SPECIFICATIONS

MODEL-104

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

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

2. END STEP SELECTION
   Step Number   : 1 – 12 steps
   Channel Selector : CH-A or CH-B
   Sequence Selector : One Time or Repeat

3. CONTROL SELECTION
   START         : Reset-Start
   CONTINUE      : Continue-Start
   STOP          : stop
   STEP          : step

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

5. OUTPUT SECTION
   Gate Outputs  : X2 ............ +14V
   Series Outputs: X2
   Parallel Outputs: CH-A X2
                    CH-B X2

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

7. POWER REQUIREMENTS
   100-120V 50-60Hz  : 5W max.
   220-260V 50-60Hz  : 5W max.
CIRCUIT DESCRIPTION

1. SEQUENCE BOARD ASSEMBLY (OP-31)

1-1. CLOCK OSCILLATOR (VCO)
Saw-tooth wave is generated by charging and discharging of capacitor(s) C201, or C201 and C202. The oscillation frequency is controlled by the voltage that is controlled by CLOCK RATE potentiometer, and EXT CV INPUT voltage, if used.
The saw-tooth wave is converted into rectangular wave by comparator (1/2 IC203), whose duty ratio can be changed from 10% to 90% by GATE TIME potentiometer.
The rectangular wave acts as trigger that drives ring counter in the next stage. It also is connected to GATE OUTPUT jack.

1-2. RING COUNTER
The ring counter is composed of 12 steps of flip-flop by use of 3 IC's (LB1501). The speed of sequence is controlled by clock signal.
When CHANNEL switch is set at CH-A, outputs of Channel A, Step 1 to End Step that is set by STEP NUMBER dial, and Channel B, Step 1 to End Step are sent to Channel A and Channel B registers, respectively.
When CHANNEL switch is set at CH-B, outputs of Channel A, Step 1 to Step 12, and Channel B, Step 1 to End Step are sent to Channel A and Channel B registers, respectively.

1-3. START/STOP FLIP-FLOP
Q214 and Q215 combined is a start/stop flip-flop that controls the clock oscillator and ring counter to on or off.
When clock oscillator stops, pulse comes out at END PULSE OUTPUT jack.

1-4. CH-A/CH-B FLIP-FLOP
Q225 and Q226 combined is Channel A/Channel B flip-flop whose output is sent to switching circuit of RANGE and CHANNEL SELECT board assembly (OP-34). This selects the output (Register A or Register B) that comes out at SERIES OUTPUT jack. This functions only when CHANNEL switch is set at CH-B. It switches from register B at Channel A, Step 12, and from register B to register A at Channel B, End Step.

2. REGISTER BOARD ASSEMBLY (OP-32) (OP-33)
The register board assembly contains 12 combinations of transistor switching circuit and voltage register. A switching transistor, when designated by output from ring counter, conducts to send the voltage, predetermined by register potentiometer, to OP-34.

3. RANGE and CHANNEL SELECTOR BOARD ASSEMBLY (OP-34)
The contains two operational amplifiers and two switching FET's, each for Channel A and Channel B. The output voltage of the operational amplifier can be varied by the setting of RANGE switch, and each output is switched on and off by the switching FET. Through this assembly, the input voltage from the register is amplified and sent out to PARALLEL or SERIES OUTPUT jack that is selected.
SEQUENCE BOARD ASSEMBLY OP-31 (149-031)
(Serial No.560960 and higher)

Front view

- 2SA1733(O)
- 2SC945(O)
- 2SK30A(GR, Y)
- 2SD414 (O)
- 2SD671 (L)
- IS-2473
- 05Z-16A
- 2SD571(L)

Top view

JPC1458C
LB1515
LB1501
IT132
TA7504M
POWER SUPPLY BOARD

Water Terminal
A-2461-8C
(010-038)

Fuse Holder TF-758 (012-003)

Heatsink No.1
(048-001)

Power Switch
MS-066 4K

Power Transformer
022-86C (100V–120V)
022-86D (220V–250V)
1. Power Supply Voltage adjustment
   a. Connect the Digital Voltmeter to terminal "10" of the PCB (PS-25 or PS-26), and adjust VR101 for reading +14V±100mV.
   b. In the same manner with connection to terminal "13", adjust VR102 for reading -14V±100mV.

2. CLOCK RATE adjustment
   Set the controls as illustrated bellow

   ![Diagram of control settings]

   (RANGE: X10, REPEAT)

   a

   ![Adjustment diagram for 10ms]

   (CLOCK RATE: 10)

   b

   a little longer than 1000ms       a little shorter than 1000ms

   ![Adjustment diagrams for 1000ms and 1000ms]

   (CLOCK RATE: 0)

   c  Step (b) may cause variation on the 10ms width on (a).
   Repeat, then, the steps (a) and (b) until waveforms are within 10ms±10% and 1000ms±10%.
3. GATE TIME adjustment

a

(CLOCK RATE: 10, GATE TIME: MAX)

b

wider than A

narrower than A

(GATE TIME: MIN)

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

=
## PARTS LIST

### Sequence Board Assembly OP-31 (149-031)

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Component</th>
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<th>Component</th>
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<tbody>
<tr>
<td>052-146B</td>
<td>PCB</td>
<td>029-062</td>
<td>IC</td>
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<td></td>
<td>041-062</td>
<td>IC</td>
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<td>020-010</td>
<td>TA7504M</td>
<td>020-049</td>
<td>LB-1501</td>
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<td>020-050</td>
<td>LB-1515</td>
<td>020-065</td>
<td>IT-132 (μPA41C)</td>
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<tr>
<td>017-013</td>
<td>2SC945(Q) (2SC828, 2SC372)</td>
<td>017-012</td>
<td>2SA733(Q) (2SA496(Y))</td>
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<tr>
<td>017-016</td>
<td>FET</td>
<td>017-014</td>
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<td>018-014</td>
<td>Diode</td>
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<tr>
<td>018-015</td>
<td>Thermistor</td>
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**Trimmer Potentiometers**

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<tbody>
<tr>
<td>028-002</td>
<td>1K (B) EVT (L) — R4XA00 13B</td>
<td>028-007</td>
<td>100K (B) EVT (L) — R4XA00 15B</td>
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**Capacitors**

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Value</th>
<th>Tolerance</th>
<th>Type</th>
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<tbody>
<tr>
<td>037-007</td>
<td>250pF</td>
<td>50V±10%</td>
<td>Ceramic</td>
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<tr>
<td>032-033</td>
<td>1μF</td>
<td>50V</td>
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<td>032-038</td>
<td>10μF</td>
<td>16V</td>
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<td>032-050</td>
<td>10μF</td>
<td>25V</td>
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<tr>
<td>032-015</td>
<td>47μF</td>
<td>25V</td>
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<td>032-047</td>
<td>220μF</td>
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### Output Range and Channel Select Board Assembly

**OP-34 (149-034)**

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<th>Part Number</th>
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<tbody>
<tr>
<td>052-148</td>
<td>PCB (less parts)</td>
<td>020-062</td>
<td>IC μPC1458C</td>
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<td>017-016</td>
<td>FET 2SK30A (GR)</td>
<td>001-092</td>
<td>Slide switch S-J0215</td>
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**Power Supply Board Assembly**

**PS-25 (100V—120V) (146-025)**

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<th>Part Number</th>
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<tbody>
<tr>
<td>052-133B</td>
<td>PCB (less parts)</td>
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<tr>
<td>048-001</td>
<td>Heatsink No.1</td>
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<td>020-031</td>
<td>IC 723CN</td>
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<td>017-010</td>
<td>Transistor 2SD234(O)</td>
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**Diodes**

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<th>Part Number</th>
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<tr>
<td>018-028</td>
<td>ESA-B01-03C</td>
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<tr>
<td>018-062</td>
<td>(MI-152)</td>
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<tr>
<td>018-029</td>
<td>ESA-B01-03N</td>
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<td>018-063</td>
<td>(MI-152R)</td>
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<td>018-022</td>
<td>IN4003</td>
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**Trimmer Potentiometer**

<table>
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<th>Part Number</th>
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<tbody>
<tr>
<td>028-002</td>
<td>1K (B) EVT (T) R4XA00B13</td>
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**Capacitors**

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<thead>
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<th>Part Number</th>
<th>Value</th>
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<th>Type</th>
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</thead>
<tbody>
<tr>
<td>037-008</td>
<td>470pF</td>
<td>50V±10%</td>
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<td>032-033</td>
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<td>032-068</td>
<td>470μF</td>
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<td>010-038</td>
<td>Wafer Terminal A-2461-8C</td>
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**PS-26 only**

<table>
<thead>
<tr>
<th>Part Number</th>
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<tbody>
<tr>
<td>012-003</td>
<td>Fuse Holder TF-758</td>
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<tr>
<td>008-024</td>
<td>Fuse (Midget) 0.5A SGA0.500</td>
</tr>
</tbody>
</table>

*For parts not listed above.

Refer to 2. DISASSEMBLY or 9. PARTS PICTORIAL.

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