**SH-101 SERVICE NOTES**

**First Edition**

**SPECIFICATIONS**

- **Keyboard**: 32 key, F-scale
- **VCO**: Range (16', 8', 4', 2')
  - Pulse Width Modulation (50% ~ 0%)
  - Tune (+50 cent)
- **VCF**: Cutoff Frequency (100Hz ~ 20kHz)
  - Key Follow (0 ~ 100%)
- **ENV**: Attack Time (1.5ms ~ 4s)
  - Decay Time (2ms ~ 10s)
  - Sustain Level (0 ~ 100%)
  - Release Time (2ms ~ 10s)
- **Modulator**: LFO/CLK RATE (0.1Hz ~ 30Hz)
- **Controller**: Portamento Time (0 ~ 5s)
  - Transpose (L/M/H)
- **Sequencer**: 100 steps max.
- **Output**: Audio (0dBm max.)
  - Phones (6.3)
  - Gate (0V = 0V, ON = 12V)
  - CV (1V/1 OCT, 0.41V = 5V)
- **Input**: Gate (+12.5V or more)
  - CV (1V/1 OCT, 0 ~ 7V)
  - EXT CLK (+25 or more)
  - DC (9V ~ 12V)
- **Power**: Dry cells 1.5V x 6
  - or 9V ~ 12V AC Adaptor
- **Power Consumption**: 1W
- **Dimensions**: 570(W) x 311(D) x 80(H)mm
  - 22 1/8 (W) x 12 1/4 (D) x 3 3/4 (H) in.
- **Weight**: 4.1 kg/9 lb. (without Dry cells)

**TOP VIEW**

1. Switch SSO02368
2. Jack HEQ0470-01-230
3. Jack HSI0789-01-020
4. Switch SWM100-4-K1S
5. Pot. EVH8540-2081-100K
6. Pot. S916BP0-05-100K
7. Switch SU113
8. Button TK-305
9. Pot. EVH5XP0-2081-100K
10. Pot. S916BP0-05-100K
11. Bender Unit PB-5
12. Switch SLE-23-18P
13. Pot. EVH18AP202-2MA
14. Switch KHD10001
15. Pot. SK-331-AR
16. Case Panel (Cabinet)
17. Switch S882273
18. Pot. SQ108BP05-1MA
19. Pot. SQ108BP05-100K
20. Jack HL050-01-010
22. Jack HL050-01-030
23. Case Battery cover

**BOTTOM VIEW**

- **How to Disassemble**
  - Remove 2-TP screws and 10-P sight screws.
- **Note**: Be sure to use plastic screws (3x10mm) when reassembling.

**INNER PARTS LOCATION**

- Bender board (149H178-1)
- Synth. board (149H177-2)
- Control board (149H177-1)
- Jack board A (149H178-2)
- Jack board B (149H178-3)
- Film (battery case) (114H008)

**MGS - I**

- Holder H158 (064H158)
- Switch EVO-PR18BK (1312020)
- Holder (064H157)
- Knob (016H083)
- Cover (065H118)
- Plug & cord (053H157)
- Cover (065H118)
- Switch EVG-PR18BK (1312020)
- pot.PB-6-RG-100K (1321927)

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*All rotary knobs (016H071)*
*All LEDa GL-BP02 (15029128)*
*All slide knobs (016H007) yellow/OA16058: green/OA16060: orange*
Technical Information

- Effective from SN-243200. The CPU may overrun if excessive static electricity is fed through the jacks, etc. To prevent this, the GND of the GATE OUTPUT jack on the Jack Circuit Board and the GND lug on the Keyboard are connected with a larger wire.
- It is advisable that this precautionary measure also be applied to the models prior to SN-243200.
- If there is an improper connection in the Keyboard keys, clean the contact (foil pattern) on the side of the Switch P.C. Board with alcohol.
The CPU 80C496-7:301 controls the various modes and functions of the SH-101 through a series of programmed steps, as shown in the attached flow chart. These actions are described below.

1. **TEST MODE**
   The Test mode allows easy adjustment of the SH-101. To enter the Test mode, first turn the power switch Off. This is necessary as the Test mode cannot be entered while the SH-101 is in any of the normal operating modes. Now simultaneously press both the LOAD and KEY TRANPOSE buttons and turn the power switch On. The CPU sets the voltage at the KCV and at the Range to zero and turns the Gate Off. The unit is now in the Test Mode. The voltage values at the KCV and the Range, and the status of the Gate change in each of the function modes listed below.

<table>
<thead>
<tr>
<th>Function Button</th>
<th>KCV</th>
<th>Range</th>
<th>Gate</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLAY</td>
<td>2.76V</td>
<td>0V</td>
<td>Off</td>
</tr>
<tr>
<td>ARPEGGIO DOWN</td>
<td>2.6V</td>
<td>0V</td>
<td>Off</td>
</tr>
<tr>
<td>ARPEGGIO U/D</td>
<td>4.76V</td>
<td>0V</td>
<td>On</td>
</tr>
<tr>
<td>LOAD</td>
<td>0V</td>
<td>4.76V</td>
<td>Off</td>
</tr>
</tbody>
</table>

   To enter a normal mode, either press the Hold button down, or turn the power switch Off and then back On again.

2. **INITIAL SET**
   The CPU performs Initial Set when the power switch is turned On or when the HOLD button is pressed during the Test mode. This operation deletes all the data that is stored in the built-in RAM, such as Keyboard and switch mode data, but does not delete the Sequencer data.

3. **RANGE DATA READ**
   The CPU reads and memorizes the positions of the VCO Range, TRANPOSE (L, M, and H) and GATE/TRIG (LFO) switches.

4. **RANGE DATA OUTPUT**
   The CPU sends the VCO Range data (read in Step 3) to the D/A Converter where it is converted into analog equivalent values.

<table>
<thead>
<tr>
<th>Range Selector</th>
<th>Range Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>1V</td>
</tr>
<tr>
<td>8</td>
<td>2V</td>
</tr>
<tr>
<td>4</td>
<td>2V</td>
</tr>
<tr>
<td>2</td>
<td>4V</td>
</tr>
</tbody>
</table>

   If the CPU contains Key Transpose data (stored during Step 8 of the previous program execution), the Key Shift data is added to the Range Selector data. For example, if the user selects the lowest F-key and sets the Range Selector to 16', the Range data value will be 0.417V. Likewise, if the user selects a higher C-key and sets the Range Selector to 2, the Range data value will be 3V.

5. **KEYBOARD READ**
   The CPU uses a 4 x 8 matrix to read the number and position of the keys being pressed on the keyboard, and determines the output priority of the CV data and whether new Gate signal should be output according to the key mode (LEGATO or NON-LEGATO) and the settings of the panel controls (PORTAMENTO, ARPEGGIO, GATE/TRIG, etc.).

6. **CLOCK CHECK**
   Any variation in the voltage of the Clock signal (LFO or EXT CLK) is detected at the T1 terminal. If a low Clock signal turns high, TR1 inverts it to low and sends it to the CPU, which then performs the following operations.
   - (a) Generates Random data.
   - (b) Prepares the data for Arpeggio and Sequencer playing.

7. **RANDOM DATA OUTPUT**
   The CPU outputs to the D/A Converter the random data generated and stored in step 6(a).

8. **FUNCTION SWITCH READ**
   The CPU scans all the function switches in order to detect any changes made by the user. If an On/Off change is detected, the CPU jumps to the appropriate step. Refer to the flow chart. The CPU can detect the On/Off status of the HOLD function at both the Panel button and the Pedal switch. When the KEY TRANPOSE button is pressed and a new key selected, the CPU identifies the key that was pressed on the keyboard and thus identifies the key (pitch) to be transposed.

9. **LOAD**
   If a Keyboard key, the LEGATO (HOLD) button or the REST (KEY TRANPOSE) button is pressed, the CPU stores information in the RAM, then jumps to step 12. If no key or button is pressed, the CPU jumps directly to step 12.

10. **PLAY**
    - In the Play mode, the CPU reads the Sequencer data stored in the RAM and prepares both the KCV and Gate data, then jumps to step 12.

11. **ARPEGGIO**
    - If the CPU detects during step 6 that the Clock signal has turned high, the CPU prepares the KCV data according to the order of the keys numbered stored in the 4-byte (32 keys) Arpeggio Key Buffer, then jumps to step 12. If the Clock Signal remains low, the CPU jumps directly to step 12.

12. **C/V OUTPUT**
    - During the Arpeggio and Sequencer Play modes, the CPU sends to the D/A Converter the necessary CV data for executing the relevant steps for Arpeggio or Sequencer playing. During all other modes, the TRANPOSE Switch data (L, M or H) is either added to or subtracted from the Keyboard information, and the resulting value is sent to the D/A Converter. Examples of this operation are shown below:

<table>
<thead>
<tr>
<th>Transpose Switch</th>
<th>Key</th>
<th>CV Data (After Conversion)</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>Lowest F</td>
<td>0.417V</td>
</tr>
<tr>
<td>M</td>
<td>Lowest F</td>
<td>1.417V</td>
</tr>
<tr>
<td>H</td>
<td>Lowest F</td>
<td>2.417V</td>
</tr>
<tr>
<td>H</td>
<td>Highest C</td>
<td>5.0V</td>
</tr>
</tbody>
</table>

13. **GATE & LED DATA OUTPUT**
    Port 2 of the CPU outputs the Gate, Clock Reset (CLK RST) and LED Illumination signals. The Clock Reset signal resets the Clock signal whenever a key on the keyboard is pressed while either the GATE/TRIG Selector is set to LFO or the ARPEGGIO mode is activated. The LED Illumination signal illuminates the LEDs above the function switches, but does not illuminate the LEDs for the LFO and power switches.

At the end of step 13, the CPU returns to program 3 and repeats the sequence of steps from 3 through 13.

**PIN CONNECTION**

- **TOP VIEW**

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**Note:**

Steps 3 through 13 are a series of program steps that are sequentially executed by the CPU at 1.5 to 3.5msec intervals. The CPU can modify this sequence any time new data is input.
ADJUSTMENT PROCEDURES

Precautions:
The order of the adjustment procedures in these adjustment specifications were determined assuming that the SH-101 unit has not been adjusted at all. Therefore, when only a few sections are to be adjusted, please keep the following points in mind.
• When adjusting the VCO Width, VCO Tune, and/or VCF, be sure that the D/A Converter adjustment has first been completed. (This is because D/A Converter failure may affect these circuits.)
• Because the VCO Width and the VCO Tune interact with each other, be sure to perform both adjustments.

1. D/A CONVERTER ADJUSTMENT

Preparations:
• Connect the digital voltmeter (with more than 4 significant digits) to the CV OUT jack.
• While pressing both the LOAD button and the KEY TRANPOSE button on the SH-101 unit, turn the Power Switch On. (The SH-101 unit is now in the Test mode.)

(A) D/A Tune
1. Confirm that the LOAD and TRANPOSE LEDs are illuminated. If any of the LEDs other than the LOAD LED is illuminated, press the LOAD button.
2. Adjust VR-2 (D/A TUNE) on the Synth. Circuit Board until the digital voltmeter reads 0V ± 1mV.

(B) D/A Width (+5V)
1. Press the PLAY button.
2. Adjust VR-1 (+5V) on the Synth. Circuit Board until the digital voltmeter reads 2.75V ± 1mV.

(C) D/A Linearity
1. Press the ARPEGGIO DOWN button.
2. Adjust VR-3 (D/A LINEAR) on the Synth. Circuit Board until the digital voltmeter reads 2.5V ± 1mV.
3. Repeat the above procedures (A) through (C) until all the voltage readings are within ±1mV of the specifications.

2. VCO ADJUSTMENT

Preparations:
• If the unit is in the Test mode, release the mode by either pressing the HOLD button or resetting the Power Switch to On.
• Set the panel controls as shown in Fig. 1.
• Connect the oscilloscope to SH-101 OUTPUT. Supply the reference F note (based on a = 442Hz) to the scope EXT. Input for the Lissajous figure.

(A) VCO Width
1. Hold the F5 key down, and adjust either VR-7 (VCO TUNE) or VR-9 (TUNE) until the Lissajous figure is motionless.
2. Hold the F3 key down, and adjust VR-6 (VCO WIDTH) until the figure is again motionless. The F5 pitch will vary as VR-6 (VCO WIDTH) is turned.
3. Repeat steps 1 and 2 until the F3 and F6 figures are motionless.

(B) VCO Tune
1. Place the unit in the Test mode. (While pressing both the LOAD button and the KEY TRANPOSE button, turn the Power Switch On.)
2. Press the U & D button.
3. Confirm that VR-8 (TUNE) is set in the center position.
4. Adjust VR-7 (VCO TUNE) until the output value is 442Hz.

(C) Range Width
1. Place the unit in the Test mode.
2. Press the U & D button.
3. Press the UP button, and adjust VR6 (RANGE WIDTH) until the output pitch is the same as the output pitch in the U & D mode.

(D) Pulse Width
1. Set the WAVEFORM to CL.
2. Adjust VR-2 (D/A TUNE) until the mark-space ratio is 1:1.

3. VCF ADJUSTMENT

Preparations:
• Set the panel controls as shown in Fig. 2.
• Connect the oscilloscope to the SH-101 OUTPUT.

(A) VCO Width
1. Hold the A4 key down, and set the CUTOFF FREQ. for approximately 1kHz.
2. Alternately, play the F4 and F5 keys, and adjust VR-8 (VCF WIDTH) until the F5 figure cycle is twice the F4 cycle.

4. LFO MOD OFFSET

Preparation:
• Connect the digital voltmeter to test points TP-1 and TP-2 on the Bender Circuit Board as shown in Fig. 3.
1. Adjust VR-3 (D/A LINEAR) until the voltmeter reads 0 ± 2mV.

Note: The adjustment can be performed from the direction of the foil pattern.