SPECIFICATIONS

OUTPUT IMPEDANCE
H: 220k ohms  L: 10k ohms

OUTPUT LEVEL
H: 5.5Vpp into 220k
L: 5.5Vpp into 10k
(VOL. ADJ. max)
TRIGGER: +15V

EXT. CLOCK
+5V to +15V
min. 5ms in length

POWER CONSUMPTION
9W (117V)
13W (220/240V)

DIMENSIONS
300(W)x280(D)x250(H) mm
11.8 x 11.0 x 8.1 in

NET WEIGHT
5.5Kg 12.1 lbs

FUSES RATING

<table>
<thead>
<tr>
<th>Fuse</th>
<th>Rating</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>-5V</td>
<td>SGA 0.125A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(008-022)</td>
</tr>
<tr>
<td>F2</td>
<td>+15V</td>
<td>SGA 1A</td>
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<tr>
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<tr>
<td>F3</td>
<td>+5V</td>
<td>SGA 0.5A</td>
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<td>(008-024)</td>
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<tr>
<td>F4</td>
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<td>SGA 0.5A</td>
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<tr>
<td></td>
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<tr>
<td></td>
<td></td>
<td>CEE T50mA</td>
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<td>CEE T270mA</td>
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<td>(008-060)</td>
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</table>
CR-78 CIRCUITS TIMING DIAGRAM

The μPD8048 is a 8-bit microcomputer fabricated on a single silicon chip. The 8048 contains a 2k x 8 ROM program memory, a 64 x 8 RAM memory, 27 I/O lines, an 8-bit timer/counter and clock circuits. Used in the CR-78 is a μPD8048C-015 version in which the programs and data dedicated to the CR-78 are stored in program memory.

CR-78 Flow Chart

1. Power on
2. Onset of a measure?
3. YES
4. NO
5. Prepare the next data
6. Read CANCEL SWITCH (Group B)
7. Read SWITCHES: A to G groups
8. START/STOP SWITCH of?
9. YES
10. NO
11. H
12. L
13. MASTOR OSCILLATOR TO?
14. YES
15. NO
16. L
17. MASTOR OSCILLATOR TO?
18. YES
19. NO
20. Output data to VOICING and LED circuits
CIRCUIT DESCRIPTION

The CR-70 is a computerized rhythm machine whose rhythms are controlled by the resident computer through internally stored programs. Rhythms other than stored can be programmed as desired by using the built-in expansion ROM and RAMs. Sequential program order is outlined in the flow chart and the timing diagram shows relationship among principal circuit waveforms. (see previous page) The following description is composed of two sections: General Introduction and Detailed Function. Title numbers refer to those in flow chart.

GENERAL INTRODUCTION

1. POWER ON

When power is first applied, two oscillators start oscillation: MASTER OSCILLATOR, determines rhythm tempo, ranging from 55a to 100a; CLOCK GENERATOR, generates timing pulses for the 8048 in each step cycle.

2. 2B. SWITCH SENSING

Even in the stop mode, the computer needs to store data on switching status so as to output rhythm patterns immediately after the START/STOP switch is depressed. And also a status data is needed at the beginning of a measure. The switch residing to obtain a switch set-up data is referred to as switch scanning. From Port 2 of 8048, signals are routed through the Decoders ID107 and IO108, and the switch matrix to Port 1. Combination of two port's pins according to switch settings becomes a data on switch status. After a rhythm runs, scanning is done once for each measure.

3. PROCESSING and PREPARING DATA

The 8048 prepares the next data according to the internal program based on switch scanning data.

4. SCANNING CANCEL VOICE SWITCH

Since switch scanning is performed once for each measure during rhythm running, switching during the measure is effective in the subsequent measure. However, “CANCEL VOICE” is scanned every cycle to cancel the unwanted voice at once whenever it is specified.

5. SENSING START/STOP SWITCHING

As long as TI, the START/STOP sensing input terminal of 804084 is kept low, the program routine is not allowed to break loop through 1-5, returning to 1. When the START/STOP switch is pushed while a rhythm stops, TI is pulled to high to start a rhythm and falls to low when the START/STOP is pushed again (in stop).

6. SENSING MASTER OUTPUT PEGGING

Although each circuit operates its own task in sequence under the control of timing pulses from the CLOCK GENERATOR, each program step must keep pace with oscillation of the master osc. (rhythm tempo) by sensing the falls and rises of waveforms of the master oscillator. A program step proceeds to the next step when the master's trailing edge goes to negative.

7. SENSING WRITE SWITCHING

When the WRITE switch is tapped, the write hold circuit ID108 is set, applying high level to INT, and causing program routine to jump to 73.

7B. WRITING PROGRAM SWITCH

Scanning signals from 5 and 7 of the decoder ID107 and ID108 tell the computer which position of INSTRUMENT and which program push switch is selected. Then the data on PROGRAM rhythm are stored into the RAMS ID102 and ID103 under the control of a program from the ROM ID104. The RAMS provide memory size for two measures for each voice.

8. SENSING MASTER RISING

The computer executes a program, synchronizing its step with a rhythm tempo. As soon as TO receives the rise of a master square, 8048 starts to produce rhythm patterns by sending data and control signals out from Port 1 and 2.

9. OUTPUTTING DATA

The Port 1 this time serves as an output port, feeding data for rhythm patterns (VOICEs) and LARGE (TRANCE) to the latches ID112-ID116 which selectively latch them in sequence under the control of signals coming from the Port 2 through the Decoder ID107. The computer performs the entire loop once for one cycle of master oscillator and 48 times per measure.

FUNCTION -Detail-

1. POWER ON

Resetting of the START/STOP flip flop ID109A inhibits a rhythm from running by holding TI of 804084 at low level until the START/STOP switch is first tapped. When power is on, since the both pins 12 and 13 of IO11A are grounded momentarily, its output (pin 11) level swings to high resetting the RS flip flop ID109A which in turn develops high output at pin 2, setting TI level to low (through Q4-Q7, IO117A and Q11). Pins 12 and 13 of IO111 will go positive as CI03 charges, but IC-109A output is kept high until the START/STOP switch is depressed.

2. NO DETAIL

2B. SWITCH SCANNING

Switch scanning cycle initiates to generate internally programmed binary signals from the Port 2, P24-P27, feeding them to ID106, binary-to-hexadecimal decoder, from which decoded signals are routed to respective switch groups. From the decoder only one pin outputs negative going pulse while the rest pins output H, and the next pin outputs H with the rest L. These outputs of signals occur in sequence within a time interval of microseconds and reverses over and over again every few milliseconds until the START/STOP switch is depressed to run the rhythm. After running, scanning signals are outputted once at the onset of a measure. This means that changing of any switch setting during a measure is ignored by the computer unless switch setting is kept unchanged until the next scanning. Similarly, changing the MEASURE of VARIATION in AUTO mode will be made into effective only after previously specified measure(s) has passed.

In MANUAL mode, VARIATION change during a measure is enabled at the beginning of the next measure by holding that changing information until the next scanning is performed.

For this purpose the MANUAL VARI hold circuit is used which consists of IO119. When the START/STOP switch is pressed while a rhythm stops, the RS flip flop IO119 (pins 1-6) is reset by a pulse from 5 of IO106, switching pin 3 to H and pin 6 to L.

5
Depressing the MANUAL switch during rhythm running sets the PP 10119A/B, holding pin 6 or pin 13 at H. When a master output goes low, a scanning pulse is generated from 8 of ID108, after inverted by ID112. It is NANDed with pin 13 input, causing pin 11 to develop a negative going pulse which is detected by the 8048 through P16, this is MANUAL OFF information.

After scanning, a reset pulse is applied from 8 of ID108 to pin 2 through the NAND circuit 10119.

3. NO DETAIL

4. NO DETAIL

5. REMINDING START/STOP SWITCHING

The START/STOP PP 1019A receives a positive going pulse each time the START/STOP switch is pushed, switching its output H or L and holding it until the next push is made.

Pushing the START/STOP switch applies a positive pulse to pin 5 of the START/STOP PP 1019A causing it to have a high or low output until the START/STOP switch is pressed again. The output from the PP is applied through G5, G6, and G4, 100 to pin 6 of the comparator 10117A which provides a reference voltage at pin 5.

When an input to pin 6 of the comparator exceeds the reference voltage of pin 5, the comparator senses it, sending output to:
1. T1 of 8048 to start the rhythm,
2. the master oscillator and 8 and 16 count dividers ID109B and ID110 through the one shot pulse generator 10111 (pins 1-6) to reset them and to synchronize their start.

When the voltage at pin 6 of the comparator drops below the reference voltage, low output is applied to T1 to stop the rhythm.

However, if the FADE IN or FADE OUT switch is in closed position, voltage swing at T1 is delayed behind START/STOP switching due to the time constant in the fade circuit (details later).

6. MASTER OSCILLATOR

The master oscillator output waveform has a duty ratio of over 90%.

The WRITE switch is tapped, the WRITE PP 10128 is set, applying high output to INT pin of 8048 which will go low when the master output falls. This is a WRITE ON information to the computer upon receiving the WRITE information, scanning pulses are sent from 5, 8, 9, and 10 of the decoder and associated data are memorized into external RAM 10102 and 10103.

The circuit configuration and function of the WRITE PP are much the same as in the MANUAL PP except for reset timing. As shown in the figure, whenever the WRITE switch is tapped, as long as it is occurred during master's high level period, information is recognized by the computer when the master output falls, however, if the write switch is tapped during low level period, it is treated as it is occurred during the next high level period, and then, sound is reproduced, being delayed by 1/4 cycle of the master oscillator.

The longer high level period of the master oscillator waveform is intended to compensate for delayed timing of key operation.

7. NO DETAIL

7B. WRITING PROGRAM RHYTHM

As described in section 6, when the write switch is tapped during a measure, information on PROGRAM rhythm are stored in RAMs at the subsequent master square trailing edge, and INT of 8048 receives H input from the write hold circuit which consists of ID118 which functions in the same way as in the MANUAL VAR(, in this case reset pulse is fed from pin 14 or 9 of ID107).

When the write switch is depressed during a measure, H level is applied at INT pin and is held until master falls, this is "write on" information, and the computer detects through switch scanning (pulses from 8 and 7 of ID108) which of PROGRAM switches and which position of INSTRUMENT switch is selected.

The selected INSTRUMENT is first stored into RAM, then rhythm patterns are stored.

When the same instrument has been addressed in the RAM track, rhythm patterns being written are added to the patterns previously stored in the RAM and will not be stored in another track independently.

Required bit numbers for two measures are:
4 (PROGRAM) x 4 (INSTRUMENT) x 96 steps (48 x 2) = 1536 bits.

Data transfer to/from RAMs and RAM are performed as follows:
- ALR (Address Latch Enable)
- This signal occurs once for 15 clock generator frequency, that is, 250kHz, and latches address being outputed from DB, through internal program, delivering the latched signals to RAMs and ROM.
- ROM (10104)
- Program memory addressed by the address signals from the latches ID105, ID106 and P32 and P32 is fetched when BUSH is low at 28 and 78 of the flow chart.

- RAM (10102, 10103)
- Stored data are read when RSH is low at 28 and 78 of the flow chart.

Information are stored when WRH is low at 78 of the flow chart.
8.9 DATA OUTPUT

- LATCH CIRCUITS -

When the program proceeds at data output routine, Port 1 this time acts as an output port since it is a bidirectional port, representing the data through internal program memory or external ROM and RAM, data are sent from P20-P17 to IO112-IO116 latch circuits whose clock input pins receive latch signals from port 2 via decoder IO107. When a latch pulse goes positive while a data signal is fed onto the clock pin, the data is latched and sent to the VOICING circuit or LCD. When the latched data is for voicing, it is applied after inverted and amplified by a buffer.

There are three kinds of latched outputs, as the master output goes negative, Qs and Qn of IO115-IO116 are cleared, maintaining their pulse lengths almost the same as the master wave length. On the other hand, Qs of IO115 and IO116 are held until the next latch signal comes since these clear pins of IC115 and IC116 are not connected to the master oscillator output.

Note: since the time interval between pulses within the arrow marked by * is 70μs, they are considered to occur at the same time.

Latch Signal
IO107, TI-14
Data Signal
Port 1, P10-P17
Latched Signal Q
IO112-IO114
Latched Signal Q
IO114-IO113
Latched Signal Q
IO113-IO112
No clear input
Master Oscillator

2) FADE and ACCENT

As described in section 4, the FADE circuits on GP-100 are enabled when the FADE IN and/or FADE OUT switches are turned on to make the rhythm sounds gradually louder (VCA) as a rhythm starts and to stop the rhythm (TI) as sounds die away. These timings are determined by the RC constants in the FADE circuits.

Accent pulses are also affected by the FADE circuits in amplitude ratio and are mixed with the sound control voltage in the coming way. IO117 from which incorporate control voltages are sent to the VCA on the VU-11 to control rhythm volume.

3) SOUND KILLER

These circuits "kill" undesired sounds resulted from transient voltages on their way to output:
1. When power is on, Q512 on the VU-11 is not supplied enough collector voltage to amplify a input signal until Q556 changes to some extent.
2. When power is off, Q558 discharges through Q535 and Q532 on the VU-11, grounding pin 1 of VCA 10502.
3. The circuit composed of Q51 and Q53 on the QF-9 is identical and functions in the same manner as the circuits described above, but is used to protect the DAMs and to prevent disorderly running of 8048.
GL-9A (142-009A)  
(Etch mask 052-438A)  
Serial No. 780700-821050  
Use GL-9B for replacement  

Serial no. up to 780699

GL-9 Circuit Board is the same as GL-9A except for portion shown left and following parts are attached on the foil side:

R202, R201, R105, C105

For the decoder (IC112, 113, 115,116) two kinds of logic IC are available; TTL (74LS175, or equiv.) and CMOS (74C175, 14175, or equiv.).

When CMOS type is used as a replacement for TTL, pin 1 of IC115 and IC116 must be connected to +5V supply through a 10k-ohm as shown in below right (R212, R213).

When TTL is used, the 10k ohms resistors become optional.
OP-100A (149-100A) (Etch mask 052-449A)

RS-15A (148-015A) (Etch mask 052-052-444A)

view from foil side

view from foil side

Serial no. up to 780699
Use RS-15A for replacement

RS-14 (148-014) (Etch mask 052-445)
view from foil side

Flat cable

Flat cable

Cables

WALTZ
SHUFFLE
SLOW ROCK
SWING
FOX TROT
TANGO
BOOGIE
ENKA
BOSSANOVA
SAMBA
MAMBO
CHA CHA
BERGUNIK
RHUMBA
SUPFB2
O01-240
SLIM-322
O01-231
RHYTHM A/B

OP-100
Serial no. up to 780699
Use OP-100A for replacement

SRM101C
(001-242)

SRM102S
(001-243)
The GL-9 and GL-9A circuits (S/N up to 821050) are the same as the GL-9B circuit shown above except for the portions indicated by the double-dotted lines, (1, 2, 3, 4). The GL-9 and GL-9A circuits for these portions are shown on page 8.
VG-11A (143-011A) (Etch mask 052-437A)
Serial No. 780700 and higher

Components on foil side:
VG-11 - R645, Q592
VG-11A - D533

OP-104A (149-104A)
(Etch mask 052-464)
Serial No. 780700 and higher

OP-103A (149-103A)
(Etch mask 052-447A)
view from foil side
ADJUSTMENT & CHECKING

1. MASTER OSCILLATOR FREQUENCY (RHYTHM TEMPO)
   Connect an oscilloscope to Q1 collector or pin 76 on GL-9.
   1-1. Set TEMPO knob to full clockwise position (10).
       Adjust VR101 for T = 10ms.
   1-2. Turn the TEMPO control fully counterclockwise.
       Adjust VR102 for T = 10ms.
       Bottom half must be perfectly square.

2. FADE TIME
   To be adjusted after step 1 is finished.
   With rhythm (may be SAMBA-B) running, turn TEMPO fully clockwise.
   Set FADE OUT to SHORT.
   Depress START/STOP button.
   2-1. When sound becomes inaudible, count the number of
       LED flashes until the LED stays on steadily.
       Factory set ranges 4 (1.5sec) to 55 (2.4sec).
   2-2. To adjust, turn VR103 on GL-9.

3. RHYTHM VOICE
   Figures in the table at the right show factory standard
   and may be slightly deviated for personal taste or to meet frequency response of an amplifier being used.

<table>
<thead>
<tr>
<th>VOICE to be</th>
<th>Oscilloscope</th>
<th>Frequency</th>
<th>Remark</th>
<th>Decay time</th>
<th>Amplitude</th>
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<tbody>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>IN</td>
<td>OUT</td>
<td>Adjust</td>
<td>for</td>
<td>Hz</td>
</tr>
<tr>
<td>BD</td>
<td>H</td>
<td>V</td>
<td>VR57</td>
<td>16</td>
<td>62.5</td>
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<tr>
<td>SD</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3.0</td>
<td>340(Drum);</td>
</tr>
<tr>
<td>RS</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>6.67</td>
<td>1480</td>
</tr>
<tr>
<td>HH</td>
<td>H</td>
<td>Q5 collector</td>
<td>-</td>
<td>Move BALANCE knob to the highest</td>
<td>Adjusting</td>
</tr>
<tr>
<td>CY</td>
<td>H</td>
<td>Q5 collector</td>
<td>-</td>
<td>-</td>
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<td>H</td>
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<tr>
<td>C</td>
<td>H</td>
<td>Q5 collector</td>
<td>1.66</td>
<td>600</td>
<td>VR51</td>
</tr>
<tr>
<td>HB</td>
<td>H</td>
<td>Q5 collector</td>
<td>2.5</td>
<td>400</td>
<td>VR52</td>
</tr>
<tr>
<td>LB</td>
<td>H</td>
<td>Q5 collector</td>
<td>4.8</td>
<td>208</td>
<td>VR53</td>
</tr>
</tbody>
</table>

To gate each VOICE circuit, BD through LC:
connect TS-1 to WRITE jack and tap it as necessary with INSTRUMENT SELECTOR set to the voice to be adjusted.

| CB | H | Q529 collector | VR67 | 1.25 | 800 | Shift scope V IN to pin 34 on VG-11 | - | 60 | - | 0.2 |
| CB | L | Q530 collector | VR68 | 1.8 | 555 | - | - | - | - |

To gate CB voice circuits, short Q527 (on VG-11) across C-H momentarily.

- Slide ADD VOICE knobs upward, (Tb, Gu, MB, respectively).
- Push in CYMBAL-HIGH HAT (CANCEL VOICE) when adjusting MB.

<table>
<thead>
<tr>
<th>Tb</th>
<th>Pin 34</th>
<th>-</th>
<th>-</th>
<th>-</th>
<th>220</th>
<th>VR62</th>
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<tbody>
<tr>
<td>Gu</td>
<td>H</td>
<td>on</td>
<td>VR59</td>
<td>8.0</td>
<td>125</td>
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<td>-</td>
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<tr>
<td>L</td>
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<tr>
<td>H</td>
<td>I0501 pin 8</td>
<td>VR64</td>
<td>0.162</td>
<td>6170</td>
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<td>-</td>
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<tr>
<td>MB</td>
<td>I0501 pin 4</td>
<td>VR65</td>
<td>0.178</td>
<td>5620</td>
<td>Shift scope V IN to pin 34 on VG-11</td>
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<td>50</td>
</tr>
<tr>
<td>L</td>
<td>I0501 pin 10</td>
<td>VR66</td>
<td>0.245</td>
<td>4080</td>
<td>-</td>
<td>-</td>
<td>-</td>
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</table>

Amplitude
V
1/10V
0.4V
BD
0.7V
0.4V
20ms
## PARTS LIST

<table>
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<tr>
<th>Code</th>
<th>Description</th>
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<tbody>
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<td>061-113</td>
<td>Cabinet no.117</td>
</tr>
<tr>
<td>111-020</td>
<td>Base no.20 (foot)</td>
</tr>
<tr>
<td>072-235</td>
<td>Panel no.235</td>
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<td>076-356</td>
<td>Name plate no.356 real OUTPUT-CONGL.</td>
</tr>
<tr>
<td>076-367</td>
<td>Name plate no.367 rear CRT. CLOCK-WRIT</td>
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<tr>
<td>061-218</td>
<td>Chassis no.218 front</td>
</tr>
<tr>
<td>061-219</td>
<td>Chassis no.219 main</td>
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<tr>
<td>061-220</td>
<td>Chassis no.220 rear</td>
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<tr>
<td>061-234</td>
<td>Chassis no.234 sub</td>
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<td>Chassis no.235 sub</td>
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<tr>
<td>061-236</td>
<td>Chassis no.236 sub</td>
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</table>

### ICs

- 179-022 μPD80480-015 computer

There are some versions of 8048. Each has an exclusive resident program. Specify 8048C-015 for the CR-78 replacement.

- 179-023 AM2706P-023 ROM
- 020-181 μPD6101C-R RAM
- 020-141 *74LS175N (TTL)
- 020-196 *74175R or 740175 (MNOS)
- *refer to 01-9A parts layout
- 020-064 μP04558
- 020-180 74LS14H
- 020-138 74LS138N
- 020-124 74LS04N
- 020-120 74LS08N
- 020-084 MC14068BCP
- 020-041 MC14013BCP
- 020-169 MC14001BCP
- 020-160 BA-6628 VCA
- 020-073 μA7605 regulator +15V
- 020-197 μA7605 or μA7805 +5V
- 020-198 μA7805 -5V

### POTENTIOMETERS

- 026-024 EVH0A725R1 10KΩ TEMPO
- 026-021 BVH0A248E1 10KΩ ACBMT
- 029-410 LYR6B001-10KB VCL. ADD VOICE
- 029-411 LYR6B001-50KB BALANCE

### Trimmers

- 028-001 BVTH4400 (SR19) 500
- 028-003 BVTH4400 (SR19) 5K
- 028-004 BVTH4400 (SR19) 10K
- 028-006 BVTH4400 (SR19) 20K
- 028-007 BVTH4400 (SR19) 50K
- 028-007 BVTH4400 (SR19) 100K

### CAPACITORS

- 032-005 0.47μF63V X tant.
- 035-109 BC0651032 600V polyester

### FUSES

- 008-024 SGA 0.5A prim. sec +5V 100/177V
- 008-026 SGA 1A sec +15V 100/177V
- 008-022 SGA 0.125A sec +5V 100/177V
- 008-053 CEB 750mA sec -5V 220/240V
- 008-060 CEB 725mA sec +15V 220/240V
- 008-062 CEB 740mA sec +5V 220/240V
- 008-060 CEB 725mA prim/sec +15V 220/240V

### SWITCHES

- 001-215 Power 6Ω-5P 100V
- 001-216 6Ω-5P 17V
- 001-217 6Ω-5P 220/240V
- 001-273 KGA1007 keyboard
- 001-206 HSW-0372-01-030 slider 8,16,COMBI
- 001-243 SML025 rotary MEASURE
- 001-242 SML010 rotary FILL IN
- 001-239 SUP2A push gанг ROCK-DISCO 2
- 001-240 SUP2B push gанг WALZER-
- 001-251 SLR322 lever Rhythm A/B. AUTO/MANU.
- 001-245 SLR323 lever FABS/OUT
- 001-246 SLR325 lever MENO/PLAY/ALL
- 001-241 SUP3j push gанг CLEAR. GANCHEL VOICE
- 001-244 SRA202B rotary INSTRUMENT

### TRANSISTORS

- 017-105 28A1015-Y
- 017-106 28C1015-GR
- 017-021 28C900-F
- 017-046 28C928-R (NL) for noise

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- 009-012 Jack 89762
- 012-040 IC630-040-3500 40-pin
- 012-041 IC630-024-3500 24-pin
- 012-042 IC630-022-3500 22-pin
- 047-004 Line cord strain relief BU8041
- 047-023 Cord clamp 1702B
- 120-001 Long nut (space/stand off) no.1 x10mm

### PARTS ORDERING INFORMATION

When ordering parts, be sure to include the following information:
1. Model and Serial Number
2. Part Number
3. Part Name
4. If the necessity for a non-listed part arises, please write describing the parts location and function as well as model and serial number of the unit.
**RECHARGEABLE BATTERY CHANGE**

4N-100AA (5.6V) to N-SB3 (3.6V)

Serial no. Serial no.
up to 862999 672900 and higher
(no name is given on the (name is definitely printed on
face of the battery) the face)

**GL-9 with 4N-100AA**

1. D109 is removed at the factory to increase charging current. However, there are some products having D109 on the market.
   REMOVE D109 on the first occasion.

   (after D109 removed)

2. Never turn on the power switch with 4N-100AA DISCONNECTED.
   HIGHER voltage will ruin IC102 and IC103.

**GL-9 with N-SB3**

1. N-SB3 being lower in voltage, can be sufficiently charged regardless of D109 existence which protects IC102 and IC103 against high voltage during an absence of N-SB3.

2. Contrary to D109, D221 and R237 are harmful to N-SB3, remove them before installing N-SB3.

**IC pins and patterns misregistered**