes 3 seconds.

Check that the remaining attack times are within 3 seconds + 40%.

19. VCF ENVELOPE DECAY

MODULE CONTROL BOARD

Change panel setting in Section 18: ATTACK to 0; DECAY to 10.

Use the same procedure as in Section 18.
Determine Decay time for each module in the following manner.
While tapping C2 key, adjust scope sweep and sync controls to display ten cycles on the screen, depress the key, measure the time required for the waveform to become one cycle.
Adjust trimmer 23 so that the shortest decay time noted becomes 4 seconds.
Check that the remaining decay times are within 4 seconds+40%.

20. VCF ENVELOPE RELEASE

MODULE CONTROL BOARD

Change panel setting in Section 18: ATTACK to 0; SUSTAIN, RELEASE to 10.

VCA RELEASE to 10.

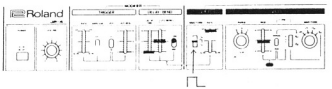
Shift scope lead to JP-4 output jack to enable VCA LEVEL active.

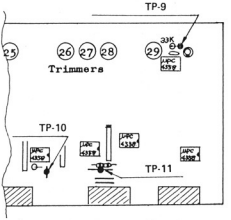
Use the same procedure as in Section 18.
Determine Release time for each module in the following manner.

While pressing C2 key, adjust scope sweep and sync controls to display ten cycles on the screen, release the key, measure the time required for the waveform to become one cycle. It will be necessary to increase LEVEL as VCA output decreases.
Adjust trimmer 24 so that the shortest release time becomes 4 seconds.
Check that the remaining release times are within 4 seconds+40%.

21. LFO VCO MODULATION

MODULE CONTROL BOARD





Module Controller Board
(052 - 235)

TEST POINT: TP-10

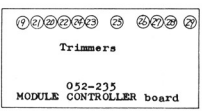
SCOPE: V. IN - AC coupling
ground - GROUND 3 (MOTHER BOARD)

Set trimmer 25 for: 130mVp-p

Earlier models:150mVp-p.
Decrease to 130mVp-p if any VCO is modulated by LFO in this setting.

22. LFO VCF MODULATION

MODULE CONTROL BOARD



Panel setting: same as above but
VCF MOD to 5

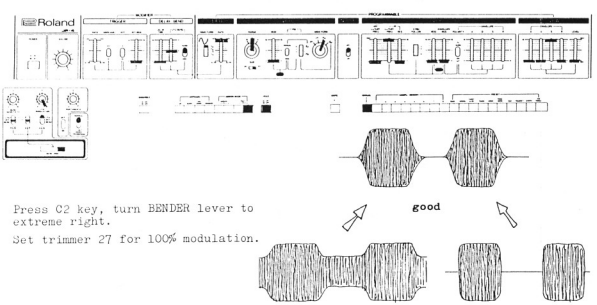
TEST POINT: TP-11
SCOPE: same as above

Set trimmer 26 for:

S/N up to 750199 - 300mVp-p±10%
S/N 750200 and up - 100mVp-p±10%

23. LFO VCA MODULATION

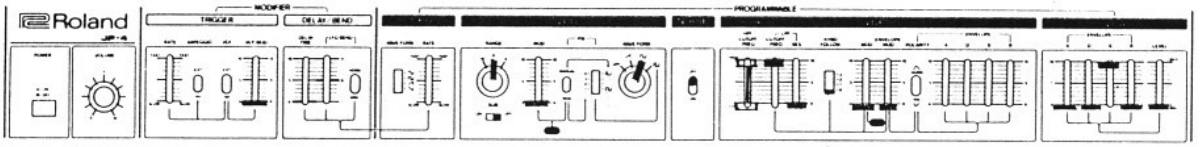
MODULE CONTROL BOARD

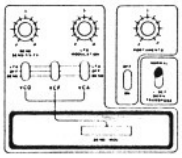


Press C2 key, turn BENDER lever to extreme right.

Set trimmer 27 for 100% modulation.

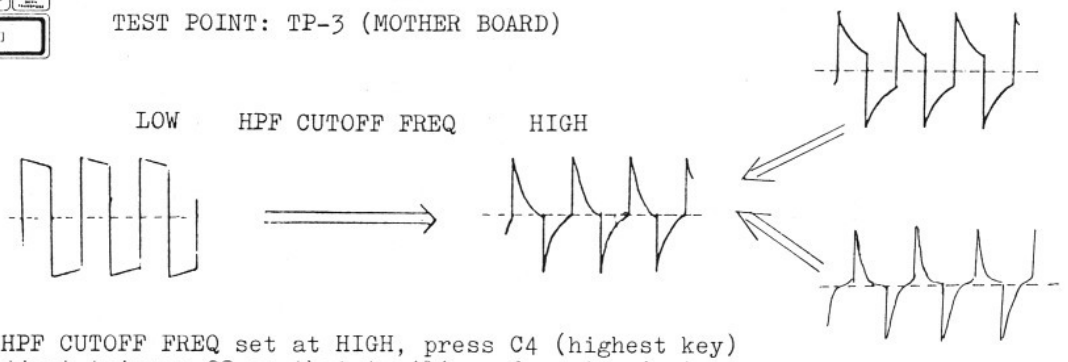
24. HPF CUTOFF FREQUENCY MODULE CONTROL BOARD





PUSH BUTTONS: MANUAL, HOLD, POLY-2 ON

TEST POINT: TP-3 (MOTHER BOARD)



With HPF CUTOFF FREQ set at HIGH, press C4 (highest key) and adjust trimmer 28 so that trailing edges terminate on the horizontal line. The waveform must be restored to rectangular when the knob is downed to LOW. If not, slightly reverse the trimmer.

25. VCF INV

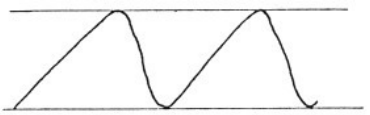
APPLICABLE TO S/N xx 4100 and higher or PCB 052-314 E w/trimmer 31 (VR11 on circuit diagram)

MODULE BOARD

Just change above panel setting by pushing VOICE in.

This adjustment should be made only after finish of all other VCF adjustments and should follow imediately Section 24 with VOICE button pushed in.

Observe every module board's waveform on the screen, adjust trimmer 31 for uniformity in shape and in level.

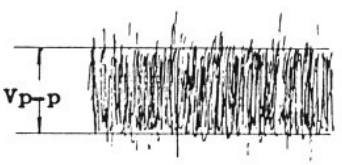


26. NOISE LEVEL MODULE CONTROL BOARD

TEST POINT: TP-9 (R94)

Connect scope ground to GROUND 3 on Mother board.

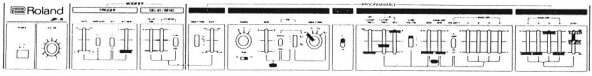
Set trimmer 29 for: 3 V_{p-p}



FEB. 23. 1981

27. CHORUS

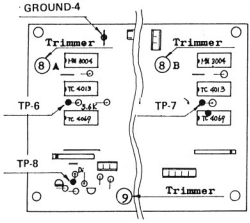
CHORUS ENSEMBLE BOARD

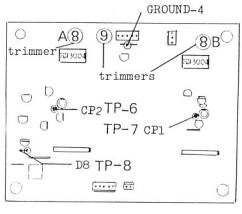


3 3

PUSH BUTTONS: POLY-2, MANUAL
HOLD

Although circuit configuration and PCB layout are different between 052-236 -A, -B or -C and -E, they can be adjusted in the same manner.





052-236 A/B/C

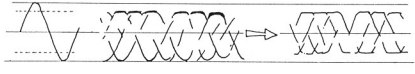
CHORUS ENSEMBLE BOARD 052-236 E (D not in use)

1. TEST POINT: TP-6

Press four keys around C2 and push HOLD. Set trimmer 8A so that when LEVEL is raised, distortions occur at the same time and symmetrically to both peaks.

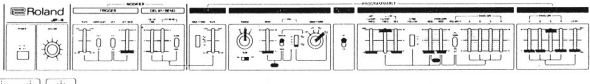
2. TEST POINT: TP-7

Adjust trimmer 8B in the same way.



28. OUTPUT LEVEL

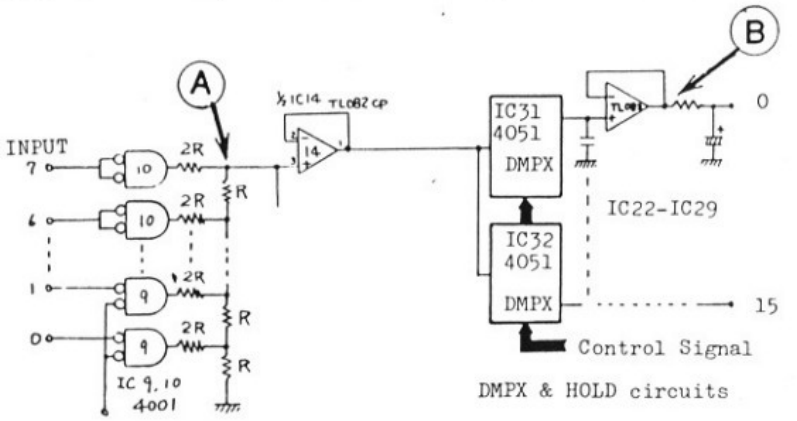
CHORUS ENSEMBLE BOARD



PUSH BUTTONS: POLY-2, HOLD, MANUAL
TEST POINT: TP-8

Press C2 key, adjust trimmer 9 for 450mVp-p.

It might be necessary to know what voltages exist at D/A converter output when a particular preset button is on, which would aid to judge tonality of the factroy programed voices.
Shown in the table below are D/A-converted preprogramed data from ROM that are fed through Demultiplexer and S/H to Module and Module Control boards to characterize Preset voices in reproduction process. These voltages are to be logically available at point A in Fig. below, but practically cannot be measured.
For reading, voltage is taken at point B, each S/H output. Variations due to the following deviations inherent in components used in the circuits, when combined, could amount up to 0.2-0.3V.



D/A Converter

DMPX & HOLD circuits

Tolerance for ladder resistors (R, 2R, ..) connecting to D/A out, max. 5% for each.

Offset voltages, ½IC14, IC22-IC29.

VOICES	CONTROLS & POINT B (IC-pin)							
	VCA A IC22-1	VCA R IC22-7	VCA D IC23-1	VCF R IC23-7	VCF D IC24-1	VCO MOD IC24-7	VCF MOD IC25-1	VCF A IC25-7
BASS	0.000	2.812	3.437	2.969	2.109	0.000	0.000	0.000
STRING	2.969	2.109	2.187	3.359	1.484	1.328	0.000	0.547
FUNK.CLAV.	0.000	1.484	3.594	2.344	1.484	0.000	3.047	0.000
PIANO	1.094	2.344	3.359	3.281	4.141	0.000	0.000	0.000
VOICE	3.828	1.328	4.297	4.844	3.203	1.953	2.187	2.500
TROMBONE	2.187	2.422	4.531	2.187	2.109	0.781	2.031	2.891
SAX	2.578	1.484	2.500	2.422	1.562	0.000	1.719	2.969
TRUMPET	2.187	2.109	2.266	2.187	1.953	0.000	2.187	2.656
B.SYNTHE	0.000	1.719	3.437	3.125	3.672	0.000	2.656	0.781
THE FORCE	4.609	0.000	3.437	0.000	2.109	2.187	1.562	0.000

	LEVEL IC26-1	LFO RATE IC26-7	HPF COF IC27-1	VCF EN MOD IC27-7	VCA S IC28-1	LF RES IC28-7	LPF COF IC29-1	VCF S IC29-7
BASS	2.109	3.047	0.000	2.266	9.532	0.781	0.547	0.000
STRING	1.328	3.125	2.266	1.484	8.438	0.937	3.047	2.500
FUNK.CLAV.	2.422	1.719	0.000	0.000	0.624	3.359	3.203	1.094
PIANO	2.891	1.094	2.266	1.484	1.874	0.703	1.875	0.782
VOICE	4.922	3.047	3.984	2.969	8.594	0.859	3.984	7.656
TROMBONE	2.578	4.375	2.969	2.109	8.124	1.016	2.031	4.218
SAX	2.344	4.531	2.266	3.281	7.188	1.250	1.172	6.874
TRUMPET	3.828	4.531	3.984	2.656	7.812	0.469	0.547	6.562
B.SYNTHE	1.250	3.203	0.000	3.750	9.688	3.203	0.000	5.000
THE FORCE	2.031	4.219	0.000	2.344	4.062	1.953	1.719	2.812

SEMICONDUCTOR

IC

020-051	TC4001BP	or MC14001
020-040	TC4011BP	or MC14011
020-083	TC4016BP	or MC14016
020-076	TC4024BP	or MC14024
020-093	TC4025BP	or MC14025
020-075	TC4049BP	or MC14049
020-090	TC4051BP	or MC14051
020-091	TC4052BP	or MC14052
020-177	MC14070	or TC4030BP
020-084	TC4069UBP	or MC14069
020-178	MC14099	or TC4099BP
020-095	MC1455	or NE555P
020-041	TC4013BP	
179-020	µPD8048C-011	computer Key Assigner
179-021	µPD8048C-012	computer Mother Board
020-181	µPD5101C-E	RAM
020-097	µPC4558C	
020-100	TL082 or TL072 or LM353	
020-141	SN74LS175	
020-120	SN74LS00	
020-180	SN74LS174	
020-160 *	BA662A	
020-096 *	BA662B	
*	BA662 factory selected	

* BA662A can replace BA662B

See page 21 for detail

020-054	LM311
020-108	µA7815UC
020-032	µA726HC
020-031	µA723DC
020-039	DN819
020-063	MN3004

Transistor

017-105	2SA1015-Y or 2SA733Q
017-128	2SB596-Y or 2SB434-O
017-110	2SC1815-Y or 2SC945-Q
017-020	2SC732TM-GR
017-138	2SD880-GR or 2SD234-Y
017-016	2SK30A-GR FET
017-046	2SC828-R NZ Selected for NOISE GEN.

Thermistor

018-015	SDT-1000

Diode

019-022	GL-3AR1 or LR0601R LED
018-082	W-02 rectifier
018-018	1N4003
018-059	1S1588
018-035	052-5.6U or RD-5.6E zener

POTENTIOMETER

Slider

029-350	EVA-V17C16A26	2MA
029-355	EVA-V17C16B54	50KB
029-370	EVA-V17C16C26	2MC
029-426	EVA-V23C16B54	50KB Cont.A VR-4 *(w/ center tap, center click)

*When using for Control Board of 052-330B/C, cut off the center tap pin.

Rotary

028-756	VM10RK20	2MA
028-762	VM10RK20	50KB
028-852	GM70AK15	50KA
028-1078	VM10AK15	100KB TUNE

Bender Unit

029-022	PB-4

Trimmer

SR19R		SR29R	
030-467	22K	030-660	4.7K
030-469	27K	030-662	10K
030-471	100K	030-666	47K
		030-668	100K

CR19R	
030-489	1K
030-499	47K

030-680	PN882H501V	500-ohm
030-685	PN822H103V (used on 052-314C)	10K
030-688	89PR500	500-ohm
030-689	89PR20K (052-314D)	20K

RESISTOR

CRB¼FX 1%		CRA¼BY 0.1%	
044-830	1K	044-927	11K
044-909	2K	044-928	62.5K
044-863	2.7K	044-929	125K
044-833	3.3K	044-930	250K
044-838	10K	044-931	500K
044-887	20K		
044-895	30K		
044-846	100K		
044-851	220K		
044-926	1M		

POWER TRANSFORMER

022-118N	100V
022-118C	117V
022-118D	220/240V

COIL

022H094	24M-333

068-024	Collar Bushing NB-300
068-029	Collar Bushing NA-310
048-046D	Heat sink No.46D
048-066	Heat sink No.66
055-003	Battery 4N-100AAS

IC SOCKET

012-040	ICC-03-040-035G	40 pin
012-042	ICC-03-022-035G	22 pin

122-001	Nylon rivet NRP-335 (front, Bender panels)
122-002	Nylon rivet NRP-345 (Module, Module Controller, Power Supply)
101-027	Felt No.27 Bender Panel
053-285	Flat Cable No.285 10-cores
053-286	Flat Cable No.286 5-cores

CHANGED PARTS

Although the manufacture has already employed new Parts Coding system (8-10 digit), this list keeps thoroughly the old one to avoid confusion.
Parts order in old number will be translated into new at the factory.

PCBs
Each pcb can replace earlier versions with or without involving alteration, see page 12-2 and individual sections.

181-022C	Key Assinger	(pcb 052-032C)
181-019D	Mother board	(pcb 052-364D)
181-020E	Module board	(pcb 052-314E)
181-021E	Module Controller	(pcb 052-235E)
181-023E	Chorus Ensemble	(pcb 052-236E)

IC

020-209	1R3109

HOLDER

064-186A	No.186A (Module, Module Controller-Mother)
064-049B	No.49B (Panel No.218G-Control A,B,C)
064-050B	No.50B (Panel No.218G-Control Board A, B, C)
064-184A	No.184A (Module, Module Controller(left)-Holder No.186A
064-185A	No.185A (Module, Module Controller(right)-Holder No.186A
064H55A	No.H55A (Pot-PCB)
064-187E	No.187E (Power switch)
064-188B	No.188B (Keyboard-Bender Panel)
064-189C	No.189C (Sideboard-Panel No.218G)
064-190A	No.190A (Keyboard-End Block)(necessary for earlier products)
064-203B	No.203B (Bender Board left)
064-204C	No.204C (Bender Board right)
064-205B	No.205B (Bender Unit)
064-210	No.210 (Bender Board center)
064-213	No.213 (Battery)
064-219B	No.219B (Music Rack)

CAPACITOR Styrol

035-279	ECQS1102K	1000pfd
035-278	ECQS1681K	680pfd

CABINET

081-108H	Assemble No.108H
111-024	Foot (Collar) No.24
115-003	Hinge No.3
064-219B	Music Rack Holder No.219B
074H004	Badge (logotype) No.H4

Keyboard

070-052	SK191-A
091-017A	End Block No.17A

PANEL

072-218G	No. 218G	upper
072-219G	No. 219G	push switches
072-220B	No. 220B	Bender
072-051	No. 51	rear trimmers

KNOB

016-033	No. 33	slider pot
016-056	No. 56	rotary pot
016-057	No. 57	rotary switch

BUTTON

016-008	No. 8	Gray
016-009	No. 9	Black
016-085	No. 85	White
016-086	No. 86	Red
016-087	No. 87	Green
016-088	No. 88	Yellow
016-089	No. 89	Blue

SWITCH

001-215	SDG-5P power (with CSA or DEMKO mark)

Slide

001-182	SSB022
001-228	SQPR-2412P
001-018	SW321-1-1

Lever

001-237	LBC-42M-18K
001-238	LBC-23M-18K

Rotary

001-224	SRM-1043 K15
001-234	SRM-1034 K15

Push

001-227	SUF-92
001-250	SUF-J2
001-225	SUF-12
001-226	SUF-12A

PCB

181-006D		Control Board A (Etch mask 052-330D)
181-007D		Control Board B (Etch mask 052-329D)
181-008B		Control Board C (Etch mask 052-328B)
181-009D		Control Board D (Etch mask 052-331D)
181-011A		Control Board E (Etch mask 052-335A)
181-012C		Control Board F (Etch mask 052-237C)
181-013		Control Board G (Etch mask 052-336)
181-019B	*	Mother Board (Etch mask 052-364B)
181-020C	*	Module Board (Etch mask 052-314C) Serial No. up to 790799
or		
181-020D	*	Module Board (Etch mask 052-314D) Serial No. 800800 and higher
181-021C	*	Module Controller Board (Etch mask 052-235C)

NOTE:
There are two versions of Mother Board and Module Controller Board to match with 181-020C or 181-020D.
See page 19 for detail.

181-022B	Key Assigner Board (Etch mask 052-032B)
181-023C	Chorus Ensemble Board (Etch mask 052-236C)
181-024F	Power Supply Board (Etch mask 052-327F)

For replecement, use PCB listed above except those noted by mark *.

JACK

009-025	HLJ-0102-01-040
009-045	HLJ-0235-01-070

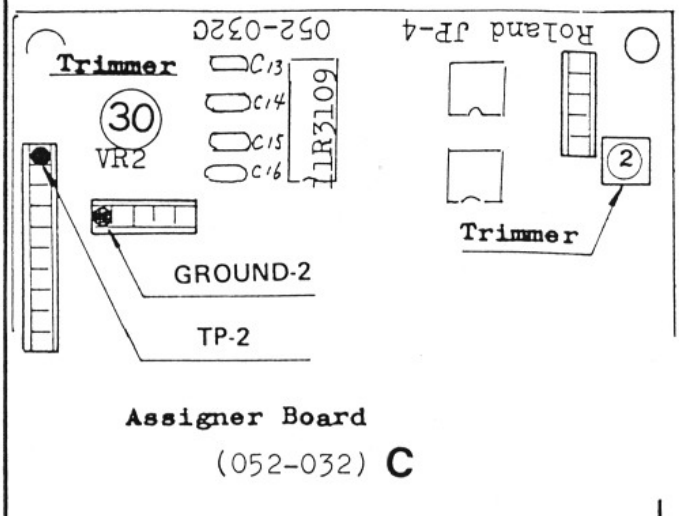
FUSE, FUSE CLIP

008-026	SGA0001 (1A)	prim.	100/117V
008-063	CEE T500mA	prim.	220/240V
008-028	SGA0002 (2A)	sec.	100/117V
008-070	CEE T2A	sec.	220/240V

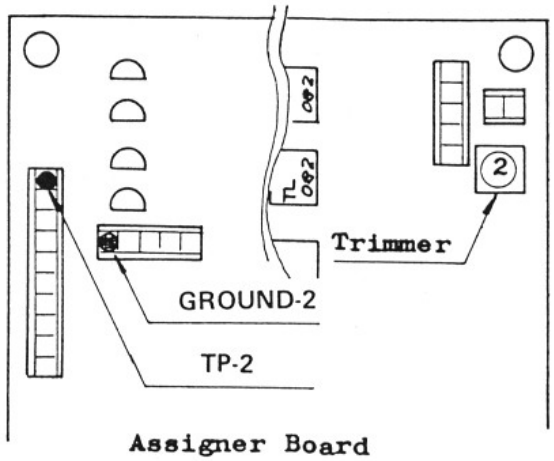
012-029	SN5054 universal, on 181-024C
012-003	TF-758 midget on 181-024D

(Revised Feb. 1981)

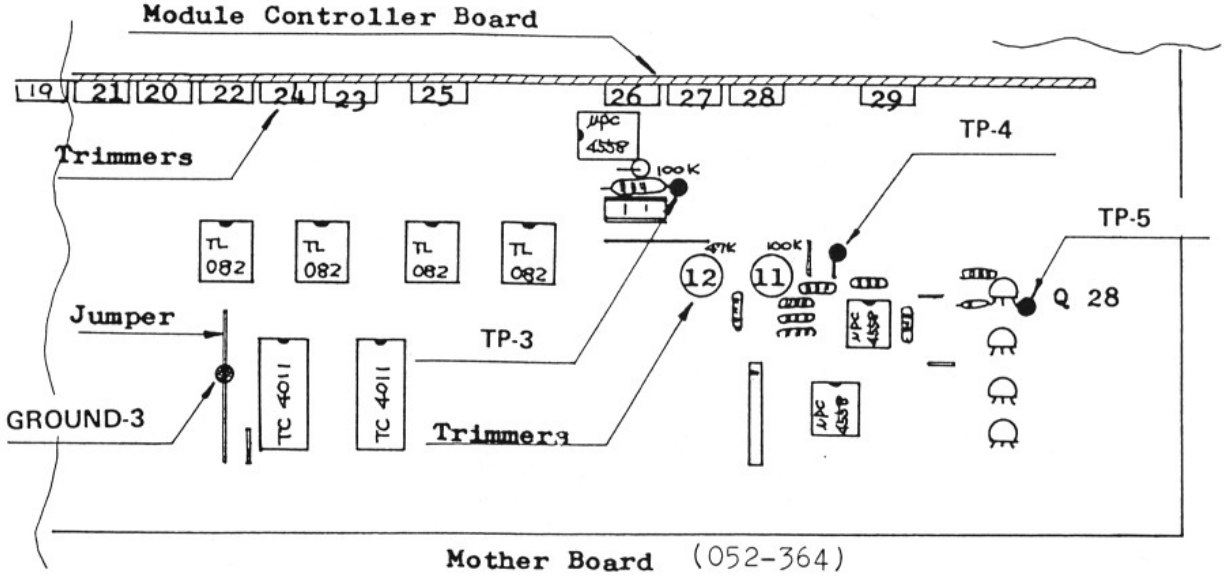
Adjusting / Test Points



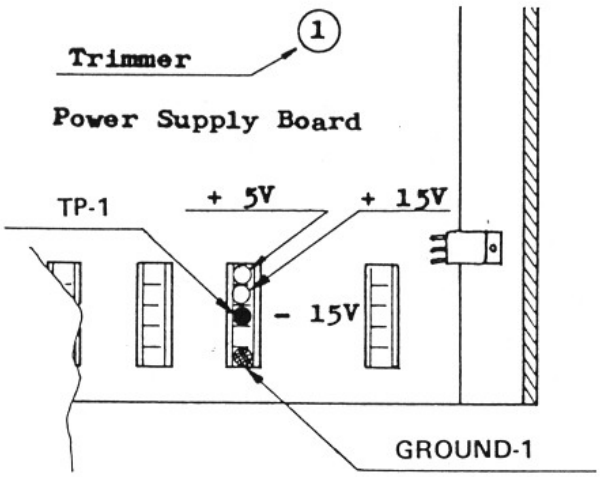
Assigner Board
(052-032) **C**

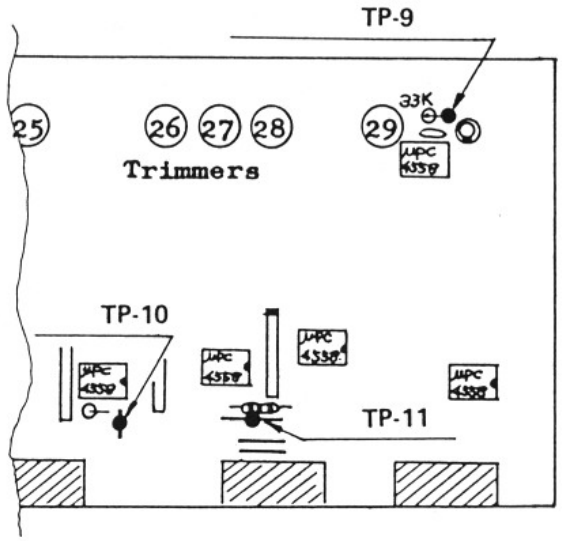


Assigner Board
(052-032) **A & B**



Mother Board (052-364)





Module Controller Board
(052 - 235)

BLOCK DIAGRAM

CONTROL BOARD A — CONTROL BOARD B — CONTROL BOARD C

MODULE CONTROL BOARD

MODULE BOARDS

MOTHER BOARD

CONTROL BOARD D

CONTROL BOARD F

CHORUS ENSEMBLE BOARD

KEY ASSIGNER

CONTROL BOARD E

- Refer to following pages for the boards.-

MOTHER BOARD ---------- PP12-13
CONTROL BOARD --------- PP14-15
(A, B, C, D, E, F,)
CHORUS ENSEMBLE ------- P16
MODULE BOARD ---------- PP18-21
MODULE CONTROL -------- PP22-23
KEY ASSIGNER --------- PP24-25
CONTROL BOARD G ------- P25
POWER SUPPLY BOARD ---- PP26-27

A5~A8 MODULE BOARD (A)
A9~A12 MODULE BOARD (B)
A13~A16 MODULE BOARD (C)
A17~A20 MODULE BOARD (D)
A21~A25 MODULE CONTROL BOARD

MOTHER BOARD Ass'y
PCB 052-364

[ ] Control Address

- IS1588
- 2SA1015-Y
- 2SC1815-Y
- 2SK30A-GR

TRIGGER | DELAY / BEND | LFO | V C O | NOISE | V C F | V C A

RATE ARPEGGIO VCF VCFMOD DELAY TIME LFO BEND | WAVE FORM RATE RANGE MOD PW WAVE FORM | HPF CUTOFF FREQ | LPF CUTOFF FREQ RES | KYBD FOLLOW | ENVELOPE MOD | ENVELOPE POLARITY A D S R | ENVELOPE A D S R LEVEL

Control Board A Ass'y PCB # 330 — A

Control Board B Ass'y PCB # 329 — B

Control Board C Ass'y PCB # 328 — C

S/NO. UP TO 810945

IC1 4558

LFO RATE

OVER-LOAD

R1~11 47K
VR1~5 50KB

R1~3 47K
R4~9 22K
VR1~11 50KB

to Rear Panel Jacks

to KEY ASSIGNER BOARD [D8]

to MODULE CONTROL BOARD [B2]

to MOTHER BOARD [A1]

to MOTHER BOARD [A2]

to MOTHER BOARD [A3]

to MOTHER BOARD [A4]

50KA

LINE OUT / GND / LINE OUT

to CHORUS ENSEMBLE BOARD [F5]

--- 1S1588
--- LR0601-R
--- 2SC1815 Y
--- 2SK30A GR

to CHORUS ENSEMBLE BOARD [F3]

to KEY ASSIGNER BOARD [D3]

to MOTHER BOARD [A30]

to MOTHER BOARD [A29]

VOLUME

Control Board D Ass'y PCB # 331 — D

IC1 4558

2MA or 50KB P.25-1

TRANSPOSE

VCO VCF VCA ← LFO ← OFF ← BEND

PORTAMENTO

NORM / OCT DOWN

to MODULE CONTROL BOARD [B1]

to KEY ASSIGNER BOARD [D7]

BENDER

TUNING

Control Board E Ass'y PCB # 335 — E

Control Board F Ass'y PCB # 237 — F

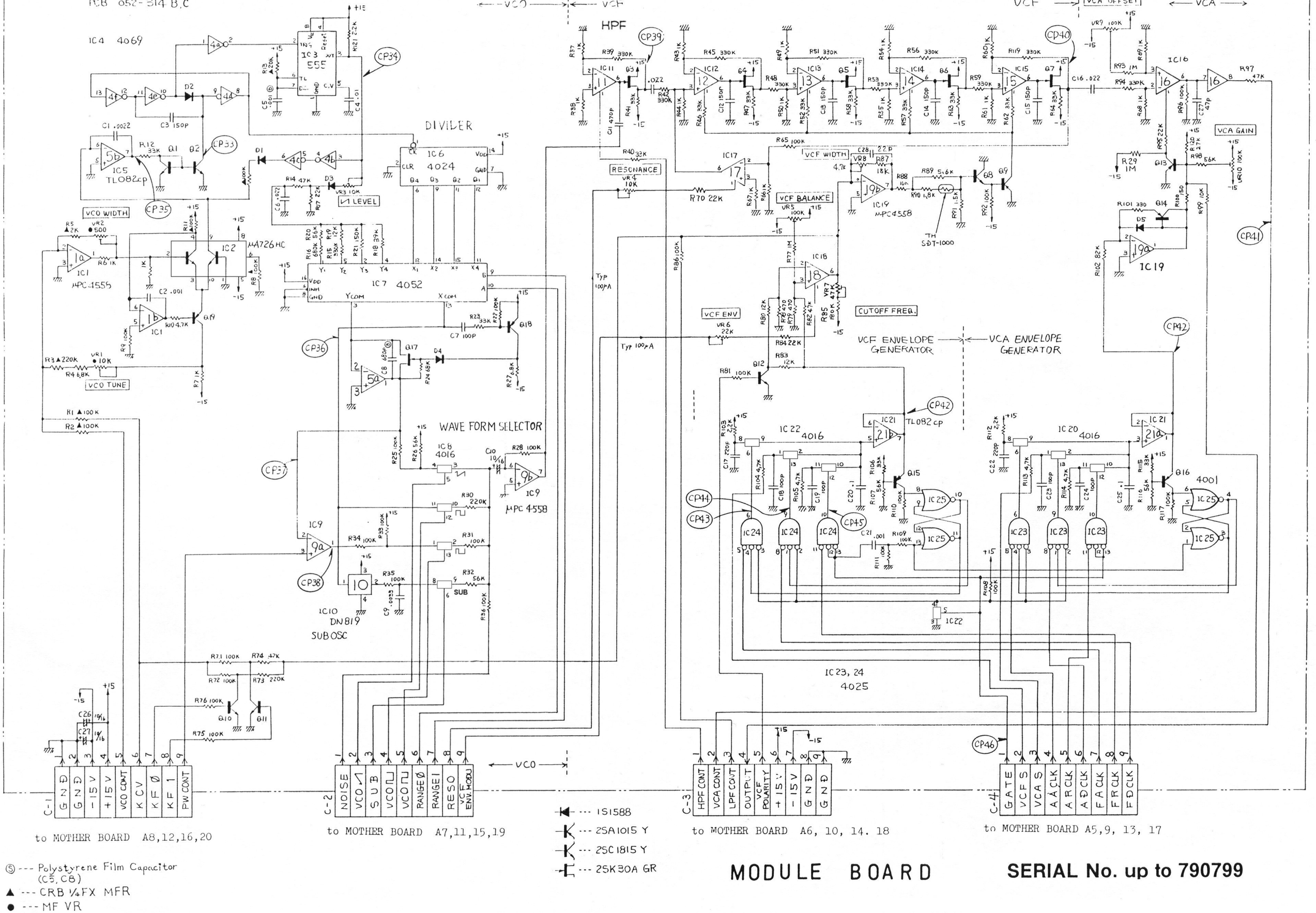
4016

〔NO USE〕

ENSEMBLE | UP DOWN UP&DOWN RANDOM 1 UNISON 2 POLY 1 2 | HOLD

WRITE | MANUAL 1 2 3 4 5 6 7 8 | COMPU MEMORY | BASS STRING FUNKY-CLAVI PIANO VOICE TROMBONE SAX TRUMPET SYNTH THE FORCE | MEMORY PROTECT

MODULE BOARD Assy 121-029
PCB 052-314 B,C



Ⓢ --- Polystyrene Film Capacitor (C5, C8)
▲ --- CRB 1/4FX MFR
● --- MF VR

MODULE BOARD

SERIAL No. up to 790799

MODULE BOARD Ass'y
PCB 052-314 D

181-020 (JP-4)
OP-105 (PROMARS) ±1%

PROMARS only

IC-5
1 VCO MIX IN
2 VCO MUX OUT

VCO | VCF | VCF | VCA OFFSET | VCA

"PROMARS" only

IC4 4069

555

DIVIDER

IC6 4024

IC5 TLO82cp

VCO WIDTH

VCO TUNE

IC1 μPC4558

IC2 μA726HC

IC7 4052

WAVE FORM SELECTOR

IC8 4016

IC9 TL-082

IC10 DN819 SUBOSC

RESONANCE

LEVEL

VCF BALANCE

VCF WIDTH

IC17 IC18 IC19 μPC4558

SDT-1000

VCA GAIN

IC16

CUTOFF FREQ.

VCF ENVELOPE GENERATOR

VCA ENVELOPE GENERATOR

IC21 TL082cp

IC22 4016

IC20 4016

IC23, 24 4025

VCO only power supply

R153 820

R154 12K

R126~R129 2.2M

R122 R123 R124 R125 R122~R125 15K

R130 15K R132 15K

R131 2.2M 2.2M

R137 100

R138 100

R140 2.2M R142 2.2M R144 2.2M R146 2.2M

R148 2.2M R150 2.2M R152 2.2M

C-1: GND GND -15V +15V VCO CONT KCV KF Ø KF 1 PW CONT
to MOTHER BOARD A8,12,16,20

C-2: NOISE VCO SUB VCO □ VCO △ RANGE Ø RANGE 1 RESO VCF ENV. MODU
to MOTHER BOARD A7,11,15,19

C-3: HPF CONT VCA CONT LPF CONT OUTPUT VCF POLARITY +15V -15V GND GND
to MOTHER BOARD A6, 10, 14. 18

C-4: GATE VCFS VCAS AACLK ARCLK ADCLK FACLK FRCLK FDCLK
to MOTHER BOARD A5,9, 13, 17

--- 1S1588
--- 2SA1015 Y
--- 2SC1815 Y
--- 2SK30A GR

Ⓢ --- Polystyrene Film Capacitor (C5, C8)
▲ --- CRB ¼FX MFR
● --- MF VR

NOTE: R153 & R154 are "PROMARS" only

MODULE BOARD

SERIAL NO. 800800 - - -

CHANGINGS of VCF

IC to 1R3109(IC12) involves some modifications on peripheral circuits whose designations are shown in type-written.

SUPPLEMENT on 181-020D Diagram

C36 and C37

S/N 861500-

Filter out pulses induced on KCV IN

uA726HC (IC2)

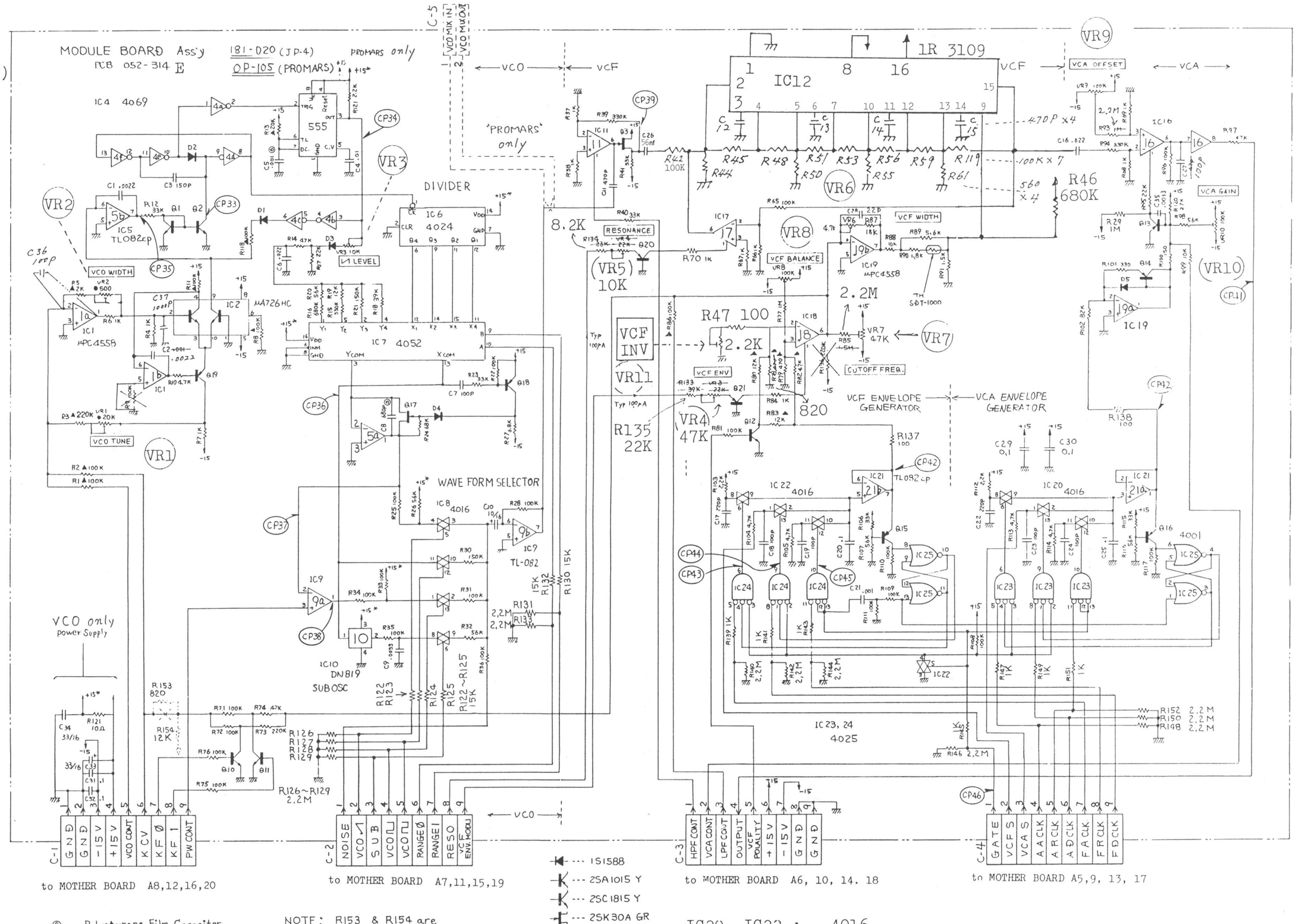
Factory selected with color dot

Resistance of R8 is to be determined according to the color on IC2.

Red -- 82K

Green-100K

Non --120K



Ⓢ --- Polystyrene Film Capacitor (C5, C8)

▲ --- CRB ¼FX MFR 1%

● --- MF VR

NOTE: R153 & R154 are "PROMARS" only

IC 11, 17, 18 : BA662 selected (same color)
IC 16 : BA662 B
IC 4 : TC4069UBP or CD4069UBE

IC20, IC22 : 4016
IC23, IC24 : 4025
The same brand IC should be mounted on four module boards for simultaneous ATTACK TIME passages.

KEY ASSIGNER BOARD Ass'y
PCB 052-032

to Control Board E [L2]

D3 GND / HOLD SW / ASS P3 / ASS P4 / ASS P5 / ASS P7 / ASS TO

CP4 CP5 CP6

40ms ± 20% min to 950ms ± 20% max

to Control Board A [G3]

D8 ARP CLK / INT CLK RATE / INT CLK

CLK Generator

Total Gate Latch

IC6b IC6a IC6 TC 4013*

T1 +15V / -15V / TUNE4 / TUNE3 / TUNE2 / TUNE1

VR1~4 47KB

Control Board G Ass'y

Control Signals

IC3 LS174 IC4 LS175 IC5 LS175

IC1 μPD 8048 - 011

IC2,7 LS00

IC8,9 4049

D/A Converter

■ CRB ¼ BY (0.1%)
▲ CRB ¼ FX (1%)

WIDTH VR1 500 MF

IC10 TL082

D6 +15V / -15V / TUNE1 / TUNE2 / TUNE3 / TUNE4

Portamento

IC17.18 TL082cp IC13~16 BA662

IC11 4052

Gate

IC12 4069

D4 CV4 / CV3 / CV2 / CV1 / RESET / TOTAL GATE / GATE1 / GATE2 / GATE3 / GATE4

to MOTHER BOARD [A26]

3.6V CPU CLOCK 3-6MHz

L1 24M-333 C1 22p C2 22p

CP3 CP15

5V 0 1.5s ±20%

Power ON — CPU RESET & RAM CHIP ENABLE — Power OFF

D2 KPORT 0 / KPORT 1 / KPORT 2 / KPORT 3 / KPORT 4 / KPORT 5 / KPORT 6 / KPORT 7

D1 K BUS 0 / K BUS 1 / K BUS 2 / K BUS 3 / K BUS 4 / K BUS 5 / K BUS 6 / GND

49 KEY BOARD Ass'y

N.C

Co A0 C1 A1 C2 A2 C3 A3 C4

D5 GND / GND / -15V / +15V / +5V

to MOTHER BOARD [A27]

D7 TUNE PORT CONT

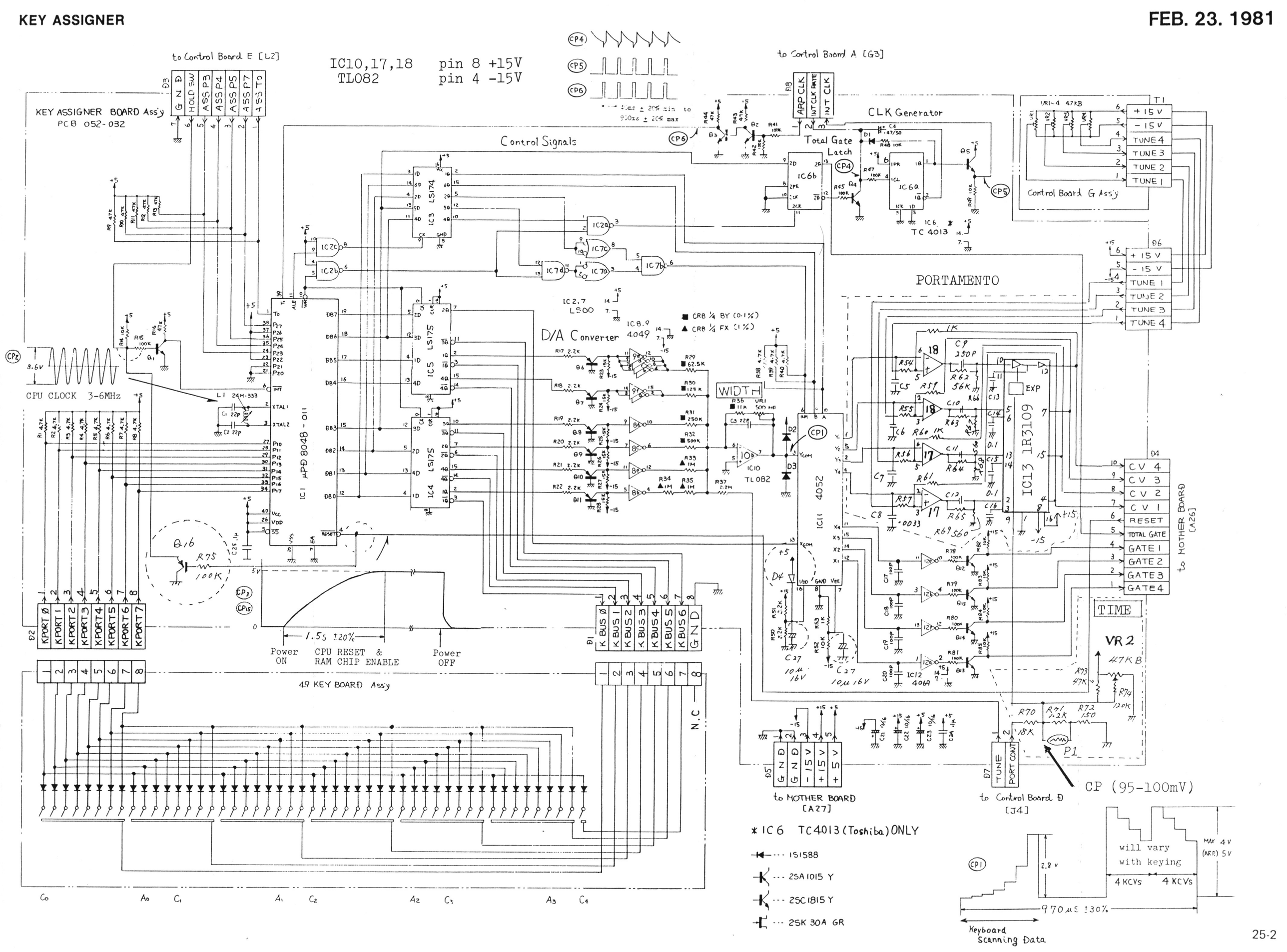
to Control Board D [J4]

* IC6 TC4013 (Toshiba) ONLY

1S1588
2SA1015 Y
2SC1815 Y
2SK 30A GR

CP1 2.8 V will vary with keying 4 KCVs 4 KCVs MAX 4V (ARP) 5V 970μs ±30%

Keyboard Scanning Data


to Control Board E [L2]
IC10,17,18 pin 8 +15V
TL082 pin 4 -15V
to Control Board A [G3]
KEY ASSIGNER BOARD Assy
PCB 052-032
Control Signals
CLK Generator
Total Gate
Latch
IC6 TC 4013
Control Board G Assy
PORTAMENTO
D/A Converter
IC8,9 4049
IC2,7 LS00
IC1 μPD 8048 - 011
CPU CLOCK 3-6MHz
3.6V
WIDTH
IC13 1R3109
IC11 4052
IC12 4069
IC10 TL082
TIME
VR2 47KB
CP (95-100mV)
1.5s ±20%
Power ON
CPU RESET & RAM CHIP ENABLE
Power OFF
49 KEY BOARD Assy
to MOTHER BOARD [A27]
to Control Board D [J4]
to MOTHER BOARD [A26]
* IC6 TC4013 (Toshiba) ONLY
1S1588
2SA1015 Y
2SC1815 Y
2SK30A GR
will vary with keying
4 KCVs
4 KCVs
2.8 V
MAX 4V
(ARP) 5V
970μs ±30%
Keyboard Scanning Data

MODULE CONTROLER

MODULE CONTROL BOARD Ass'y

PCB 052-235

to Control Board D [J1]

to Control Board A [G4]

B1: P.TRANSP, VCO B.LFO, VCO BEND, VCF B.LFO, VCF BEND, VCA B.LFO, VCA BEND, GND, -15V, +15V

B2: VCF P, PVCFEDS, VCFCONTCLK, P DELAY T, LFO BEND, LFO LED

ENV CLK Generator

VCA A, VCA R, VCA D, VCF A, VCF R, VCF D

IC1 4069 *

IC2 4069 *

IC3 4069 *

IC4 4049

AACLK, ARCLK, ADCLK, FACLK, FRCLK, FDCLK

CP24, CP23, CP22, CP21, CP20, CP19, CP30, CP29, CP28, CP27, CP26, CP25

* IC 1~3
TC4069UBP ONLY

C21 10/25

C22 10/25 +15

VCO Controller

VCO MOD

LPF Controller

VCF MOD

22K S/N up to 790799→

VCA Controller

VCA MOD

PW Controller

Noise Generator

NOISE LEVEL

Noise S/H

HPF Controller

HPF COF

LFO Delay

* Q27 2SC828
Selected for
Noise Generator

B3: A ACLK, A RCLK, A DCLK, F ACLK, F RCLK, F DCLK, GND, GND, -15V, -15V, +15V, +15V, +15V, VCA A, VCA R, VCA D, VCF A, VCF R, VCF D

to MOTHER BOARD A21

A22

B4

B5: GND, -15V, +15V, A BENDC, TRANSPOSE, VCO.MOD, VCF MOD, LPF COF, HPF CONT

to MOTHER BOARD A23

B6: VCO CONT, LFO SIG, PW Ø, PW 1, LEVEL, VCA CONT, PW/PWM, NOISE CONT, NOISE

A24

B7: PW CONT, LPF CONT, TOTAL GATE, LFO BEND, LFO LED, HPF COF, +15V, GND, GND

A25

STD-1000

1S1588

2SC1815 Y or 2SC828

2SA1015 Y

2SK30A GR

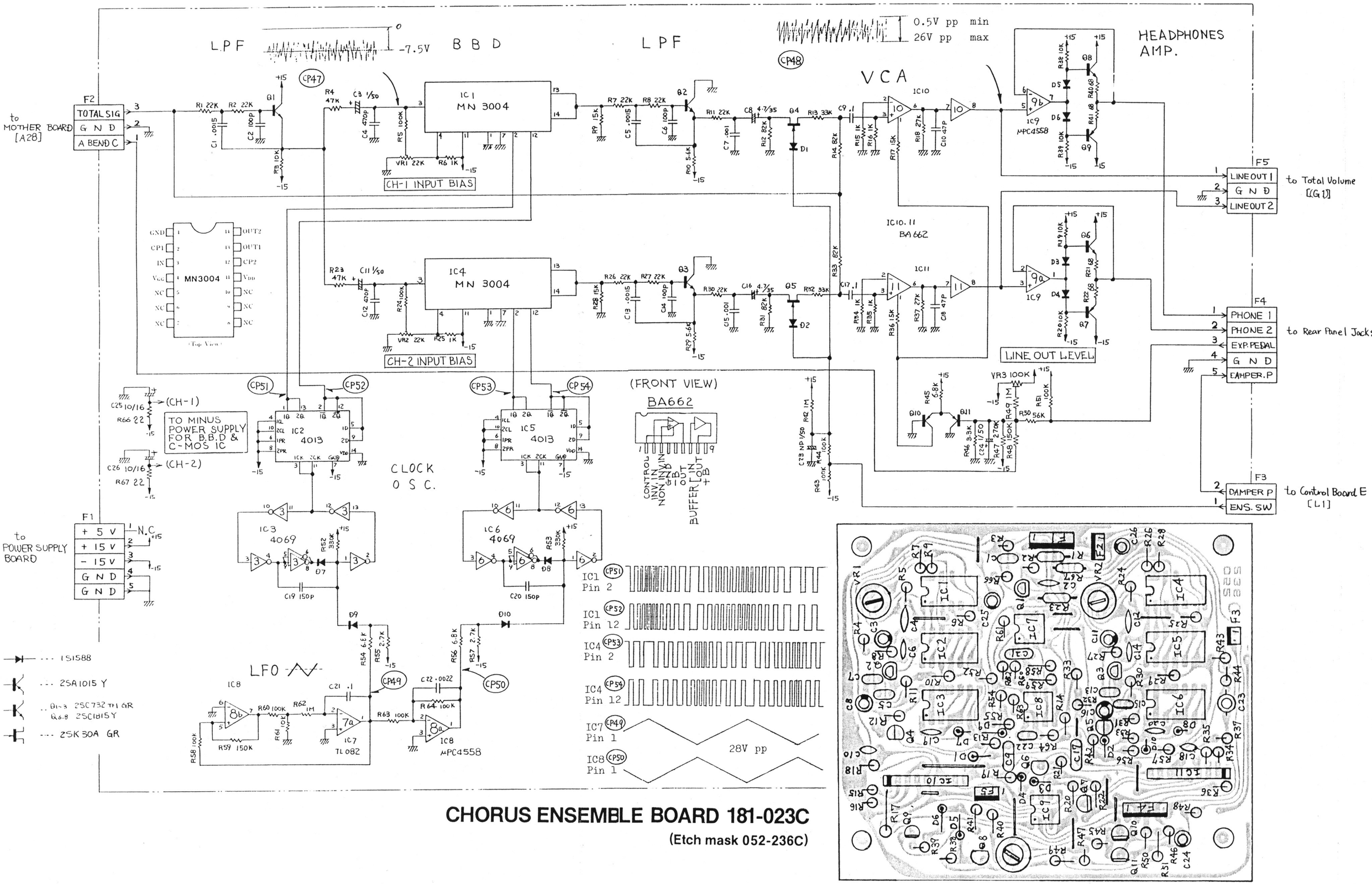
BA662

4558

CP32 DELAY LFO control signal
IC12 Pin 7
15s max
GATE ON

CP31 NOISE Q24 Emitter
2Vp-p

CHORUS ENSEMBLE BOARD



CHORUS ENSEMBLE BOARD 181-023C

(Etch mask 052-236C)

SUPPLEMENT PAGE 16

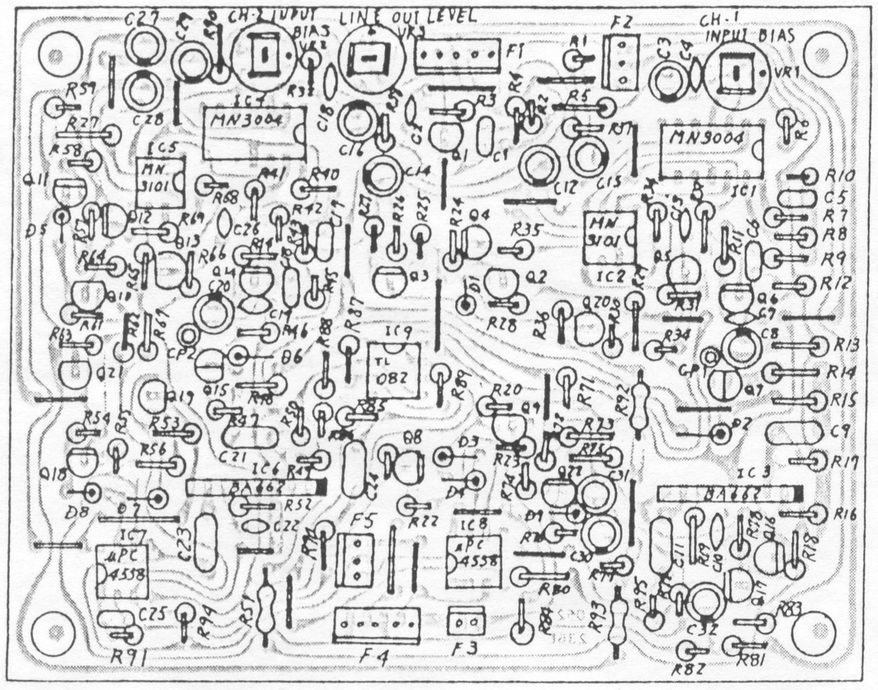
IC3 IC6 Designation

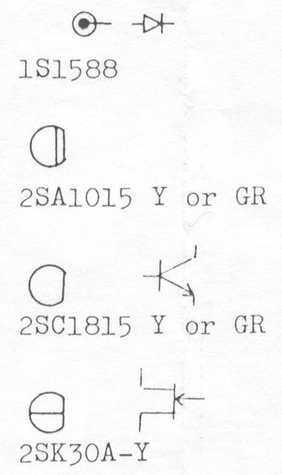
MSM4069RS is dominant because of its greater S/N ratio, but its threshold varies from IC to IC within slightly larger range when compared with other brands.
These variations in threshold are compensated for by changing the value of R52 and R53 from 330k to 390k ohms.

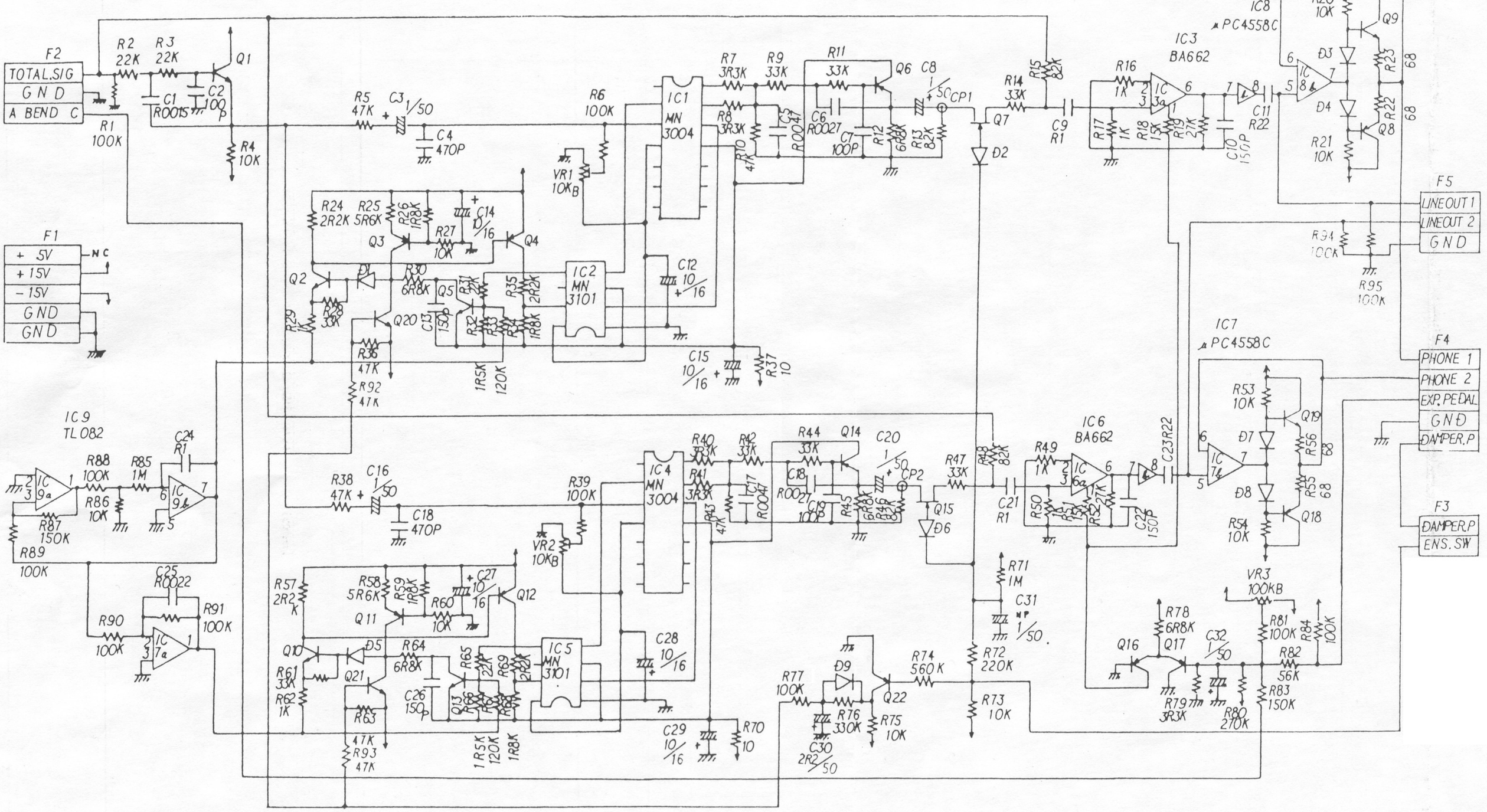
CHORUS ENSEMBLE BOARD 181-023E
(Etch mask 052-236E)

Compatible with 181-023C

(Effective S/N is not set forth at the date of issue.)
Clock Oscillators and BBD drivers are different from those on 181-023C and are disabled during ENSEMBLE "off" mode. No Clock leakages in off-mode.







INFORMATION ON DESIGN CHANGES

PART 1 PCB IMPROVEMENTS & COMBINATIONS

Some of circuit-design-changes involve modification on more than one pcb, causing matched pcbs to be used. Replacement-pcbs supplied from the factory may be the latest version and can fulfill the purpose with or without minor modifications.

See page 16-2 (PART 2) for:

Details for the pcb listed below
Design changes on sole board
Other major improvements

INTERCHANGEABLE

BASIC CONBINATION

MOTHER BOARD	MODULE BOARD	MODULE CONTROLLER	SERIAL NO.
181-019B (052-364B)	**181-020B or C (052-314B or C)**	**181-021 A, B or C (052-235 A, B or C)**	750100
with Q15 and Q16	without Q20, Q21	R36 = 22K	
VCF: current control by Q15,Q16 (constant current sources)			790799
needs some modifications(see P.19)		just change R36	800800
181-019 B (052-364 B)	**181-020 D (052-314 D)**		
without Q15,Q16	with Q20 and Q21	R36 = 47K	
VCF: voltage control by IC27,IC28 via Q20,Q21 (V-I converters)			912200
	VCF IC: BA662		942749
	181-020 E (052-314 E)	**181-021 D or E (052-235 D or E)**	952750 / 952799
	VCF IC: 1R3109	R36 = 47K	952800 / 952849
181-019 C or D (052-364 C or D)			952850
with transistor mounting holes to accommodate Q15 and Q16 for modification	VCF ADJUSTMENT: partially different from B/C/D versions Additional ADJ. SECTION 25 VCF INV (VR11) effective with S/N ..4100		993400 00.... 01.... 02.... first 2 digits cycles

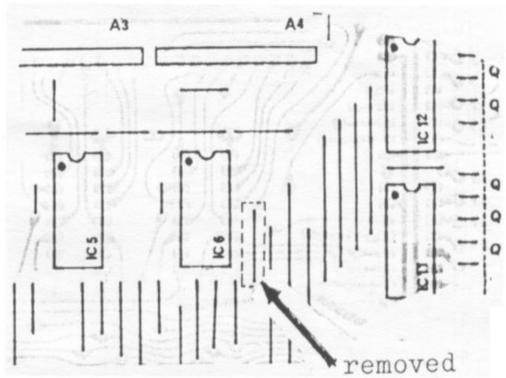
BASIC COMBINATION

KEY ASSIGNER	CONTROL BOARD D
181-022 A or B (052-032 A or B)	**181-009 C or D (052-331 C or D)**
IC (PORTA.) BA662	VR3 = 2MA
181-022 C (052-032 C)	**181-009 D (052-331 D)**
IC (PORTA.) 1R3109	VR3 = 50KB
needs additional adjustment (VR2) ADJ. SECTION 3	
181-022 B (052-032 B)	**181-009 D (052-331 D)**
IC (PORTA.) BA662	VR3 = 2MA
181-022 C	**181-009 D**
IC: 1R3109	VR3 = 50KB

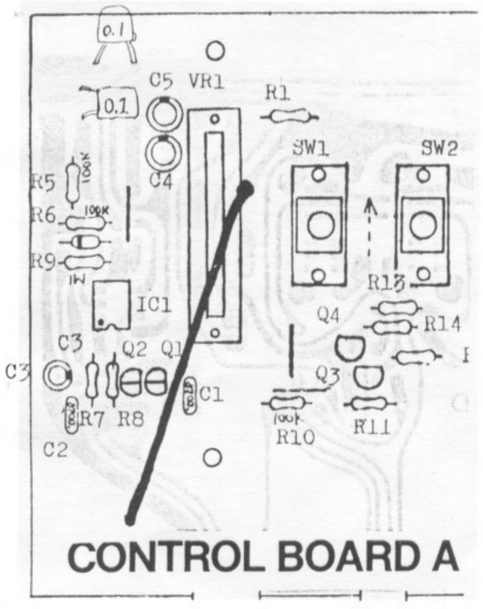
REDUCING NOISES ON GROUND PATH CONTROL BOARD-A, B, C

Noises are induced on GND of these PCBs while the ground path is passing through Mother board to DC source, causing ripples to be superimposed on Control board output voltages.
To by-pass M board, the jumper leading to A4 pin no.1 is removed. A wire is placed between the GND and ground lug on top panel as shown below.

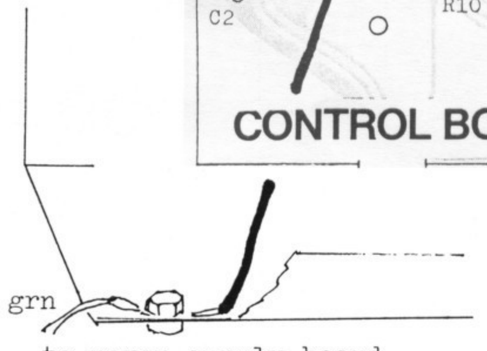
This modification would be effective if frequency fluctuates during VCF osccillation with RES knob raised.



MOTHER BOARD



CONTROL BOARD A



to power supply board

INFORMATION ON DESIGN CHANGES

PART II LIST OF MAJOR MODIFICATIONS

SERIAL NO.	WHAT IS IMPROVED	A F F E C T E D P C B		PAGE
800800	easy adj. by addopting V-I converter for VCF, multi-turn trim for VCO	MODULE BOARD MOTHER BOARD MODULE CONTRLR	181-020D 181-019B 181-021C	19 13 22
820950	noises on panel control outputs is reduced by by-passing Mother board GND path	MOTHER BOARD CONTROL BRD A	181-019B 181-006	12-2 14
861500	IC11 is protected from charged voltage fed at its pins by providing C26, C27 and D4.	KEY ASSIGNER	181-022B	25-1 25-2
871600	VCO fluctuation due to connectors' loose contacts (-15V and CV path) is reduced by direct wirings	MOTHER BOARD KEY ASSIGNER POWER SUPPLY CONTROL BRD D	181-020 181-022B/C 181-024 181-009	12-1 25-1 26-1 14
952750	VCFs configurations are simplified and leveled by using 1R3109	MODULE BOARD	181-020E	16-2 21-1 21-2
	1R3109 ensures synchronous PORTAMENTO time of 4-VCO without adjustments	KEY ASSIGNER CONTROL BRD D	181-022C 181-009	25-1 25-2 14
..3800	cause of faulty analog voltages i.e. misreading of D/A bits is prevented by re-connecting IC13-14 (MANUAL mode)	MOTHER BOARD	181-019C/D	12-1
..4100	VOICE (preset) envelope can be tailored by adjusting VCF INV pot.	MODULE BOARD	181-020E/F	21-1 21-2
.....	S/N ratio is increased	CHORUS ENSEMBLE	181-023E	16-1

NOTE: Unfulfilled serial numbers indicate that no effective numbers are predictable at the issue date of 2nd edittion. First 2-digit in serial number increases by 1/month and is reset to 00 after 99.

IC SPECIFICATION

Although most of ICs of various makers are interchangeable, because of JP-4's sever design factors, some of them must be selectively used in accordance with designations on the circuit diagrams for sufficient performances.

1. Brand Classifications

PCB	DEGIGNATION		MANUFACTURE
MODULE CONTROLLER 181-021	IC1-IC3	CD4069UBE	RCA
MODULE BOARD 181-020	IC4	TC4069UBP or CD4069UBE	Toshiba RCA
CHORUS ENSEMBLE 181-023 A, B, C	IC3 IC6	MSM4069RS	Oki
KEY ASSIGNER 181-022	IC12	TC4069UBP or CD4069UBE	Toshiba RCA
	IC6	TC4013	Toshiba
	IC11	4052	exclude RCA

READ THROUGH ADDITIONAL PAGES (WITH A SUFFIX)

even if they seem to have no relation to the work being done based on original pages. Some of the contents on additional pages will supplement or correct those on the original pages; may include improvement on early products, since originals are kept unchanged as possible.

Often on several pages, will appear the same explanation that makes it well understood. These pages have interrelations in terms of alteration, pcb combination and so forth.

1R3109

The IR3109 contains four variable transconductance amplifiers designed for VCF applications in electronic musical instruments.
The device is equipped with four high input impedance buffers, and anti-log circuitry (V-in to I-out) which controls conductances of four amps.

. wide transconductance variable range (1μU -10mU)
. low input offset voltage (less than ±3mV) (transconductance amplifier)
. high input impedance. MOS P-channel (buffer)

2. Quadruple-use of The Same IC

The quadruplicate stages in the 4-voice JP-4 circuits require the same IC to be mounted for the same tonal characteristic.

MODULE BOARD IC20, IC22 4016 for concurrent
181-020 IC23, IC24 4025 ATTACK TIME
the same brand for four modules

BA662 factory selected with a paint dot

Ideally, each of the following groups must be in complete set of the same color, but one or two ICs on a PCB would be of a color in a range ±2 of the group grade. See color code shown in the table below.

MODULE BOARD
181-020 A/B/C/D IC11-IC15 181-020 E IC17,IC18
of the same color for four modules for simultaneous tonal change

KEY ASSIGNER IC13-IC16
181-022C for synchronous Portamento time

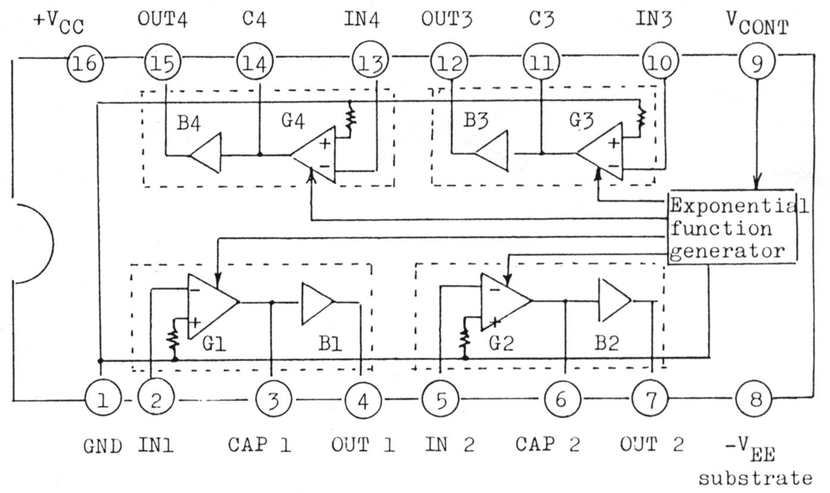
BA662 color code

grade	1	2	3	4	5	6	7	8	9
color	BRN	RED	ORN	YEL	GRN	BLU	D.GRN or VIO	GRY or BLK	WHT

low ←---- gm ------ high ---→

Mixed use of BA662A and BA662B is allowed for above applications.

1R3109
(top view).

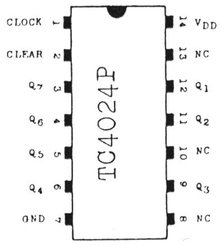


TC4024P 7-STAGE BINARY COUNTER

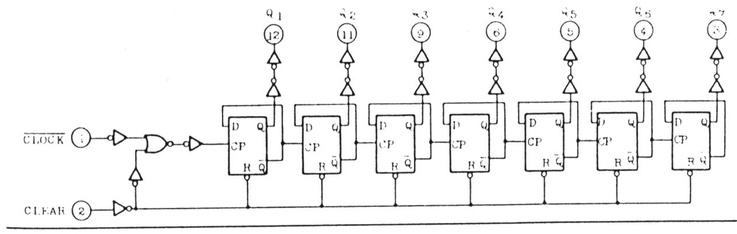
TRUTH TABLE

CLOCK	CLEAR	OUTPUT STATE
※	H	All Outputs='L'
∫	L	No Change
⌐	L	Advance to Next State

▵ ; Level Change, ※ ; Don't care

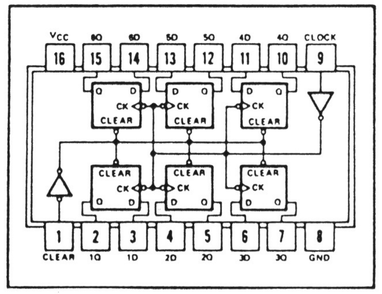


LOGIC DIAGRAM



SN74LS174 HEX D-TYPE FLIP-FLOP

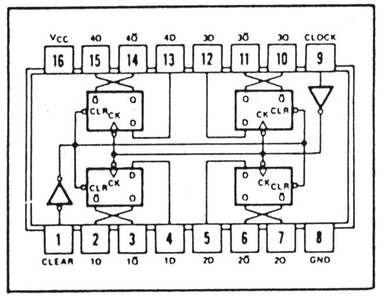
(TOP VIEW)



H = high level (steady state)
L = low level (steady state)
X = irrelevant
↑ = transition from low to high level
Q_0 = the level of Q before the indicated steady-state input conditions were established.
† = '175, 'LS175, and 'S175 only

SN74LS175 QUADRUPLE D-TYPE FLIP-FLOP

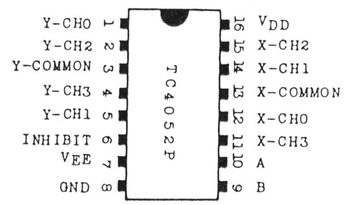
(TOP VIEW)



FUNCTION TABLE
(EACH FLIP-FLOP)

INPUTS			OUTPUTS	
CLEAR	CLOCK	D	Q	$\bar{Q}$†
L	X	X	L	H
H	↑	H	H	L
H	↑	L	L	H
H	L	X	Q_0	$\bar{Q}_0$

TC4051BP SINGLE 8-CHANNEL MULTIPLEXER/DEMULTIPLEXER
TC4052BP DIFFERENTIAL 4-CHANNEL MULTIPLEXER/DEMULTIPLEXER



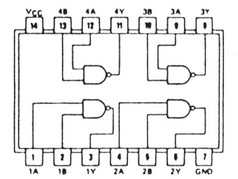
TRUTH TABLE

CONTROL INPUTS				'ON' CHANNEL		
INHIBIT	C▵	B	A	TC4051BP	TC4052BP	TC4053BP
L	L	L	L	0	0X, 0Y	0X, 0Y, 0Z
L	L	L	H	1	1X, 1Y	1X, 0Y, 0Z
L	L	H	L	2	2X, 2Y	0X, 1Y, 0Z
L	L	H	H	3	3X, 3Y	1X, 1Y, 0Z
L	H	L	L	4	—	0X, 0Y, 1Z
L	H	L	H	5	—	1X, 0Y, 1Z
L	H	H	L	6	—	0X, 1Y, 1Z
L	H	H	H	7	—	1X, 1Y, 1Z
H	※	※	※	NONE	NONE	NONE

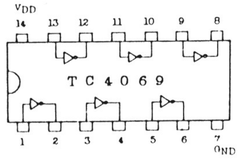
※ Don't Care, ▵ Except TC4052BP

74LS00

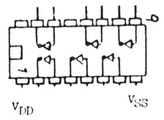
QUADRUPLE 2-INPUT POSITIVE-NAND GATES



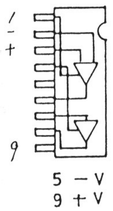
TC4069



TC4049P

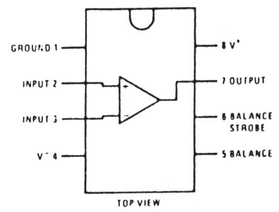


BA662

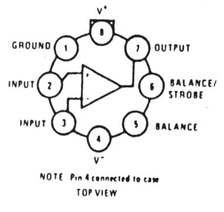


LM311

Dual-In-Line Package

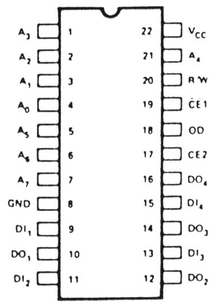


Metal Can Package

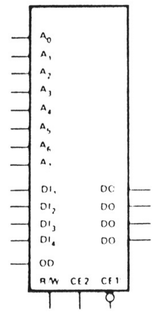


μPD5101C-E

PIN CONFIGURATION



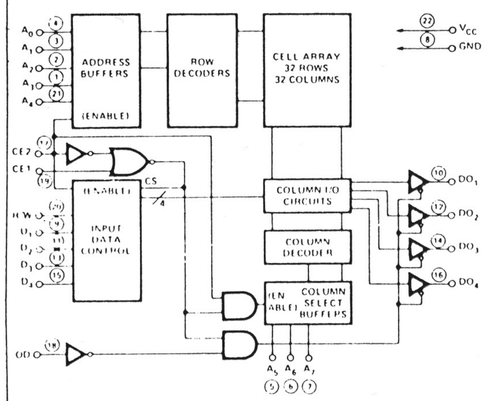
LOGIC SYMBOL



TRUTH TABLE

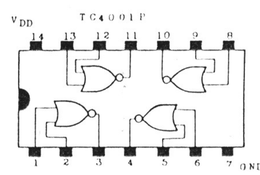
$\overline{CE}_1$	CE_2	OD	R/W	D_{IN}	Output	Mode
H	X	X	X	X	High Z	Not Selected
X	L	X	X	X	High Z	Not Selected
X	X	H	H	X	High Z	Output Disabled
L	H	H	L	X	High Z	Write
L	H	L	L	X	D_{IN}	Write
L	H	L	H	X	D_{OUT}	Read

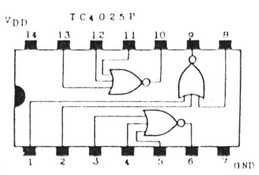
BLOCK DIAGRAM



TC4001P QUAD 2-INPUT POSITIVE NOR GATE

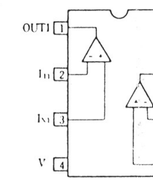
TC4025P TRIPLE 3-INPUT POSITIVE NOR GATE



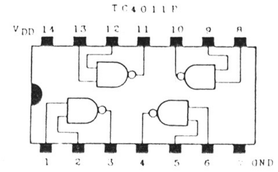


TL082, TL072
LM353
μPC4558C

Connection Diagram (Top View)

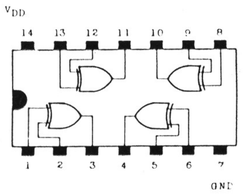


TC4011P QUAD 2-INPUT POSITIVE NAND GATE



MC14070B
TC4030BP

QUAD EXCLUSIVE-OR GATE

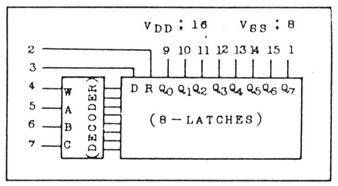


TRUTH TABLE

INPUTS		OUTPUT
A	B	X
L	L	L
L	H	H
H	L	H
H	H	L

TC4099BP

BLOCK DIAGRAM



TC4099BP 8-BIT ADDRESSABLE LATCH

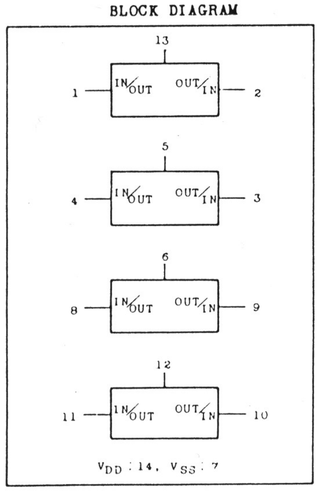
TRUTH TABLE

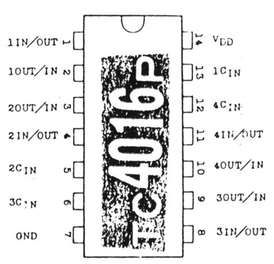
CONTROL INPUTS		ADDRESS INPUTS			OUTPUTS							
RESET	W.DIS.	C	B	A	Q0	Q1	Q2	Q3	Q4	Q5	Q6	Q7
H	H	※	※	※	L	L	L	L	L	L	L	L
L	H	※	※	※	—	—	—	—	—	—	—	—
H	L	L	L	L	D	L	L	L	L	L	L	L
H	L	L	L	H	L	D	L	L	L	L	L	L
H	L	L	H	L	L	L	D	L	L	L	L	L
H	L	L	H	H	L	L	L	D	L	L	L	L
H	L	H	L	L	L	L	L	L	D	L	L	L
H	L	H	L	H	L	L	L	L	L	D	L	L
H	L	H	H	L	L	L	L	L	L	L	D	L
H	L	H	H	H	L	L	L	L	L	L	L	D
L	L	L	L	L	D	—	—	—	—	—	—	—
L	L	L	L	H	—	D	—	—	—	—	—	—
L	L	L	H	L	—	—	D	—	—	—	—	—
L	L	L	H	H	—	—	—	D	—	—	—	—
L	L	H	L	L	—	—	—	—	D	—	—	—
L	L	H	L	H	—	—	—	—	—	D	—	—
L	L	H	H	L	—	—	—	—	—	—	D	—
L	L	H	H	H	—	—	—	—	—	—	—	D

※ ; DON'T CARE D ; DATA INPUT
— ; HOLDS PREVIOUS DATA

TC4016 QUAD BILATERAL SWITCH

BLOCK DIAGRAM





TRUTH TABLE

CIN	Impedance Between IN/OUT – OUT/IN ※
H	$2 \sim 20 \times 10^2\,\Omega$
L	$> 10^9\,\Omega$

※ See Electrical Characteristics

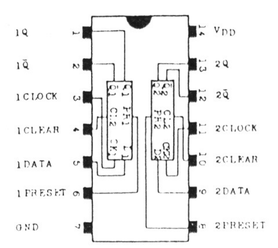
TC4013P

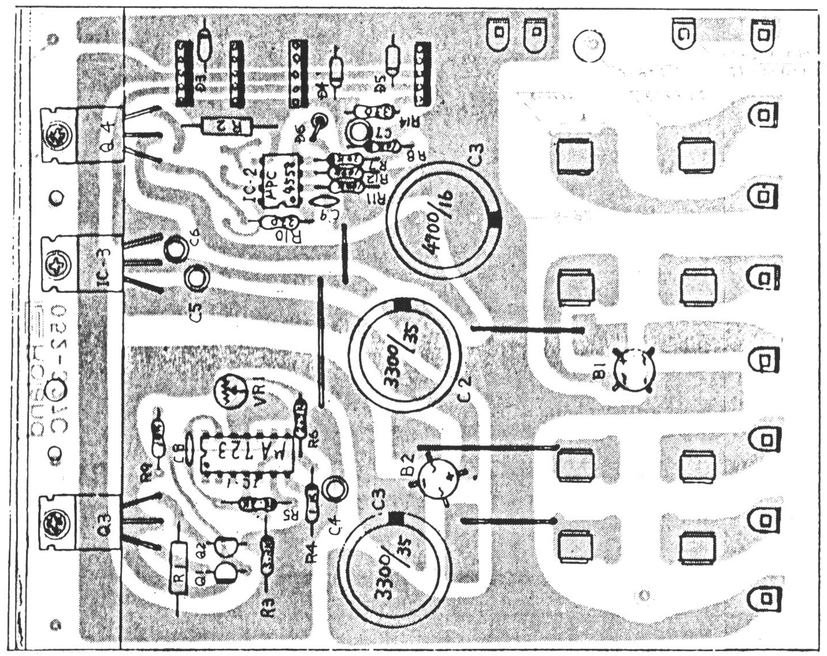
TRUTH TABLE

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

DUAL D-TYPE FLIP-FLOP



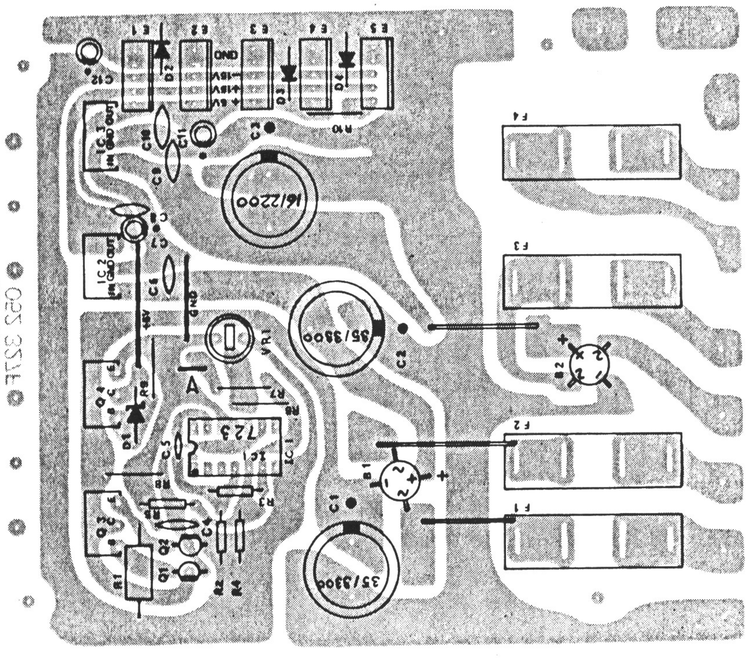


181-024C
Right

Serial No. up to 790799

Use 181-024F for replacement

DIFFERENCE BETWEEN 181-024 E and F: only conductor spacing



POWER SUPPLY BOARD 181-024F
(Etch mask 052-327F)
Serial No. 800800 and higher

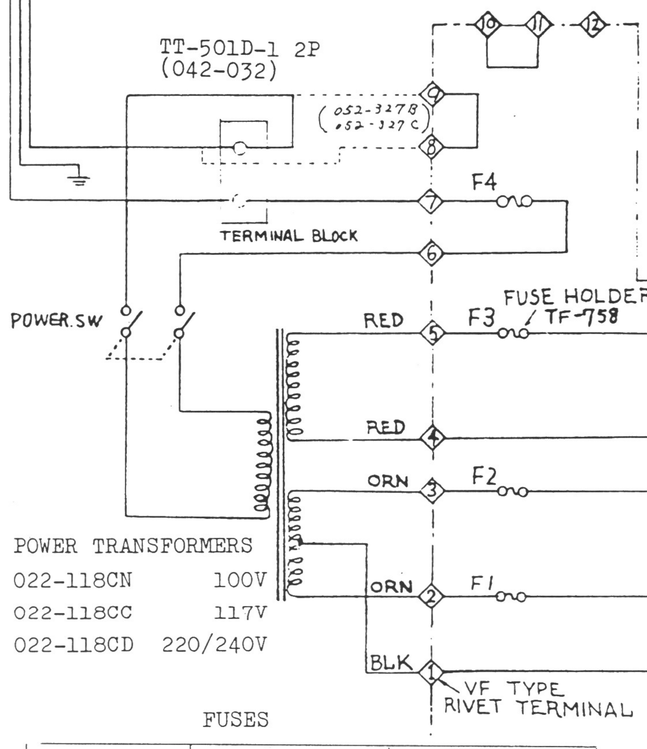
DESTINATIONS of CONNECTORS

E1: Mother Board IC30 (Output Mixer)
Control Board D(via Module Controller B5(1,2,3))
Module Board C3(2,6,8,9) VCF,VCA, ENV GEN

E2: Mother Board,Module Board C1(1-4)
Key Assigner D6, Control Board(except D)
Module Controller B3(7,8,9) B4(1,2,3)

E3: Chorus Ensemble Board F1

E5: Power Indicator (LED)

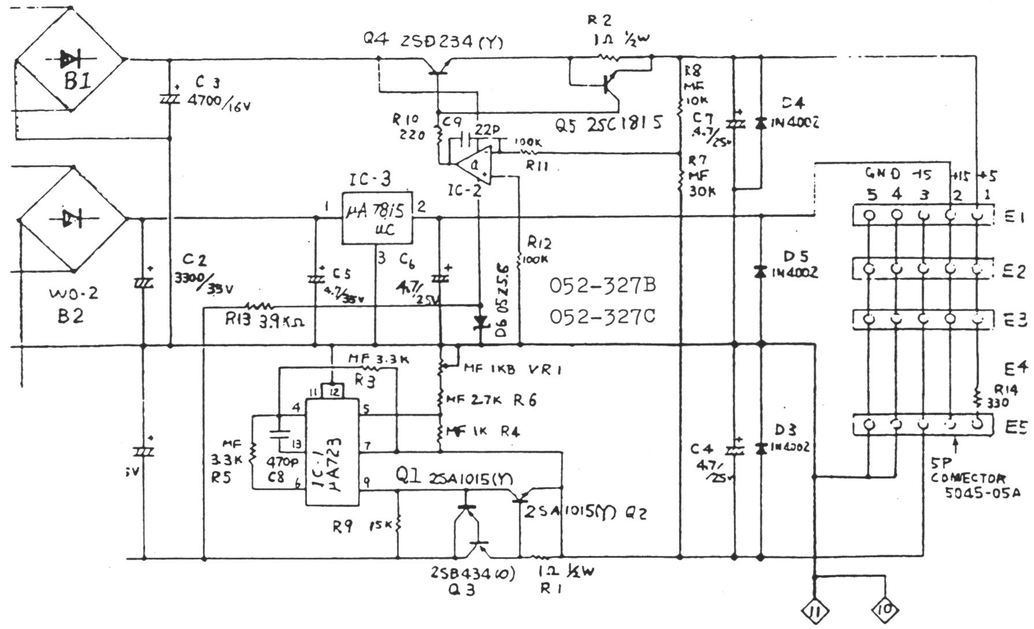


POWER TRANSFORMERS

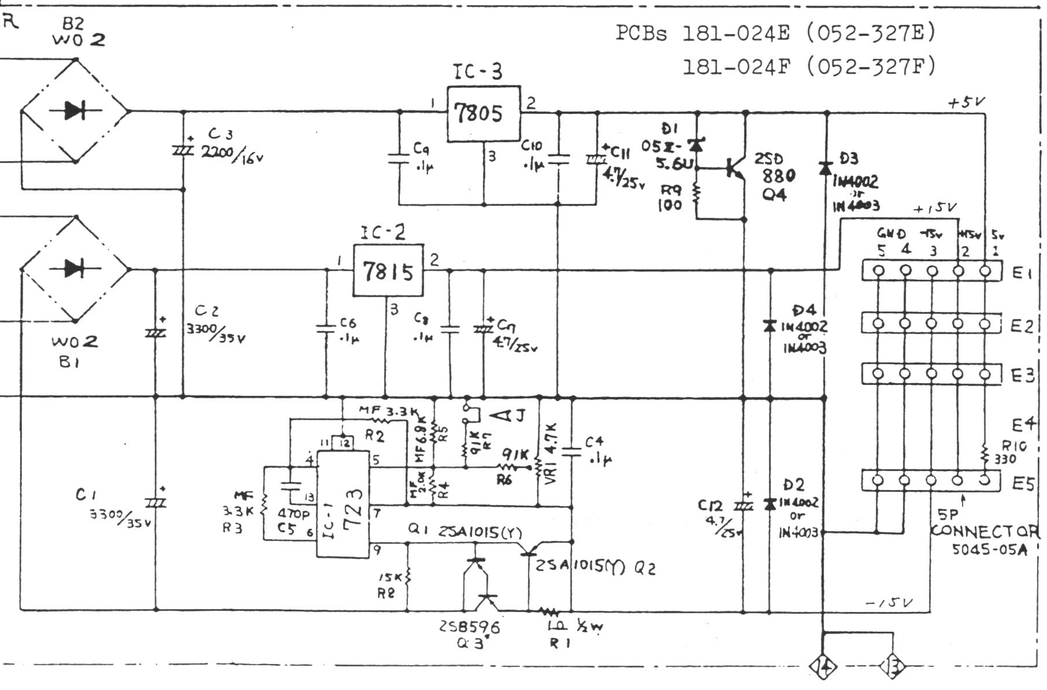
022-118CN	100V
022-118CC	117V
022-118CD	220/240V

FUSES

AC	F1-F3	F4
100/117V	SGA0002(2A) (008-028)	SGA0001(1A) (008-026)
220/240V	CEE T2A (008-070)	CEE T500mA (008-063)



PCBs 181-024E (052-327E)
181-024F (052-327F)

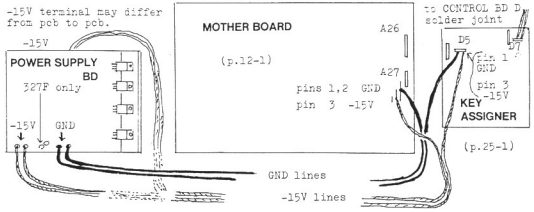


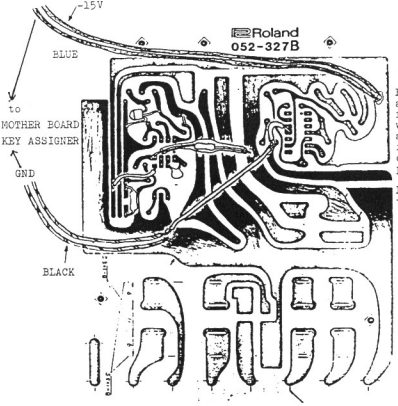
DIRECT WIRINGS —15V & GROUND, TUNE & PORTAMENTO

POWER SUPPLY to MOTHER AND KEY ASSIGNER BOARDS
KEY ASSIGNER to CONTROL BOARD D

One of the important modifications for stable VCO pitch. Prevents voltage fluctuations on -15V and XCV circuits resulting from connectors' loose contacts.
This has been done at the factory with serial number 871600 and subsequent, and will prove effective when done on the products left undone.

For the details about the wirings other than power supply, see respective pages.



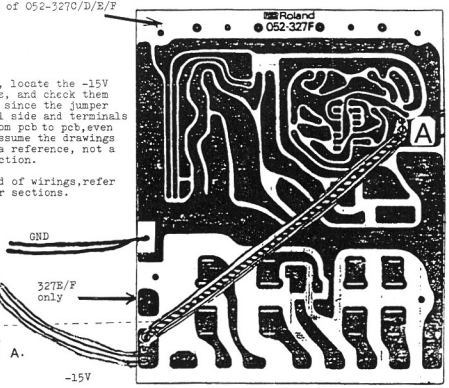


representative of 052-327C/D/E/F

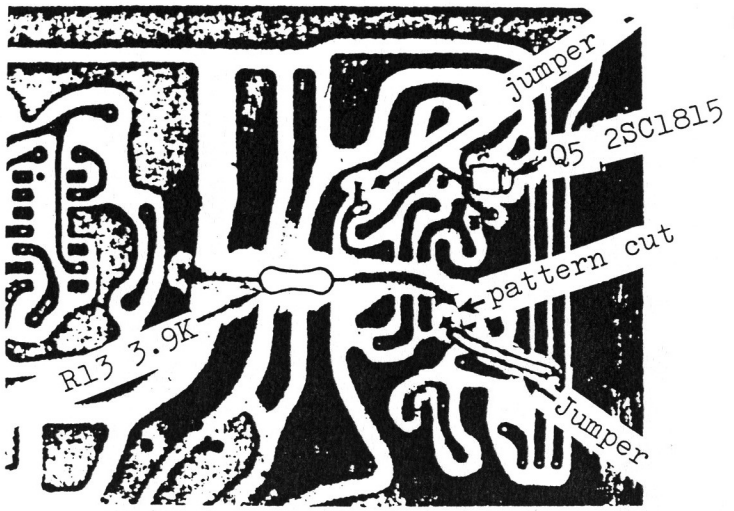
IMPORTANT

Before soldering, locate the -15V and ground points, and check them for the voltages since the jumper wires on the foil side and terminals are different from pcb to pcb,even in a version. Assume the drawings on this page as a reference, not a practical instruction.

For the other end of wirings,refer to the particular sections.

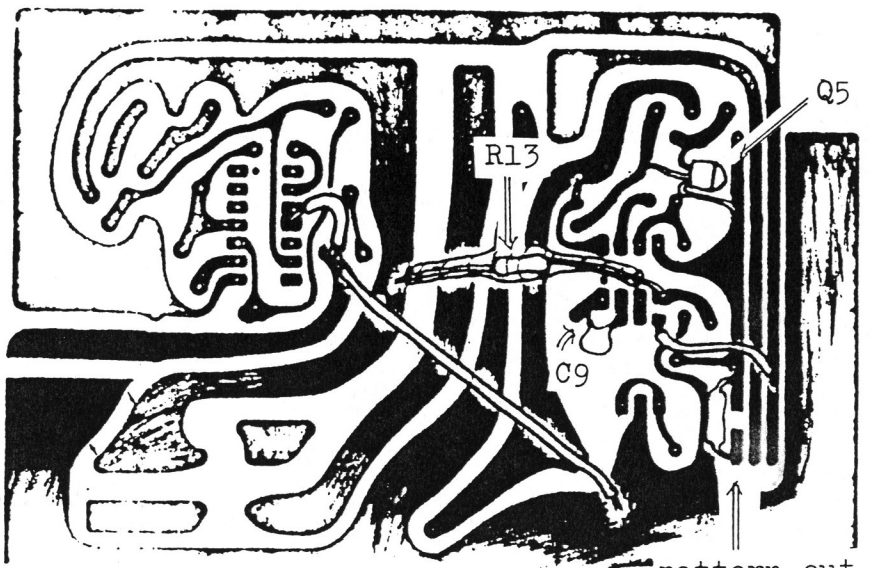


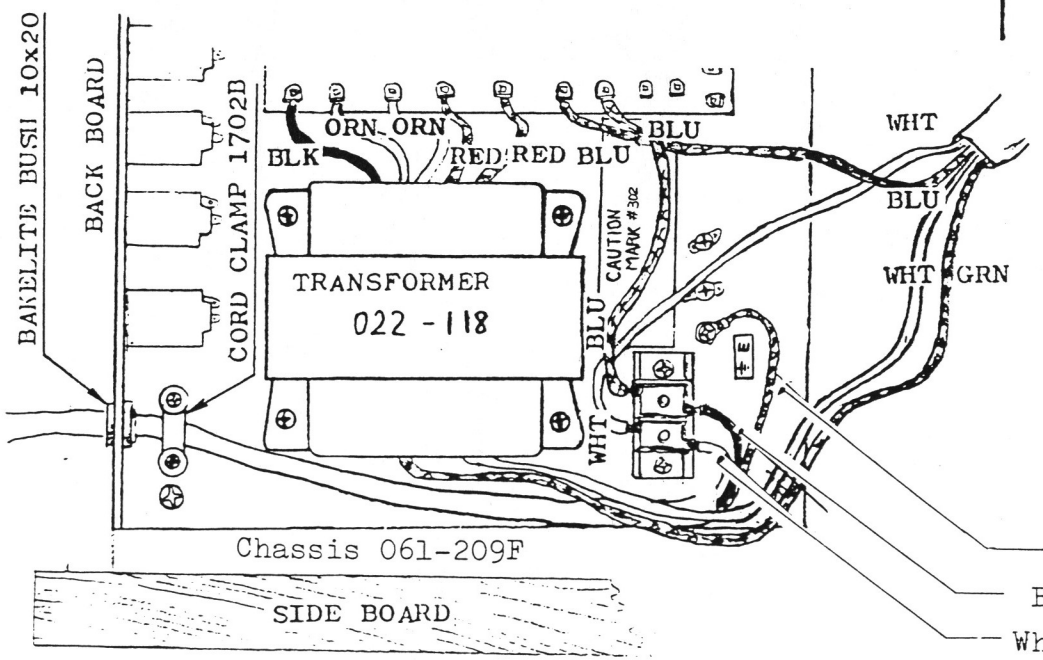
Components, jumpers and pattern cut on foil side



TOP VIEW

view from component side





Green (3-phase)

Black (100/117V) Brown (220/240V)

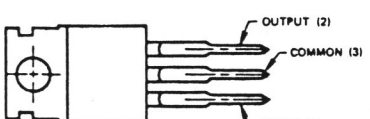
White (100/117V) Blue (220/240V)

7805

7815

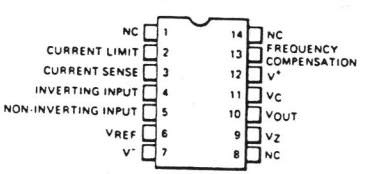
(TOP VIEW)

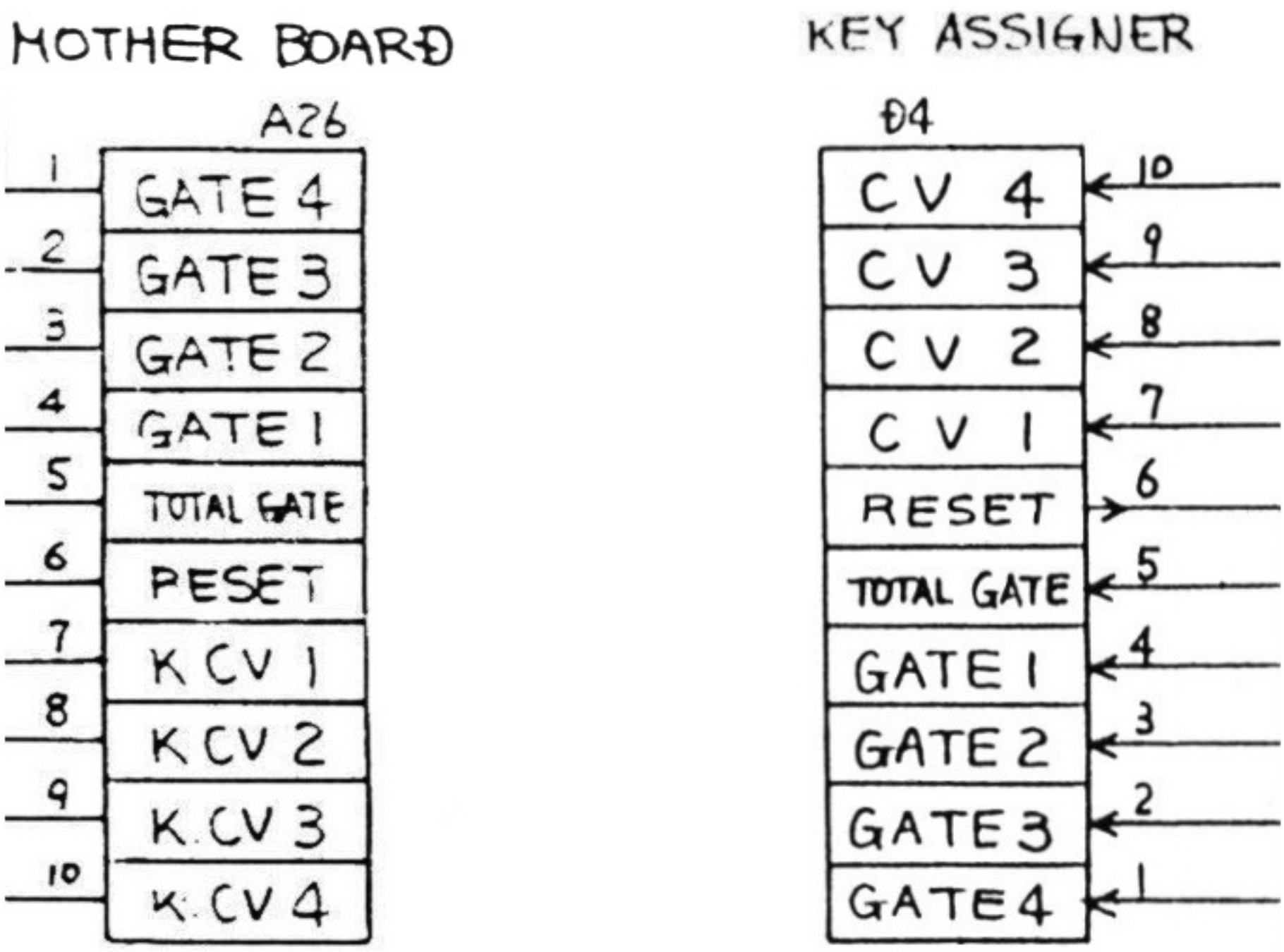
PACKAGE OUTLINE GH



μA723

(TOP VIEW)




MOTHER BOARD
A26
1
GATE 4
2
GATE 3
3
GATE 2
4
GATE 1
5
TOTAL GATE
6
PESET
7
K CV 1
8
K CV 2
9
K.CV 3
10
K.CV 4
KEY ASSIGNER
D4
CV 4
10
CV 3
9
CV 2
8
CV 1
7
RESET
6
TOTAL GATE
5
GATE 1
4
GATE 2
3
GATE 3
2
GATE 4
1

REPLACING PCB INVOLVES ADJUSTMENTS

After replacing PCBs, the following adjustments must be performed.

POWER SUPPLY BOARD
(including IC change on this board)
Basically, all sections are to be examined since variations in DC supply can affect most circuits.

MOTHER BOARD
Sections 4-24
except CHORUS

KEY ASSIGNER BOARD
Sections 2-3

MODULE BOARD
Sections 7-20 except CHORUS

MODULE CONTROLLER BOARD
Sections 7-26 except CHORUS

CHORUS ENSEMBLE BOARD
Sections 27-28

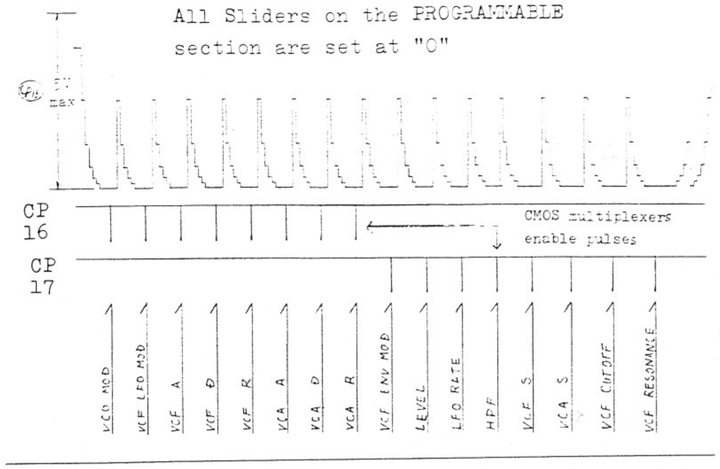
DIFFERENT ADJUSTMENT BETWEEN SERIAL NUMBERS & VERSIONS

Before replacing PCB, refer to pp.12-2, 16-2 for compatibility, modifications involved or PCB combination.
Some adjusting sections and steps are selectively applicable to particular PCB as shown below.

① Steps are different from for other versions.
② Sole adjustment to this version.

<table>
<tr><th>SERIAL NO.</th><th>KEY ASSIGNER
181-022</th><th>MODULE BOARD
181-020</th><th>CONTROL BOARD A
181-006</th></tr>
<tr><td>750100
790799</td><td rowspan="2">052-032
A or B</td><td>052-314 B or C
Sections 11-12 ①</td><td>052-330
Section 6 ②</td></tr>
<tr><td>800800
942749</td><td>052-314 D ①
Sections 11-12</td><td rowspan="4">Changing of VR4 LFO BEND (DELAY/BEND) to a pot with center click can omit above adjustment</td></tr>
<tr><td>952750
952799</td><td>052-032 C ②
Section 3</td><td rowspan="3">052-314 E ①
Sections 11-12</td></tr>
<tr><td>952800
952849</td><td>052-032 B</td></tr>
<tr><td>952850
..4100</td><td>052-032 C
Section 3 ②</td><td>052-314 E
Section 25 ②
Sections 11-12 ①</td></tr>
</table>

(Revised Feb. 1981)

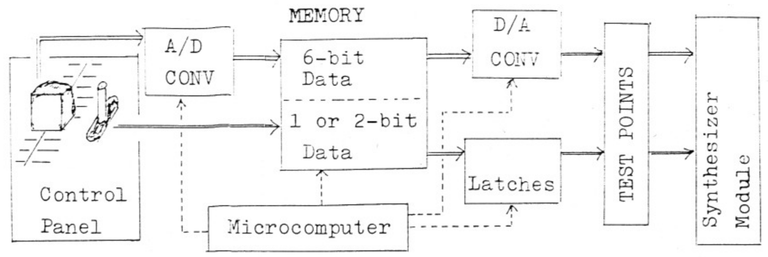


MOTHER BOARD 181-019B

(Etch mask 052-364B)

IMPORTANT

In replacing the Mother board, check both the existing board and the new replacement board for existance or absence of Q15 and Q16. If different, see page 19 for modification.



Figures in TP colum in the table to immediate right and figures at top of the other tables refer to test points shown in the PCB layout below. The following applies.

1. For sliders; voltage will vary within the range of 0V to +5V as the designated slider is being moved.
2. For switches; the output will be a logical 0 (low) or 1 (high): (0V,+15V),(-15V,+5V),(0V,+5V), depending on the lever position.

TP	SLIDER
20	VCO MOD
21	VCF MOD
22	VCF ENV A
19	VCF ENV D
18	VCF ENV R
15	VCA ENV A
17	VCA ENV D
16	VCA ENV R
28	VCF ENV MOD
29	VCA LEVEL
30	LFO RATE
27	HPF C O F
26	VCF ENV S
23	VCA ENV S
25	LPF C O F
24	LPF RES

NOISE

TP	11
OFF	0
ON	1

SUB

TP	5
OFF	0
ON	1

VCF POLARITY

TP	7
NORMAL	1
INVERT	0

VCF KEY FOLLOW

TP	6	13
3	0	0
2	0	1
1	1	0
0	1	1

VCO WAVEFORM

TP	2	9
OFF	0	0
	1	1
	1	0
	0	1

PW/PWM

TP	14
MANUAL	1
LFO MOD	0

LFO WAVEFORM

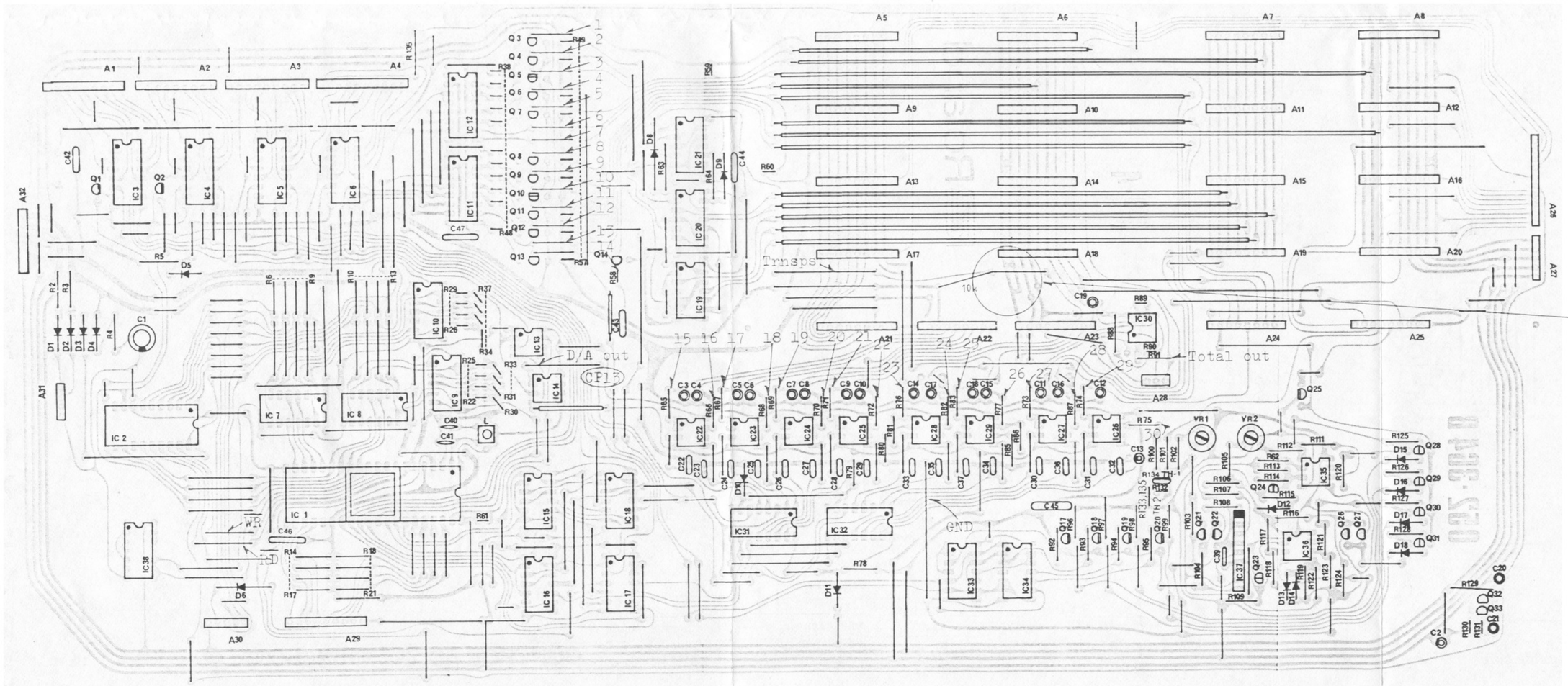
TP	4	12
	1	1
	1	0
	0	1
	0	0

PULSE WIDTH

TP	3	10
4/	1	1
3/	1	0
2/	0	1
1/	0	0

VCO RANGE

TP	1	8
16'	0	1
8'	1	0
4'	1	1



Components on foil side:

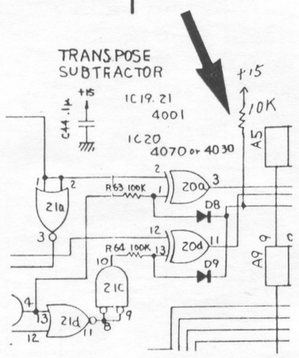
C48, C49

Connector A6, A10, A14, A18, A23 (connections to Power Supply Board E1)

To comensate for loose connection in A27, pins 1 and 2···· GND pin 3 ····· -15V are directly connected to Power Supply Board via exclusive wires - both at the foil side. SEE pp. 12-1(5), 26-1.

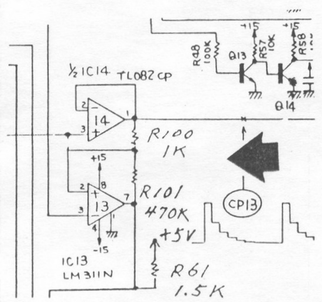
Protecting IC20 against breakdown
With S/N 891900
(181-019B)

1



Preventing IC13 and IC14 from misreading D/A outputs
With S/N xx3800
(181-019 C/D)

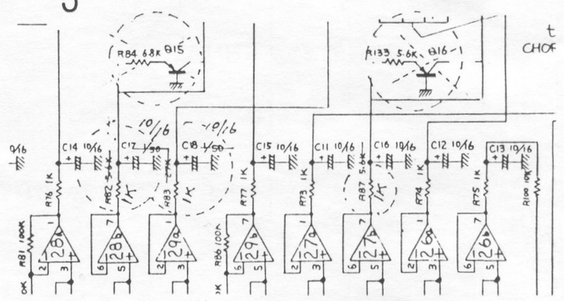
2



Primary Circuit Change

Circuits in dash circles concern VCF control system.
The modifications show constant voltage application for use together with Module board 181-020 -D, -E or -F, while original ones for 181-020 -A, -B or -C.
(Refer to pp. 12 and 19.)

3



MODIFICATIONS ON MOTHER BOARD
other than those described on the left

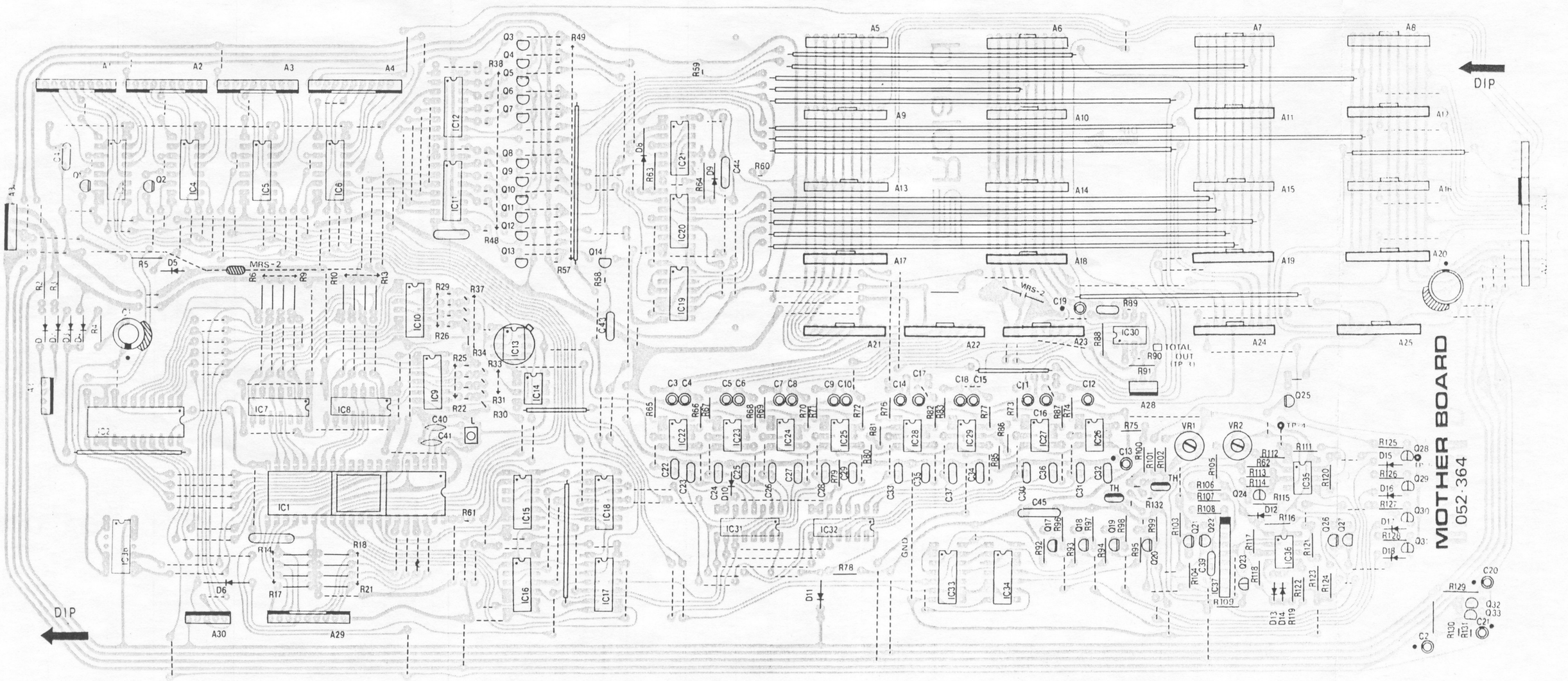
4. Disconnecting ground path from Control Boards A, B and C

The jumper wire leading to pin 1 of terminal A4 is removed to prevent noises from being induced on control boards.
With Serial Number 820950. Refer to illustration on back page.

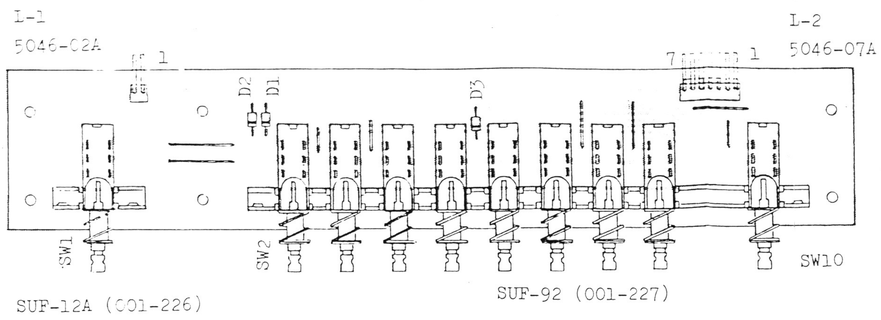
5. Direct wiring to avoid loose connections

For stable VCO performance, lead wires (-15V and ground) from power supply board 181-024 are directly soldered at terminal A27.
With Serial Number 871600. See pp. 16-2, 26-1.

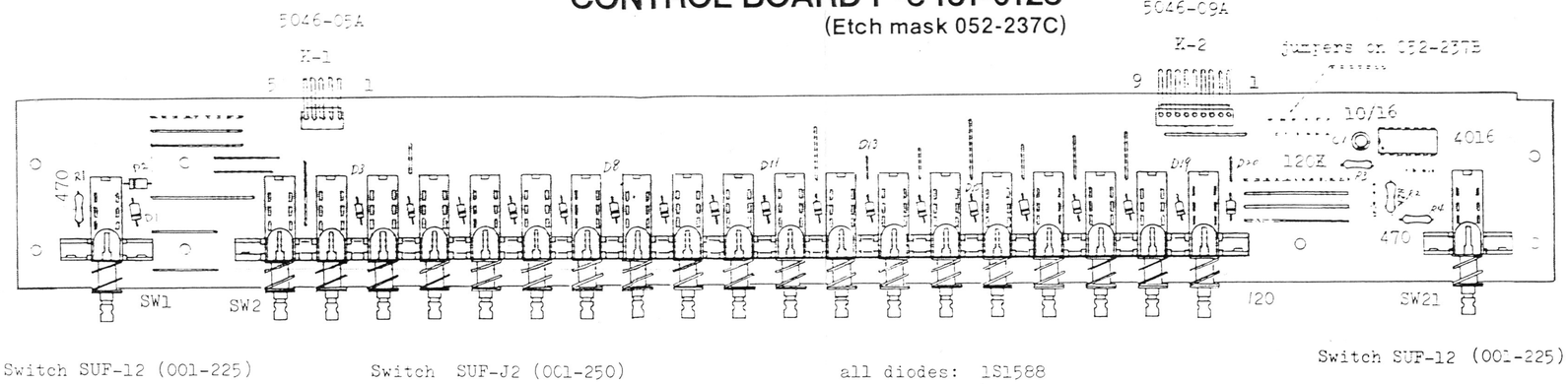
MOTHER BOARD 181-019C/D (pcb 052-364C/D)
With Serial Number 993400
(C and D: the same circuit, but minute pattern differences)
Interchangeable with B version with small modifications.
Refer to no. 3 above, and pp. 12-2, 13 and 19.



CONTROL BOARD E-a 181-011a (Etch mask 052-335A)

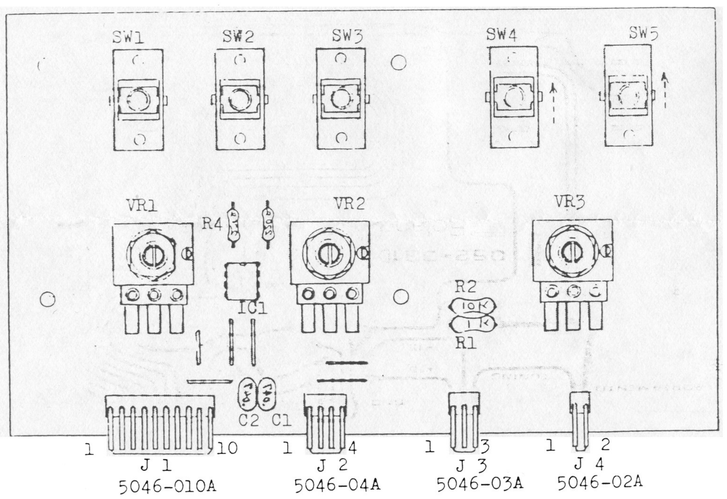


CONTROL BOARD F-c 181-012c
(Etch mask 052-237C)



CONTROL BOARD D-d 181-009d

View from foil side



CONTROL D

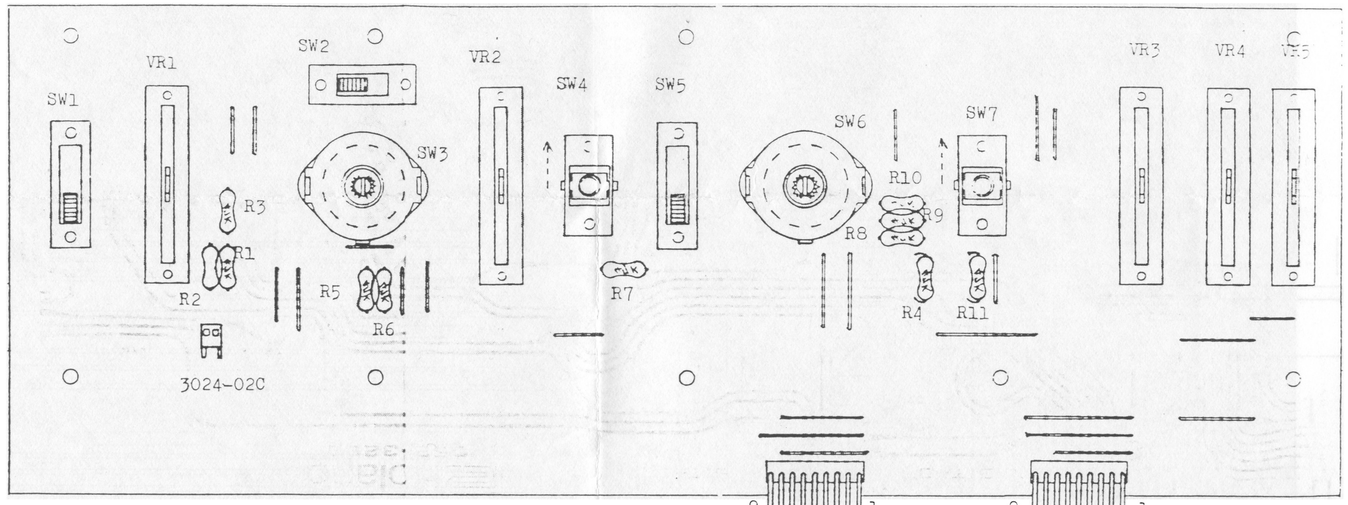
SW1,2,3
LBC-23M-18K (001-238)
SW4,5
LBC-42M-18K (001-237)
VR3 VM10RB10C2MAK20 (028-756)
VR1,2
VM10RB10C50KBK20 (028-762)

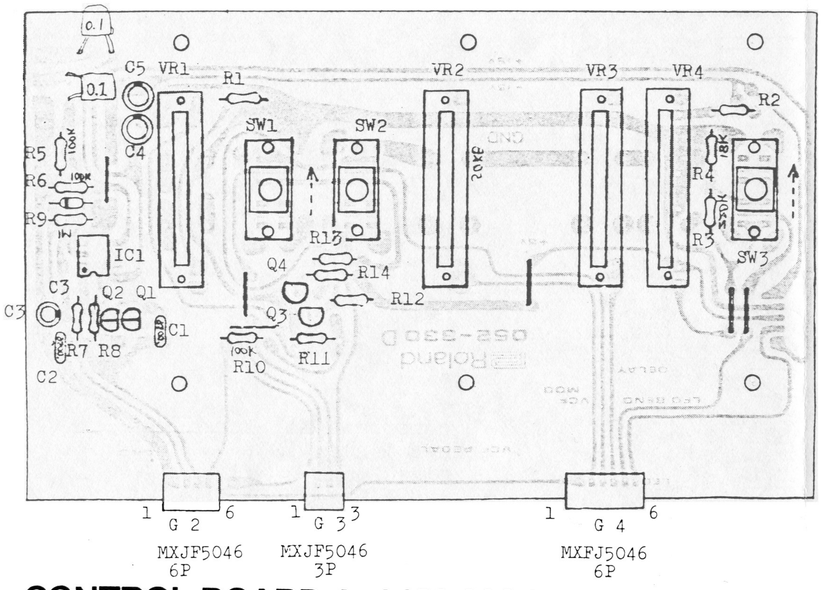
CONTROL B

SW1,5
SQPR-2412P (001-228)
SW2 SSB-022 (001-182)
SW3 SRM-1034-K15 (001-234)
SW4,7
LBC-42M-18K (001-237)
SW6 SRM-1043-K15 (001-224)
All Pots
EVA-V17C16B54 (029-355)

CONTROL BOARD B-d 181-007d

View from foil side





CONTROL BOARD A-d 181-006d

View from foil side

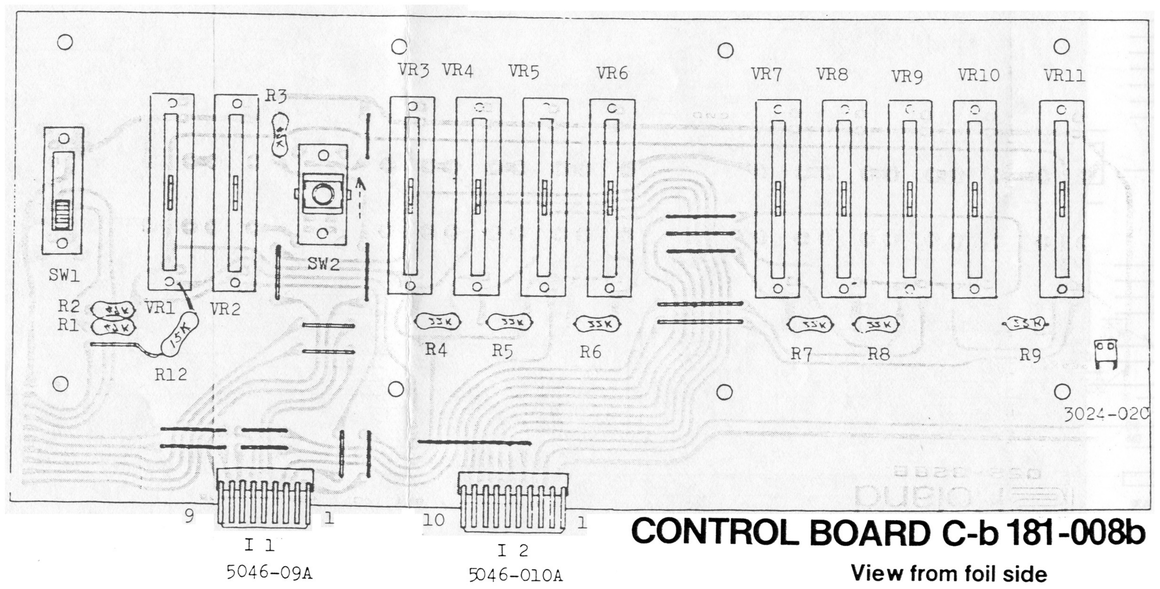
CONTROL A

VR1 EVA-V17C16A26 (029-350)
VR2 EVA-V17C16B54 (029-355)
VR3 EVA-V17C16C26 (029-370)
VR4 EVA-V23C16B54 (029-426)
When used for VR4 on 052-330B/C, center tap pin should be cut off.

SW1,2,3
LBC-42M-18K (001-237)

CONTROL C

SW1 SQPR-2412P (001-228)
SW2 LBC-42M-18K (001-237)
All Pots
EVA-V17C16B54 (029-355)



CONTROL BOARD C-b 181-008b

View from foil side

IMPORTANT
BOARD A -- GND of this board should be connected to top case's ground lug. See p. 12-2 for detail.
BOARD B -- VR3's value is determined according to version of KEY ASSIGNER accompanying; 052-032A/B-2MA: 052-032C-50KB.
Pins of connector J-4 are solder joint to avoid loose connection. See pp. 16-2 (list) and 25-1.

JULY 31, 1979 (Revised Feb. 1981)

IMPROVEMENTS on MODULE BOARD and ITS PERIPHERIES

The VCF circuit on the Module Board has been changed for easier RESONANCE adjustment and this change affects the Mother and Module Controller boards. Simplified circuits shown below illustrate the differences between the new and the old configurations.

Basic differences between the designs

Old circuit (right) Current from Constant Current Sources Q15 and Q16 is shared with four ICs. Changing one trimmer changes the loads and upsets the balance of the other modules. Adjusting the trimmer so as to accurately divide the current sources is difficult.

New circuit (left) In the new circuit, the trimmers are independent of each other because they are supplied from constant voltage sources, IC27 and IC28. Q20 and Q21 serve as V-I converters.

Information about REPLACEMENT, MODIFICATION and ADJUSTMENT

1. Replacement
   Replacement will be a new one, it requires some modifications on itself when it replaces old one. Or it requires other PCBs to be modified when new "VCF" is needed.

Note that Modules A, B, C and D in the same JP-4 must be identical.

2. Modification

-Module Controller-

Just change R36 in value.

181-020 D or E
(052-314 D or E)
Serial number 800800 and higher

-Mother Board-
Being of the same pattern, can easily be modified.

-Module Board-

New to Old
Follow the dotted lines; solder resistors in parallel. When VR4=47K, R135=22K, 47K and 22K in the dotted parentheses are not required.

Old to new
Practically difficult, no component holes in the PCB to accommodate Q20 and Q21.

3. Adjustment

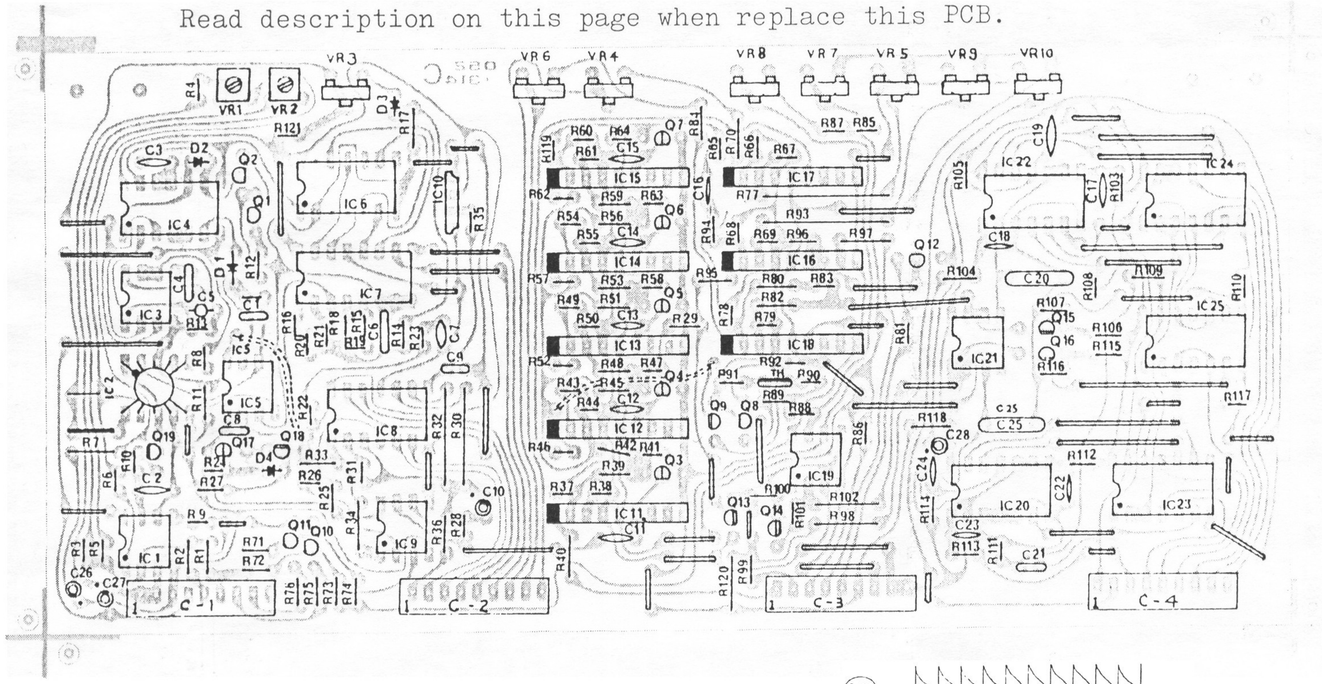
Some steps are different between versions:

Section 11. VCF RESONANCE
052-314 A/B/C -- 11-A
052-314 D/E -- 11-B

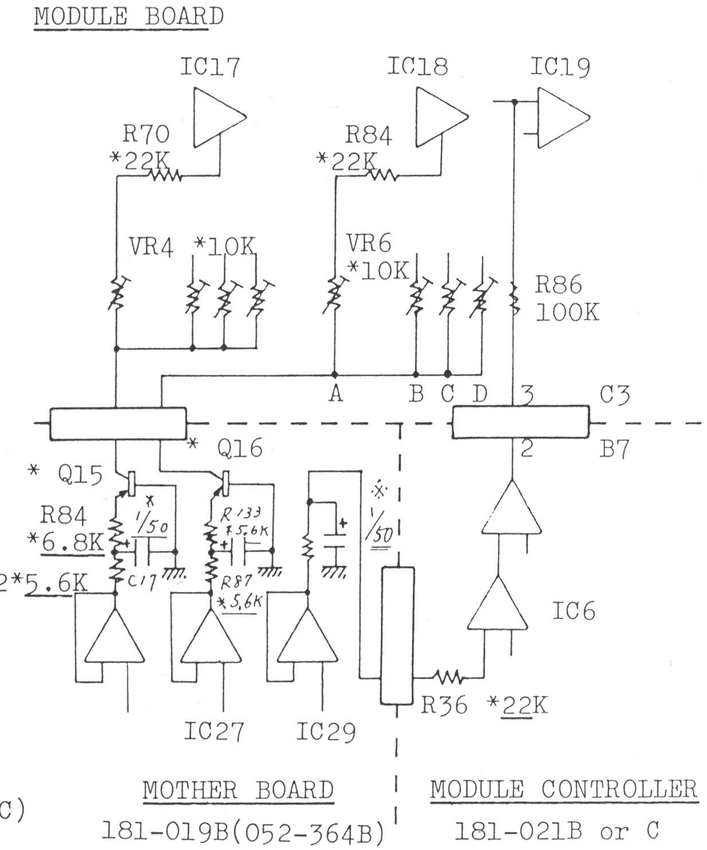
Section 25
052-314 E only

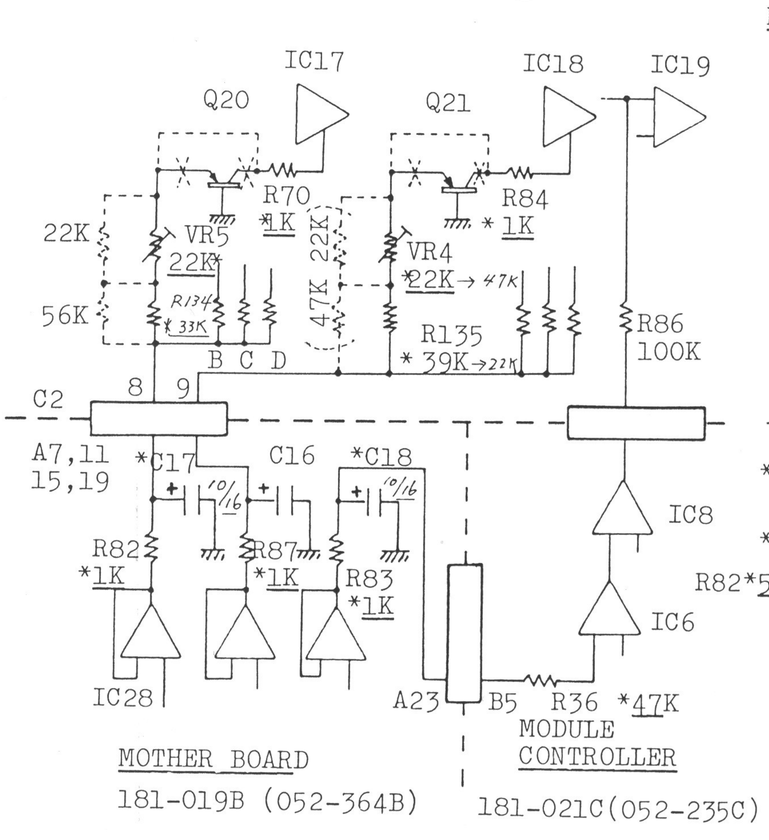
MODULE BOARD 181-020C (Etch mask 052-314C)

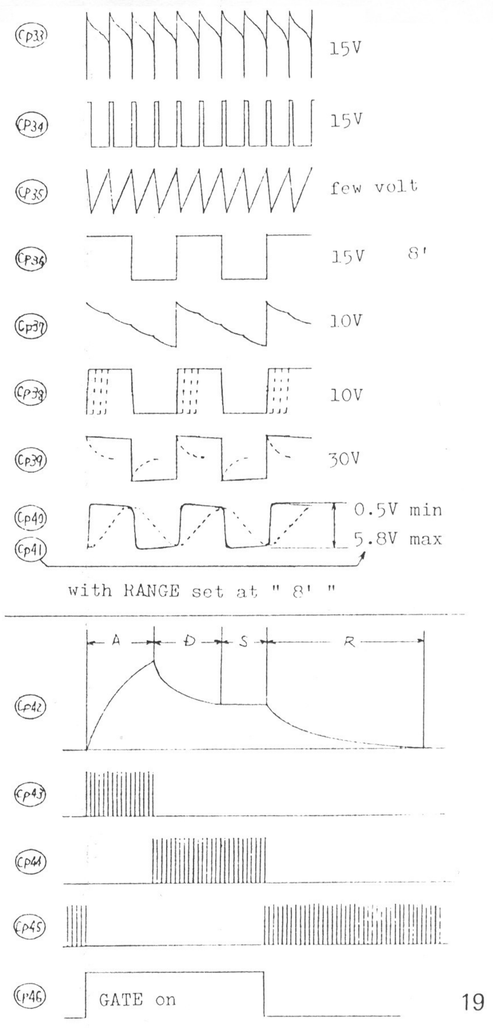
Read description on this page when replace this PCB.



181-020C (052-314C)
Serial no. up to 790799







JULY 31, 1979

MODULE BOARD 181-020D (Etch mask 052-314D)

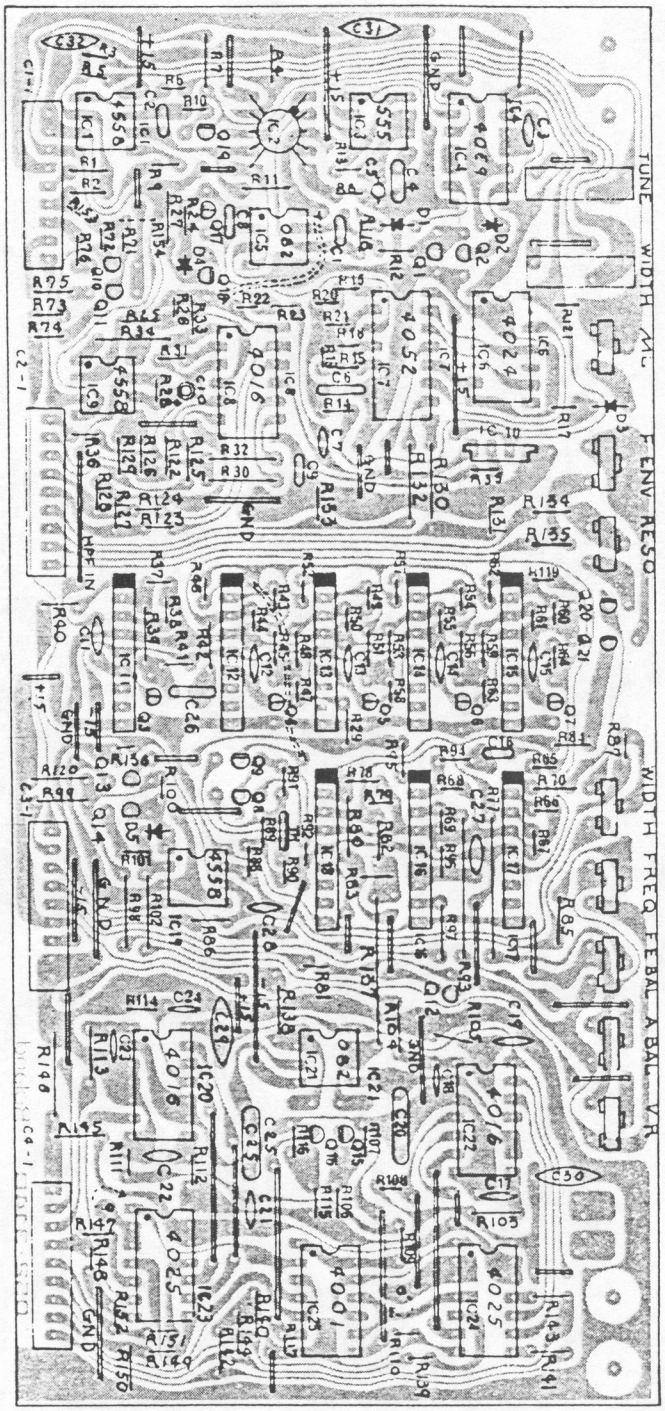
S/N 800800 to 942749

BA662

Besides BA662A and BA662B, there are factory-selected BA662's which are marked with paint in different colors accoding to their electrical characteristics.

When replacing:

1. BA662A's are good replacements for BA662B's.
2. BA662B's cannot be used for BA662A's.



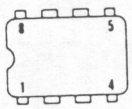
3. In any Module Board, factory-selected IC's must be a set of the same color. (except IC6 -- non selected)

Pins jumper wired:
IC3 pin 3 ---- IC4 pin 14

R153 blank
R154

MC1455P

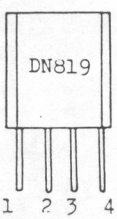
P1 SUFFIX
PLASTIC PACKAGE
CASE 626
(Top View)
(MC1455P1 only)

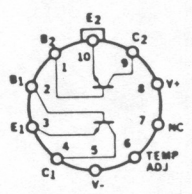


1. Ground
2. Trigger
3. Output
4. Reset
5. Control Voltage
6. Threshold
7. Discharge
8. Vcc

(TOP VIEW)

μA726H





MODULE BOARD 181-020E (Etch mask 052-314 E)

Serial No. 952750 and higher

DIFFERENCES FROM THE PREDECESSORS

Using IC12 IR3109 for VCF in place of BA662 selected.
Adding VCF INV ADJ. for easier preset "VOICE" sound tailoring.

Although interchangeable with former PCBs, the following are involved when replacing:

Different steps for VCF FREQ and WIDTH adjustments
Some alterations on this pcb - when existing one is 181-020 B or C - to meet circuit configuration indicated on p.19 (in this case read 181-020D as 181-020E).

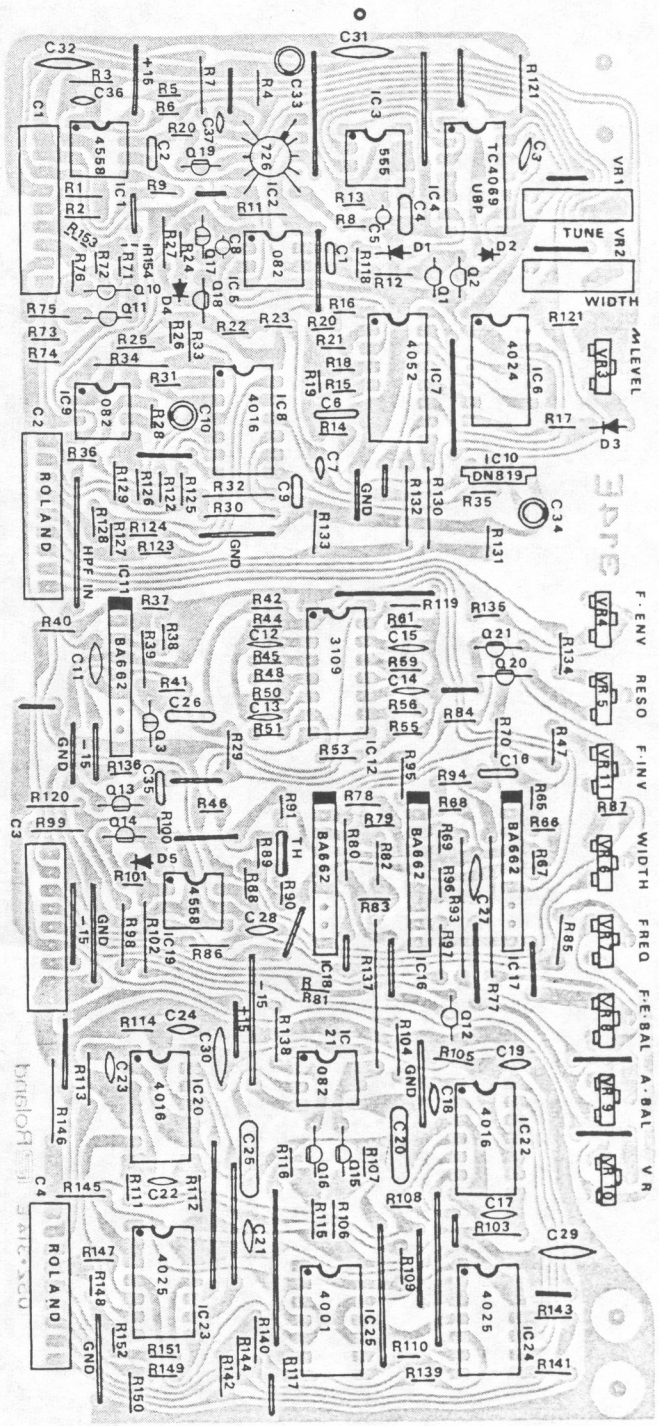
SUPPLEMENT p.21

BA662 (also see p.16-2 "2")

The BA662 is a current controlled variable transconductance (vari-gm) amp custom made for Roland products. Device with A suffix features low offset coefficient than one with B suffix. "A" can replace "B" except when "gm" is a great factor.
Some devices miss suffix at IC-maker and need markings wherever stored for future use.

Factory Selected (colored) BA662

BA662's are further graded based on "gm", painted in a color.
Both "A" and "B" in the same color are characterized by a gm in the same range.
Colored IC can replace uncolored one on which no specific gm is placed by the circuits. Factories might use selected ICs for non-selected in assembling pcbs, if colored ICs are surplus, in stock.



CORRECTION

p.20 Trimpot, VR number

RESONANCE	VR-4 to VR-5
VCF ENV	VR-3 to VR-4

p.21 3. In any Module .... to

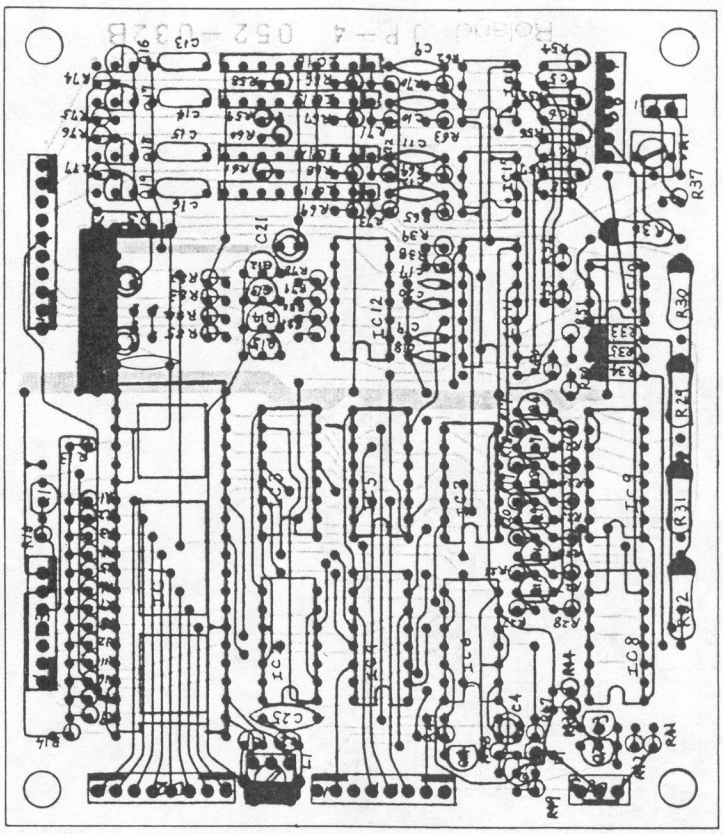
3. In any Module Board as well as in four modeles, factory selected ICs should be a complete set of the same colore except IC16.

See p.16-2 IC SPECIFICATION 2.

KEY ASSIGNER BOARD 181-022B

(Etch mask 052-032B)

5045-10A



5045-07A

Parts attached on foil side:

D2, D3 --- 1S1588

C3 ------- 22pfd

5045-08A

5045-03A

NOTE:

BA662A can replace BA662B.

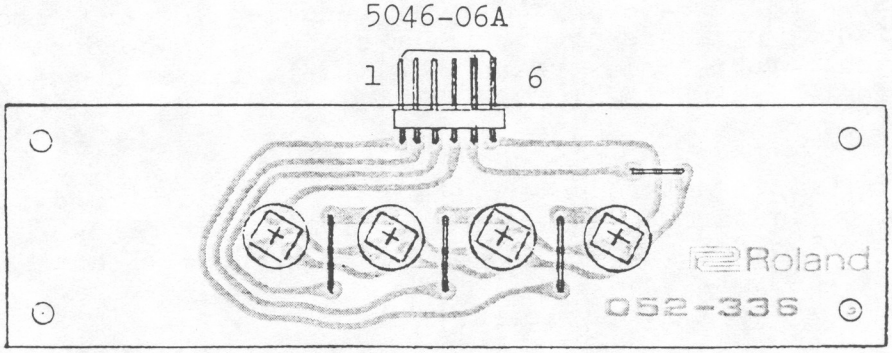
Factory selected BA662's (painted) must be a set of the same color.

When a PORTAMENTO TIME is not coincident with other Modules' due to IC replacement,(IC13-IC16), cut and try the capacitor. (C13-C16)

CONTROL BOARD G 181-013

(Etch mask 052-336)

5046-06A



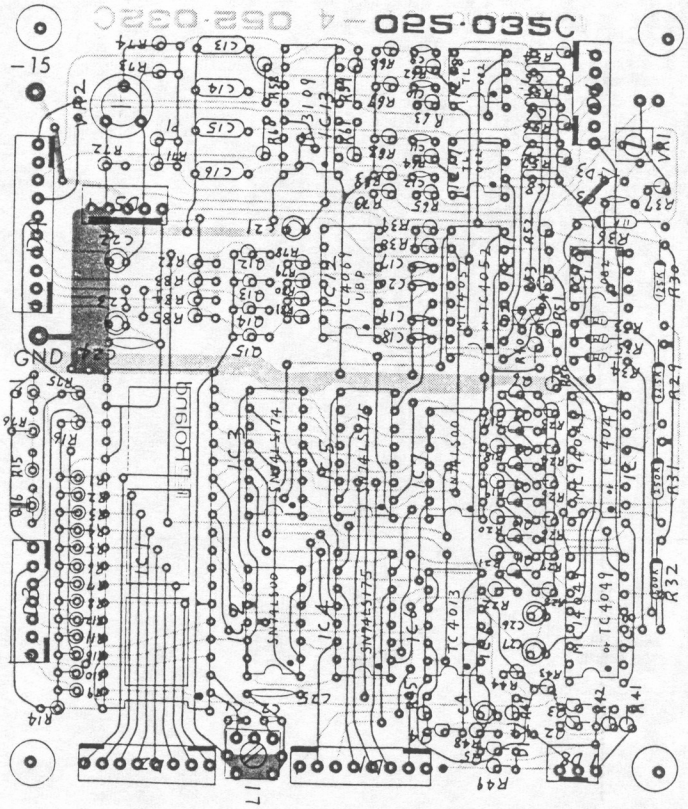
View from foil side

All trimmers
CR19R 47KB

KEY ASSIGNER 181-022C (pcb 052-032C)

Serial Numbers 952750-952799
952850-

NOTE: S/N 952800-952849
181-022B



to CONTROL BOARD D
J-4

181-022B and 181-022C
INTERCHANGEABLE
With PORTAMENTO (VR-3)
on CONTROL BOARD D
changed as PCBs change:

181-022B--VM10RB10C
K20 2MA

181-022C--VM10RB10C
K20 50KB

ADJUSTMENT

PORTAMENTO - VR2
C version only

IC13 1R3109

Four circuits on one chip provide synchronous Portamento Times.

IMPROVEMENTS ON 181-022B

Capacitors and Diode for IC11 protection
S/N 861500-
C26, C27 and D4 are connected to IC 4052 as shown in dashed cicles on circuit diagram, facing page, to protect it against breakdown due to charged voltages.

Connector By-Pass Wirings - for stable CV and VCO voltages -
Compensation for loose-connections
S/N 861500-
Plugs and receptacles on D7 (Key Assigner) and J-4 (Control Board D) are solder jointed, or leads are directly soldered on conductive foils at terminal areas. This treatment also eliminates impedient Portamento effects in PORTAMENTO OFF mode.

S/N 871600-
Besides original wirings through connectors, -15V and Ground for Key Assigner are fed through additional sole wires from Power Supply board to D5 pin 3 (-15V),and pin 1 or 2 (GND). Lead ends are soldered at the foil side.
(Refer to p. 26-1 Power Supply Board.)

MODULE CONTROLLER BOARD 181-021C

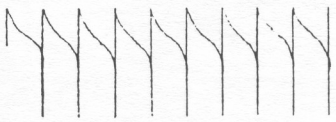
(Etch mask 052-235C)

NOTE:
R36 = 47K when associate Module Boards are 052-314D
R36 = 22K when the Module Boards are 052-314C
Refer to "Improvements on MODULE BOARD" on page 19.

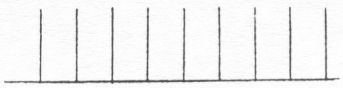
Holder No.185A

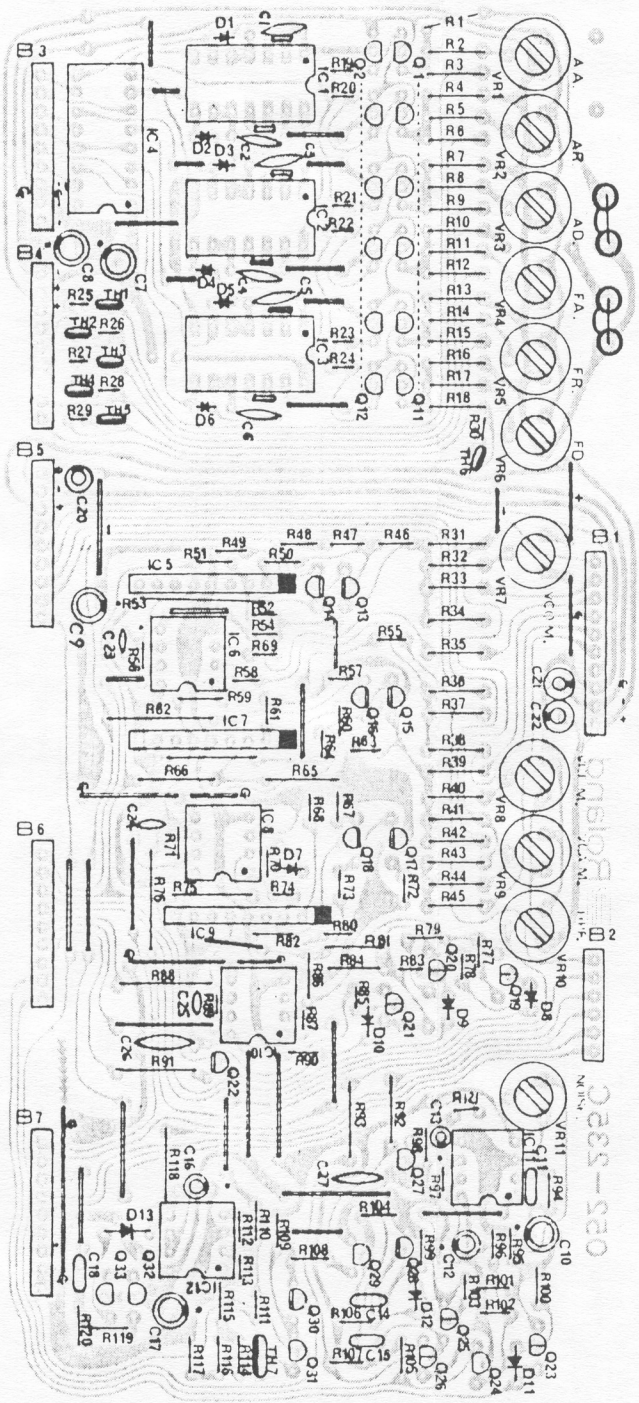
Nylon rivet NRP-345

D1-D6 Cathodes



CLKs(TC4049) Outputs





Moving the A, D or R sliders from bottom to top will increase the frequency by approximately 1000.

Wafer terminal
5045-10A

Wafer terminal
5045-06A

Holder No.184A

Housings PICD-9S-TL1

MODULE CONTROLLER BOARD 181-021D/E

(Etch mask 052-235D/E)
S/N 912200 and above

DIFFERENCES BETWEEN PCBS WITH DIFFERENT SUFFIX

- No differences in circuit configuration -

C suffix vs D or E suffix

components which are surface mounted (at foil side) or series-connected outside component holes on C suffix are accomodated in holes on D or E.

D suffix vs E suffix

Only conductor spacings at terminal areas are different.