MRS-2 SERVICE NOTES

SPECIFICATIONS

- **KEYBOARD**
  - (37 keys, 3 octaves, F-1)
- **VCO (VOLTAGE CONTROLLED OSCILLATOR) (X2)**
  - VCO RANGE (H6, B', 4')  
    - WAVEFORM: (-, t)  
      - LFO RATE: 0.1 Hz – more than 80 Hz
- **DELAY/BEND SECTION**
  - DELAY TIME (0 - 10 sec)
- **TUNING**
  - MASTER TUNING (greater than ± 1 semitone)
  - VCO-2 “A” tuning (greater than ± 1 octave)
  - VCO-2 “B” tuning (greater than ± 1 octave)
- **CONTROLLER SECTION**
  - PORTAMENTO (0 - 3 sec)
  - VCO: greater than ± 2 octaves
  - VCF: greater than ± 2 octaves (resonance pitch)
  - VCA: greater than ± 6 dB, ± 12 dB

INPUTS AND OUTPUTS

- OUTPUT LEVEL selector (H: Octave, M: -6 dB, L: -12 dB)
- HEADPHONE jack (screw, 8 V)
- HEADPHONE LEVEL selector (H, M, L)

BEND CONTROL IN jack, with BEND SENSITIVITY control at "10".

- **GENERAL**
  - Power consumption: 20W
  - Overall size: 760W x 402D x 82H (mm)
  - Weight: 14kg
  - Accessories: 2.5m connection cord

DISASSEMBLY

1. --- Front Upper panel
2. --- Bender Control Block
3. --- Keyboard

Removal Screws

(1) Blind H52 (065H052)
(2) (3) End block No.17A (091-017A)

Holder No.203B (064-203B)
Holder No.205B (064-205B)

Foot (collar) BU480 OA25 black (111-024)

Pelt No.27 (101-027)
Knobs No.56 (016-056)
Panel No.268B (072-268B)

Holder No.232A (064-232A)
Bender Board QF-107 (149-107)

Key CV Board CV-3 (152-003)

Nylon Rivet NHR-335 4pcs (122-001)
Bender Unit PB-4 (029-022)

Printed in Japan Jul. '82 E-2
**Control Board A**  
OP-109 (149-109)

**Control Board B**  
OP-110 (149-110)

**Control Board C**  
OP-111 (149-111)

**Control Board F**  
OP-108 (149-108)

**Power Supply Board**  
PS-52  
(146-052) 100V

**PS-53**  
(146-053) 117V

**PS-54**  
(146-054) 220/240V

**Module Board**  
OP-105 (149-105)

**Module Control Board**  
OP-106 (149-106)

**LEVEL Switch**  
Board I  
OF-112 (149-112)

**LEVEL Switch**  
Board II  
OF-113 (149-113)

**Mother Board**  
OF-104 (149-104)

---

When ordering PCB, suffix an alphabetical letter to the part number referring to the Parts List and PCB Wiring Layout.

---

**Chassis No. 242B**  
(061-242B)

**Switch**  
S8B02332  
(001-271)

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**KEYBOARD PARTS**

---

**INSTRUMENT MODEL**  
**NO. OF KEYS**  
**KEYBOARD MODEL**  
**KEY SPRING**  
**BUS BAR**  
**PCB**  
**RESISTOR**

<table>
<thead>
<tr>
<th>Instrument Model</th>
<th>No. of Keys</th>
<th>Keyboard Model</th>
<th>Key Spring</th>
<th>Bus Bar</th>
<th>PCB</th>
<th>Resistor</th>
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<td>32</td>
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<td>070-052</td>
<td>071H034</td>
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<td>071-007</td>
<td>052-081</td>
<td>052-082</td>
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</table>
CIRCUIT DESCRIPTION

1. Operational Principles:
   In the conventional synthesizer, the circuits (VCO, VCF, VOA, etc.) are directly controlled from the control panel.
   In the compu-phonics synthesizer, it is the computer that comes in between and provides control voltages suitable to those VCO, VCF, VOA, ENV, SYN, etc.

2. Hardware:
   Compu-phonics Synthesizer is composed of the "Synthesizer Control Circuits" with PROM as its central point and the "synthesizer circuits" which are fully controlled by voltage.

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 let the computer know of their positions or the states 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, programmed and/or given by the computer, with self-contained transconductance amps or analog switches, etc. However, the circuit and function themselves of VCO, VCF, VOA 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 peripheral circuits. (refer to the General Block Diagram when reading the following)

Mother Board Block Diagram

(1) Scanning of all the switches on the Control Panel such as Memory Write SW, Manual SW, Comp-Memory SW, Proc-Set Selection SW, etc.
(2) Converting the Analog signals obtained from Sliders and switches of the Programmable Section on the Control Panel into 8-bit digital data (A/D conversion). (This data is read and repeated 16 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.

- 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. 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, Comp-Memory Selection Switch and Proc-Set 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 8-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 10-bit data. These are held there for a while.
Circuit Description

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 Box.  

5. 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 senses the matrix made of the diodes and switches on the Control Board F to find out which switch is depressed among those of WHITE through MEMORY Projects.  

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, DB5, DB6, DB7 on 8048-012. The blocks are then routed through the pins P20-P27 on Port 2 of 8048-012. They are then made a matrix. (Refer to the Circuit Diagram, Control Board F)  

2. To Scan the Switches  
The 8048-012 outputs "X" onto DB0 alone and "Y" on all other 255-255. They are cut on the data bus and latched on D7, D7, 74LS157 by the pulse from pin AIX (Address Latch Enable) to be put out onto D0-D6 of TEST.  

Next, 8048-012 reads the Port 2 (P20-P27). If it finds here that the P20 alone is "L" while all others are "H", then it can know of 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 (SW2) is so wired that it is only enabled when Comp-Memory selection switch is ON with the PROJECTION switch (SW1) being depressed at the same time.  
(See circuit diagram, CONTROL BOARD F)  

- Reading of CONTROL PANEL -  

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

Of the Control Panel, the section named "PROJECTION" consists of 16 pots and 14 switches, those 16 pots produce 16 different kinds of analog voltage varying between 0V to 5V. The 14 SWs, on the other hand, produce binary digital data of "F" or "0", given by +5V or 0V, respectively. The 16 analog voltages that come in parallel to each other are re-arranged through the analog multiplexer(MUX) I05, I06 4051, to be put on a single line in time sequence.  

Those outputs of the MUX go into the A/D converter (will be described later) to become 8-bit data of 16 kilo. The 16 binary data of the switches are also re-arranged into 2 groups of 7 kinds (total 14) with each group entering each respective MUX I05, I06 where they are made to 2-bit data and be output from there in time sequence as above. Those 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 15)  

- D/A and A/D Conversion -  

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.  

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. I05, I06 serve as an inverter, making the input to follow negative logic. The output is +5V maximum, therefore, when it receives the input LLLLLL, or 0V minimum when HHHHHH.  
(XX are for those least significant bits that are made nil.)
The 8048-012 tries at first putting D7 to "L", thus making the digital data at first to LHHHHHXX, tentatively. These are latched on LS175 by the pulse from AL8 pin, then out onto the D/A converter. On the one hand, 8048-012 reads the output level of the comparator, 1011, 11 through T1 pin. It makes comparisons between these two, the A/D input and a D/A converted output to LHHHHHXX (= 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 LHHHHHXX(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 D7 hereafter. Now, 8048 turns to D6 in putting here again "L" tentatively, to output LHHHHHXX. With this data, the D/A output becomes higher than the A/D input as in step 2 on figure. It makes the comparator 1111 turn to "H". That means, that 8048 has now to decide that D6 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.

### Memory

Here provided on this Compu-Phonic Synthesizer are "WORD RAM", I/O, 1101 for memory of the tone color (timbre) data to be used on Compu-Memory and ROM which resides in 8048-012 for use on FRESH mode.

8 bit ACCESS to 5101

<table>
<thead>
<tr>
<th>Memory Address</th>
<th>12</th>
<th>11</th>
<th>10</th>
<th>9</th>
<th>8</th>
<th>7</th>
<th>6</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Port A</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>AL8</td>
<td>LS175</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Port B</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The 8048-012 outputs from Port 1 the address data to turn the Chip Enable (CE) to "1" on 5101. Then, 8048-012 outputs the pulses from AL8 pin to make LS175 (107, 108) latch the data and define the memory address upon 5101. While the memory address being defined by LS175, 8048-012 outputs onto DBO to DB3 the data to be written. These data are then written onto 5101 by turning CE to "L", and are read by 8048 through DBO to DB4 when CE is "L". The digital data on the Control panel are 8 bits format. However, when made access to 5101, they are divided into 7 by 8048-012. (Because 5101 handles 4-bit quantization.) 5101 is backed up by the NiCd battery for protection of its memory. The NiCd battery will be fully charged for more than 48 hours. The memory on 5101 are also protected for an hour by the electrolytic capacitor (100nf/6.3V) just in case when the battery is removed for replacement or other.

5/31/1980

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

- Generation of Control Signals to Module Board(s) -

1. The 8048-012 reads out these digital data of 16 bytes successively from RAM or ROM. Upper 6 bits (I07 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, DMP5 IC17, IC12, 4051.

2. The lower 2 bits data, DB1, DB0 are fed in time sequence to the input pin of each respective address data latch 4099, 1011, 1012. The two 4099 latches then 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.
- OTHERS -

The circuit is to protect 8048-012 from running program inadvertently. When R8077 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)

- MODULE BOARDS -

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

1. VCO and its Peripherals

The VCO (pin 1, 2, 5) makes the vibrato voltage VCO OUT and keyboard key voltage KCV mixed and sends them out onto the antilog transistor IO2 which outputs antilog current from pin 9. This antilog current is then compared at the Comparator IC8b (pin 5, 6, 7) with the current flowing in from pin 6 of IO4 through R128. The output of the comparator IC8b 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 IO2. The VCO outputs are in the pulse form of the constant width converted by the one shot multivibrator IC8 (555).

It is therefore necessary to double the number of pulses if the antilog current is doubled. IC8b 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.

IC8a generates sawtooth waveform synchronized to that of the selected frequency. The amplitude of the sawtooth waveform is kept constant by choosing either of R81-R84 by the multiplexer IC7 regardless of any change made at the tone foot.

On FORMIC, 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-IQ15 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. Q5 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 obtain 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.
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.

Studying 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 Comp-T-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.

### Circuit Description

#### Designation

<table>
<thead>
<tr>
<th>DESIGNATION</th>
<th>PIN NO.</th>
</tr>
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<tbody>
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<td>DB0</td>
<td>12</td>
</tr>
<tr>
<td>DB1</td>
<td>13</td>
</tr>
<tr>
<td>(Data Bus)</td>
<td>2</td>
</tr>
<tr>
<td>DB3</td>
<td>3</td>
</tr>
<tr>
<td>DB4</td>
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</tr>
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<td>PORT 1</td>
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<tr>
<td>WR</td>
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</tr>
<tr>
<td>ALE</td>
<td>11</td>
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</tbody>
</table>

#### Function

- Panel Switches Data
- Panel Sliders
- Data
- I/O address
- 8048B-012 Logical Symbol

### µP8048

The µP8048 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 Comp-Phonic Synthesizers are µP8048B-012 and µP8048B-012 (JP-4 only) versions in which programs and data dedicated to the Comp-Phonics are stored in the program memories.
All Sliders on the PROGRAMMABLE section are set at "0"

Figures in TP column 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.

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

Components on foil side:
C48, C49

Connector A6, A10, A14, A18, A23
(connections to Power Supply Board B1)
IMPROVEMENTS on CV-3

1. FORTAMENTO (with serial number 850370 -- CV-3B)
With Circuit A in the figure right, C charges close to CV IN relatively fast, but will not charge up to the exact CV IN for a while (theoretically, indefinitely).

Circuit B
One of the diodes keeps IC2 output 0.6V higher (in the case figure immediately right) or lower than CV IN and C10 charging (discharging) rate is speeded up along curve B.
Once voltage across C10 reaches the CV IN, feedback resistor 3.3K will cause the circuit maintain the CV.
Improvements on CV-3 cont'd

2. Shifting TRIG. GEN. - CV-3A only
   This relieves the following:
   When keys on MRS-2 are played in legato with the CV and GATE IN/OUT
   jacks being connected to a CSQ-100,
   tones corresponding to the subsequent
   keys can fade away along with the
   first key's envelope decay(a remarka-
   ble example is Preset PIANO).
   This is because Gate-retrigger pulse,
   being blocked with CSQ-100 circuits,
   does not exist at GATE IN, failling
   to re-set envelope generator for in-
   dividual keying that follows to the
   first keying in sequence.
   After modification, MRS-2 has no de-
   trimental effects on sequencers other
   than CSQ-100.
   The modification was conducted on
   MRS-2 with serial number 840630;
   besides, products bearing the
   following numbers have been
   modified before shipment.

830568-830599  830600-830617
810628-810629  830528-830529
830533-830534  830540-830545
830547-830548  830556-830557
830552,830554  830619,830621

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

D1-D6 Cathodes

CLKs(TC4049) Outputs

resistors on
the foil side

All shifted from
the component side

Roland

052-440A

foil scraped off
For the circuits 1, 2, 3 of 052-314B see right below.

Capacitors on the foil side: (OP-104D) C33, C34, C35 and 100p, 1000p connect to IC1.

MODULE BOARD OP-105D compatible
MODULE BOARD

BA662

Besides BA662 -A and -B, there are factory selected marked with various colors. Although they are interchangeable, however, because of electrical characteristic differences, use only in complete set of the same color. For non-selected, BA662A is a good replacement for BA662B while BA662B cannot replace for BA662A.

OP-105D (149-105D)  
(PCB 052-314D)

OP-105E (149-105E)  
(PCB 052-314E)

POWER SUPPLY BOARD

PB-52P(146-052P) 100V
PB-53P(146-053P) 117V
PB-54P(146-054P) 220/240V
(PCB 052-327F)

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<th>FUSE</th>
<th>AC</th>
<th>F1-F3</th>
<th>F4</th>
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<td>100/117V</td>
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<td>80A002(1A)</td>
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<td>(008-026)</td>
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<tr>
<td>220/240V</td>
<td>CEE T2A</td>
<td>CEE T500mA</td>
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<td>(008-070)</td>
<td>(008-063)</td>
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Q1, Q2  28A1015-Y
Q3  28B596-Y or 28B434-0
Q4  28D880-GR or 28D234-Y
ADJUSTMENT

Because certain circuits of FROMARS are voltage controlled, Power Supply Board, PS-52/53/54 is the first to be checked and adjusted. Also repairing or replacing PS-** Board forces readjustment of some associated PCBs, CV-3, OP-104, VCO-9 and OP-105.

Replacing a PCB other than Power Supply Board involves readjustment of its own.

1. DC VOLTAGE (-15 Volt)

Allow at least five minutes for warm-up.
1. Connect a digital voltmeter to TP-1.
2. Adjust P-1 for \(-15.0\pm10\text{mV}\).
3. Check other voltages, they must be
   \(+5.0\pm250\text{mV}\) and \(+15.0\pm750\text{mV}\).

2. KEY CV and WIDTH

   - Connect digital voltmeter to the hot terminal on CV OUTPUT jack.
   - While depressing C1 and C2 keys alternately, adjust P-3 so that
     \(O2V = O1V + 1.00\text{V} + 3\text{mV}\).
   - Hold down C1 key and adjust P-2 to provide 2.00\pm2\text{mV}.
   - Check octave keys for errors:
     \(O2 = 5.00\pm3\text{mV}\) \(O3 = 4.00\pm3\text{mV}\)

3. LFO WAVEFORM

Connect oscilloscope to TP-4 on Mother Board OP-104 (see next page).
1. Adjust P-4 for slope straightness.

4. LFO RATE

Connect scope to TP-5 on OP-104.
1. Set P-5 for 5\text{Hz}.

22
5. VCO FREQUENCY and WIDTH

- Switch to A or B before adjusting VCO-9 Board.
- Connect and set instruments as above.

MODULE BOARD OP-105
1. While depressing A2 key, Adjust P-7 for 1:2 Lissajous figure.
2. While depressing AO key, adjust P-6 for 2:1 Lissajous figure.

VCO-9
To disconnect VCO-1 signal path:
Pull the housing off the PCB.
Reverse it and plug in the right pin only.
Set VCO-2 TUNE switch to A-TUNE or B-TUNE.
Adjust P-6 and P-7 on VCO-9 Board following the steps in OP-105.

6. VCO WAVEFORM (Pulse width 50%)

- Test Point - TP-3 on OP-104
- Place at A or B and disconnect VCO-1 signal (see section 5) during VCO-9 adjustment.

7. VCF FREQUENCY and WIDTH

NOTE: Due to the digital control characteristics of this VCF, if CUTOFF FREQ knob is moved steadily and slowly, the resonating VCF will produce frequencies in a series of steps. If CUTOFF FREQ is set at a point exactly between two of these steps, the resulting frequency will be unstable as it jumps up and down between these two steps. The knob must be set at a point near "5," where VCF output frequency looks positively on one frequency or the other.

Test Point - TP-3 on OP-104
1. While depressing F1 and F2 keys alternately, adjust P-11 on OP-105 to display two figures of 2:1 period.
   Reset KEY FOLLOW at "O".
2. Adjust P-12 on OP-15 for 860Hz.
   (by displaying Lissajous figure, etc.)
3. Check F1, F2 keys for deviations in step 1.
8. VCF RESONANCE

Test Point - TP-3 on OP-104

1. While depressing a key, adjust F-10 on OP-105 so that VCF just begins oscillation. Approx. 800mVpp sine with RESONANCE set at "8".

9. VCF ENVELOPE BALANCE

Test Point - TP-3 on OP-104

1. Adjust F-13 on OP-105 so that moving ENVELOPE MOD between "0" and "10" produces no frequency change.

10. VCF ENVELOPE MODULATION DEPTH

Test Point - TP-3 on OP-104

1. With one key holding down, set F-9 on OP-105 for 1.2mV/lKHz.

MRS-2

11. VCA BALANCE

Test Point - TP-3 on OP-104

1. While modulating the VCA with BEND MOD lever, adjust F-14 on OP-105 to minimize click sound.

12. VCA LEVEL

Test Point - TP-3 on OP-104

1. While depressing down C2 key adjust F-15 on OP-105 for:

1.2Vpp

13. LFO VCO MODULATION

Test Point - TP-10 on OP-106
Connect scope ground to G-3 on OP-104

1. Set F-20 on OP-106 for 150mVpp ±10%.
14. LFO VCF MODULATION

Test Point - TP-11 on OP-106
(see section 20)
Grounding Point - Ground 3(0-3) on OP-104


15. LFO VCA MODULATION

Test Point - TP-11 on OP-106, Ground Point - G-3 on OP-104

1. With C2 key held down, push BEND MOD extremely right and
set P-18 on OP-106 for 100% modulation.

16. VCF ENVELOPE ATTACK

Test Point - TP-11 on OP-106
Ground Point - G-3 on OP-104

Attack Time is defined as the time from a
keying to a sudden frequency drop.

1. Depress C2 key and adjust P-23 on OP-106
so that Attack time becomes 3 sec.

Measuring Attack time by listening to the
sound is easier than observing the screen.

17. VCF ENVELOPE DECAY

Test Point - TP-11 on OP-106
Grounding Point - G-3 on OP-104

1. Adjust P-21 on OP-106 so that frequency
lowers to 1/10 of its initial value in
4 sec after depressing C2 key.

18. VCF ENVELOPE RELEASE

Test Point - TP-11 on OP-106
Grounding Point - G-3 on OP-104

1. Adjust P-22 on OP-106 so that frequency lowers
to 1/10 of its initial value in 4 sec after C2
key is released.
The amplitude decreases as its frequency lowering.
Increase scope vertical sensitivity accordingly.

19. VCA ENVELOPE ATTACK

Test Point - TP-11 on OP-106
Grounding Point - G-3 on OP-104

1. Adjust P-26 on OP-106 so that Attack Time
is 3 sec with C2 key on.
20. VCA ENVELOPE DECAY

Test Point - TP-11 on OP-106
Grounding Point - G-3 on OP-104

1. Adjust P-24 on OP-106 so that amplitude decreases to 1/10 in 5 sec after pressing C2 key.

21. VCA ENVELOPE RELEASE

Test Point - TP-11 on OP-106
Grounding Point - G-3 on OP-104

1. Adjust P-25 on OP-106 so that amplitude decreases to 1/10 in 5 sec after releasing C2 key.

22. HPF CUTOFF FREQUENCY

Test Point - TP-11 on OP-106
Grounding Point - G-3 on OP-104

1. While pushing BEND MOD lever extremely left, adjust P-17 on OP-106 so that sound ratio of STRING and VOICE becomes 1:1.1 in amplitude.

23. NOISE LEVEL

Test Point - TP-9 on OP-106
Grounding Point - G-3 on OP-104

PARTS LIST

061-242E Chassis (case) no.242E
072-265D Panel (top) no.265D
072-268B Panel (bender) no.268B
083-069B Side Panel no.69B right
083-070B Side Panel no.70B left
111-024 Foot (collar) no.24 black BU480 CA25
115-003 Hinge no.3
064-219B Music Rack Holder no.219B

004-011 Keyboard Assy SK-132G
091-017A Endblock no.17A right
085H52 Blind H52

KNOB, BUTTON
016-033 Knob no.33 slider
016-056 Knob no.56 rotary small
016-057 Knob no.57 rotary large
016-009 Button no.9 black
016-085 Button no.85 white
016-086 Button no.86 red
016-087 Button no.87 green
016-088 Button no.88 yellow
016-089 Button no.89 blue

SWITCH

Push
001-250 SUP-2 J2 interlock
001-225 SUP-12 REMO/WRIT. M PROTCT
001-226 SUP-12A HOLD
001-215 S095P-501-1 power 100V
001-216 S095P-501-2 117V
001-217 S095P-502 220/240V

Lever
001-237 LBC-42M-18K FW. NOISE, etc
001-238 LBC-23M-18K TUNE A/B, PORTA, etc

Slide

001-182 SSB-022 RANGE (SUB on/off)
001-205 SSB-023
001-271 SSB-02332 LEVEL
001-228 SQFR-2412P LFO WAVE, FW

Rotary

001-224 SBRM-1043K15 VCO WAVEFORM
001-234 SBRM-1034K15 VCO RANGE

PCB

149-104B OP-104B Mother Board (PCB 052-364B)
149-105D OP-105D Module Board (PCB 052-314D)
149-105B OP-105B compatible with OP-105D
149-105C OP-105C Module Control (PCB 052-235C)
149-107B OP-107B Bender Board (PCB 052-441B)
149-108C OP-108C Control Board F (PCB 052-2370)
149-109A OP-109A Control Board A (PCB 052-442A)
149-110D OP-110D Control Board B (PCB 052-239D)
149-111B OP-111B Control Board C (PCB 052-328B)
149-112A OP-112A Level SW Board I (PCB 052-443A)
149-113A OP-113A Level SW Board II (PCB 052-443A)
149-134A OP-134A VCO-9 Control Board (PCB 052-468A)
152-003B CV-3B KOE Board (PCB 052-440B)
152-009A VCO-9A VCO-2 Board (PCB 052-439A)
146-052F PS-52F Power Supply Board (PCB 052-327F)
146-053F PS-53F Power Supply Board (PCB 052-327F)
146-054F PS-54F Power Supply Board (PCB 052-327F)
052H195A LBD Mounting Board power switch
052-307

JACK

009-002 LJ-039-1-6 or stereo
009-045 HLJ-0235-01-070
009-025 HLJ-0102-01-040

POTENTIOMETER

029-022 PB-4 Bender unit assy
028-756 VM0LRB100K 20k
028-762 VM0LRB100K 50k
028-992 BVH10D1K15 50K BRILLIANCE
028-1109 BVH06A1K15 50KA VOLUME
028-1118 BVH12A1K15 50KB M. TUNE
030-951 BVHLWAD2531B15 50KB A/B TUNE

Slide

029-355 BVA17C16B54 50KB
029-370 BVA17C16026 2MC
029-426 BVA23C16B54 50KB

Trimmer

030-469 SR-19R 47KB horizontal
030-471 SR-19R 100KB
030-660 SR-29R 4.7KB erect
030-662 SR-29R 10KB
030-666 SR-29R 47KB
030-668 SR-29R 100KB
030-493 CR-19R 4.7KB horizontal blue
030-505 CR-19R 47KB
030-689 89PR 20K helical
030-688 89PR 500-ohm helical

RESISTOR

CRE4FX #W 1K
044-909 2K 044-846 100K
044-844 6.8K 044-849 180K
044-905 16K 044-926 1M
044-887 20K

CAPACITOR

035-091 BCQ2334MX polypropylene
035-278 BCQ31681K2 poly styrene
035-279 BCQ51102KZ poly styrene
مصغرة-

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