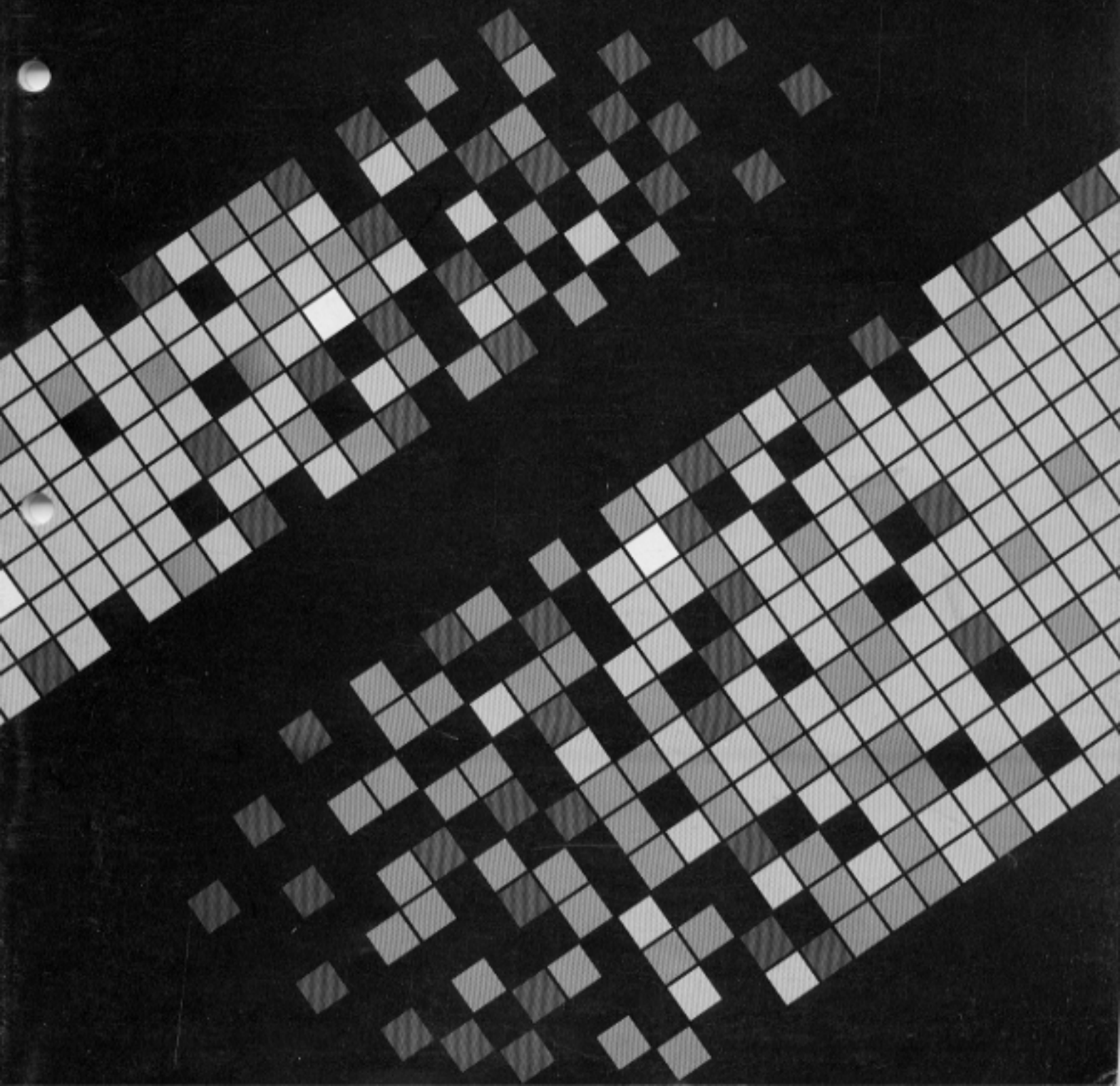
# YAMAHA

## PROGRAMMABLE MEMORY SYNTHESIZER
## CS SERIES

# 20M/40M

## OWNER'S MANUAL



# PROGRAMMABLE MEMORY SYNTHESIZER

Thank you for your purchase of our YAMAHA PROGRAMMABLE MEMORY SYNTHESIZER.

The YAMAHA PROGRAMMABLE MEMORY SYNTHESIZER is a new professional keyboard that has been developed based on Yamaha's rich experience in music and the most advanced LSI technology. By providing the performer with a wide range of sound variations and by incorporating a programmer, this synthesizer is ideal for live performances.

## ■ FEATURES

- **Built-in PROGRAMMER**
  As these units incorporate RAM (LSI's for memory), the CS-20M can store 8 original voices with the use of 32 parameters, while the CS-40M can store 20 voices with the use of 50 parameters.
- **Equipped with Back-up Batteries**
  As back-up batteries (two alkaline batteries) are provided, the memorized program data is held intact even after the power switch has been switched off.
- **Built-in Cassette Interface**
  A built-in cassette interface enables storage of programs (recording onto cassette tape) and loading of programs (writing into RAM from cassette tape). This provision giyes the user the ability to create an infinite library of original sounds.
- **Control Panel Designed with Emphasis Placed on Sound-Creating and Ease of Operation**
  The CS-20M is eequipped with two VCOs, and the VCF and VCA are both provided with an independent EG. On the other hand, the CS-40M has four VCOs, each of which is provided with a special EG. The VCF and VCA are also equipped with independent EGs. Furthermore, the panel is laid out in a manner which permits ease of operation and the ability to create fine-textured sounds.

  In order to fully understand these functions and to gain maximum efficiency with this instrument, we urge you to read the contents of this owner's manual carefully.

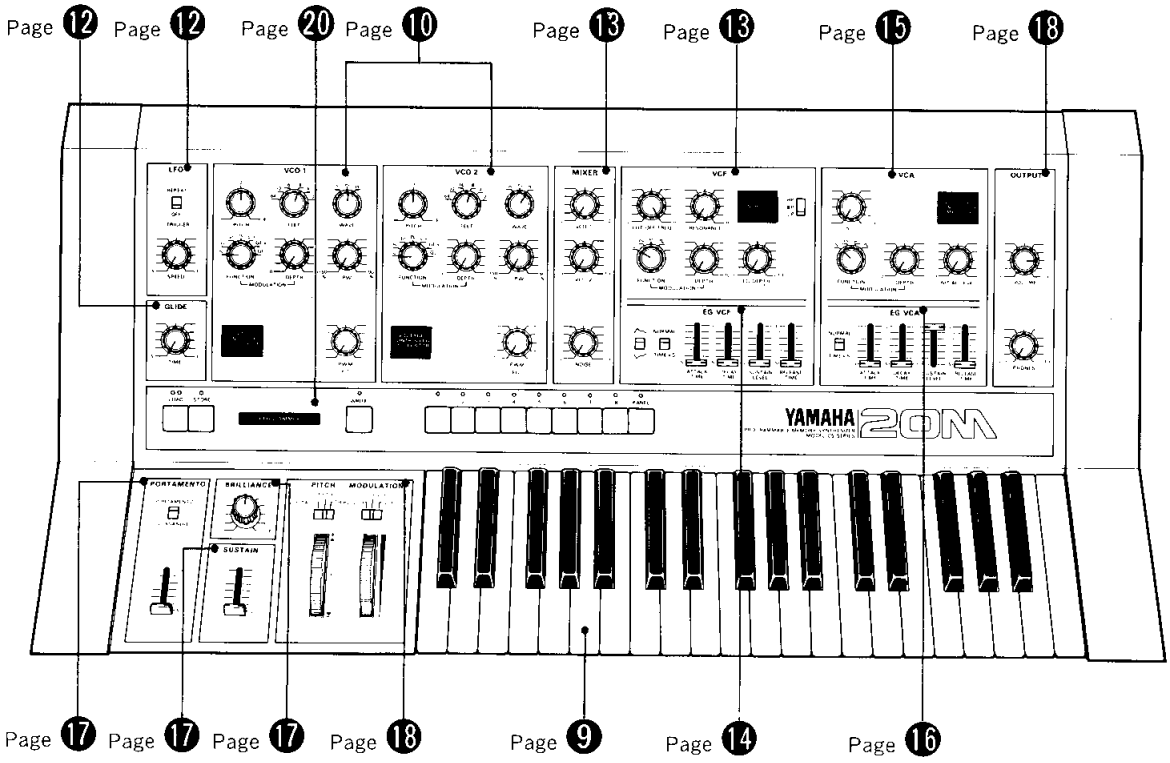
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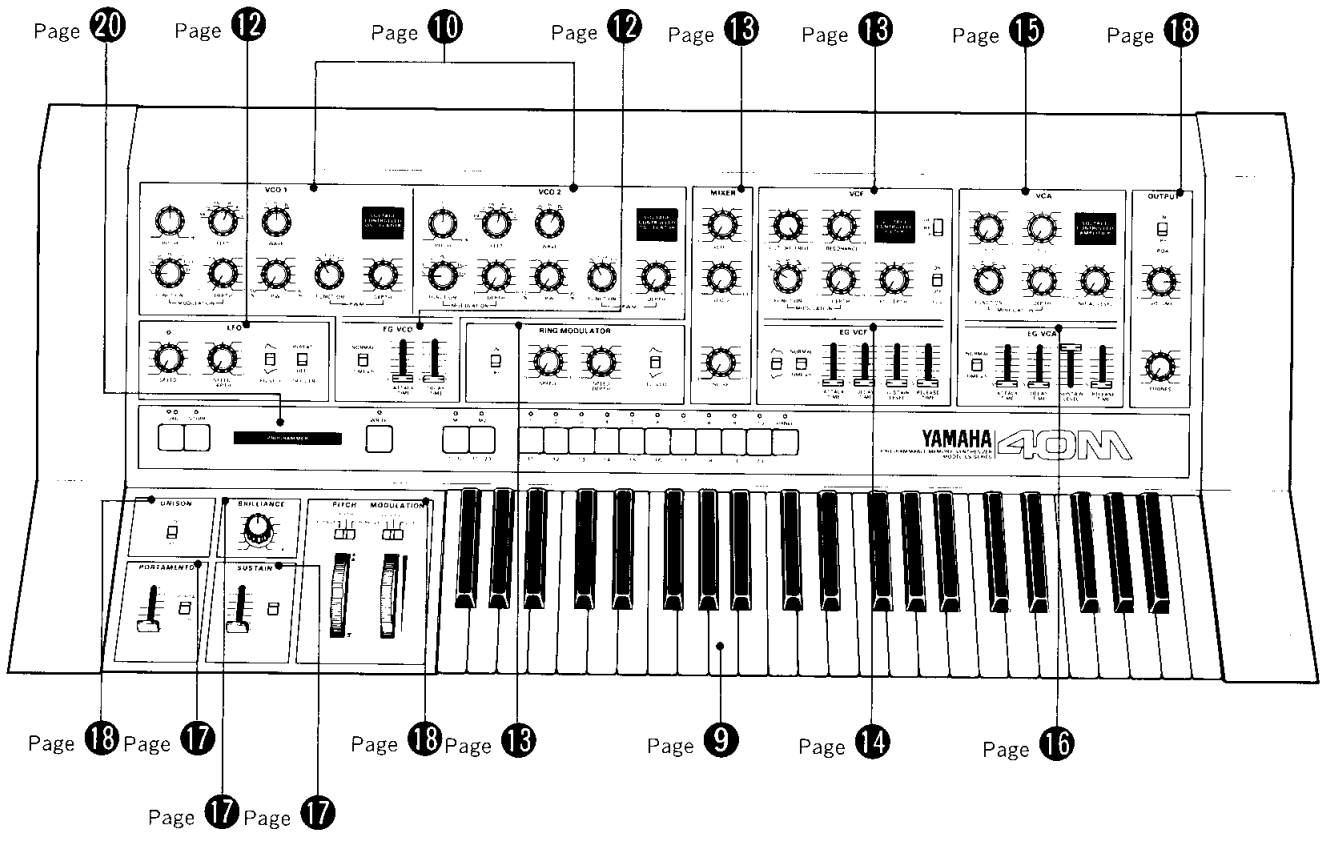

## ■ Points of Attention

- **Installation**
  Avoid places subjected to direct sunlight, high humidity, or dust. Never use the synthesizer near fire or heat-producing objects, such as on top of a power amplifier.
- **Cleaning**
  When cleaning the set, do not wipe the panel or keyboard with thinner or other cleaning liquids, as this may leave stains or cause discoloration. Always use a soft and dry piece of cloth only.
- **Connections**
  Connections to an amplifier or other equipment must be made appropriately and with due care, as wrong connections may lead to damage in the synthesizer or amplifier.
- **Volume**
  The volume level should always be set with care, as the application of excessive input to the amplifier may cause damage to the amplifier or speakers.
- **Back-up Batteries**
  The back-up batteries (two alkaline batteries) for RAM have a life of approximately 2 years. However, it is recommended that the batteries be replaced a little earlier than the regular life span. (Refer to Page 6, regarding insertion and replacement of back-up batteries.)

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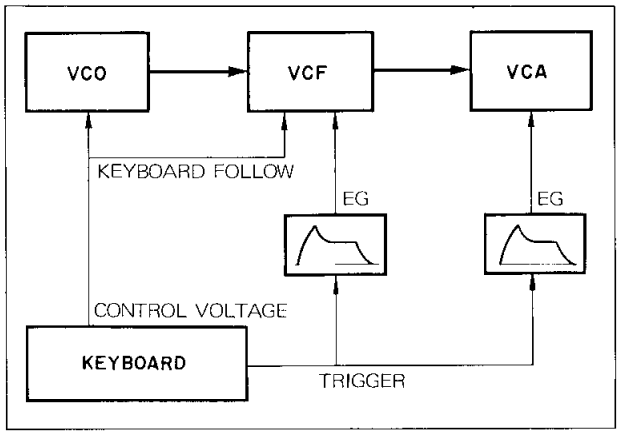
## CS-40M


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# CHARACTERISTIC POINTS OF A SYNTHESIZER

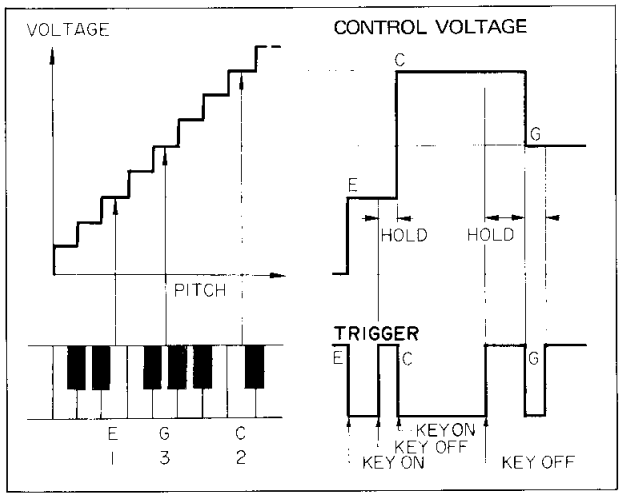
The function of the synthesizer is to electrically synthesize and control the three elements of sound, that is, pitch, tone and volume as well as the transient change from the instant a sound is generated to the point it fades away.

The pitch is controlled by the VCO, tone by the VCF, volume by the VCA and the transient variation of sound by the EG. "VC" in VCO, VCF and VCA designates "voltage-controlled". Now, let us consider what kind of function this voltage control has in the synthesizer. The drawing described below is the block diagram showing the basic composition of a synthesizer.



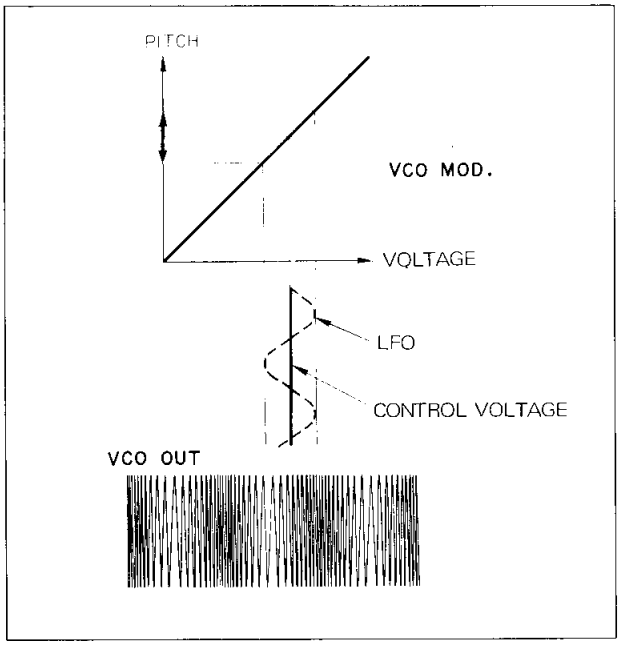

- **KEYBOARD CIRCUIT**

  This circuit generates the key's voltage (CONTROL VOLTAGE) that corresponds to the pitch, and the signal voltage (TRIGGER) that indicates that the key is being depressed. Although the TRIGGER voltage will stop when the finger is released from the key, the CONTROL VOLTAGE that indicates the interval will be held by the SAMPLE AND HOLD (S/H) circuit until the next key is depressed. The drawing described below shows the relationship between the key's interval and CONTROL VOLTAGE, together with the waveforms produced by the TRIGGER and CONTROL VOLTAGES when mi (E) →do (C), →and sol (G) are depressed.




- **VCO (Voltage controlled oscillator)**

  The VCO produces the basic sound source, with the frequency of this sound corresponding to the CONTROL VOLTAGE from the keyboard circuit. The VCO simultaneously produces (oscillates) such sound source waveforms as the sawtooth and square wave which are rich in harmonics, as well as the pure-sounding sine wave (containing no harmonics). The oscillator frequency corresponds to the CONTROL VOLTAGE value in a linear fashion. In addition, if the oscillator is also controlled by adding an AC voltage, such as a low frequency oscillator (LFO) or other AC sources, the key interval will be modulated accordingly. The function of adding this voltage is carried out by a circuit called an adder. Therefore, it is possible to freely control the VCO's oscillating frequency in accordance with the voltage value applied, since a synthetic voltage formed by several AC waveform sources is used instead of a fixed DC voltage. The drawing described below shows a case of VCO control in which a sine way from the LFO is added to the CONTROL VOLTAGE. Of course it is also possible to add other voltages such as an EG voltage in place of, or simultaneously with, the LFO.

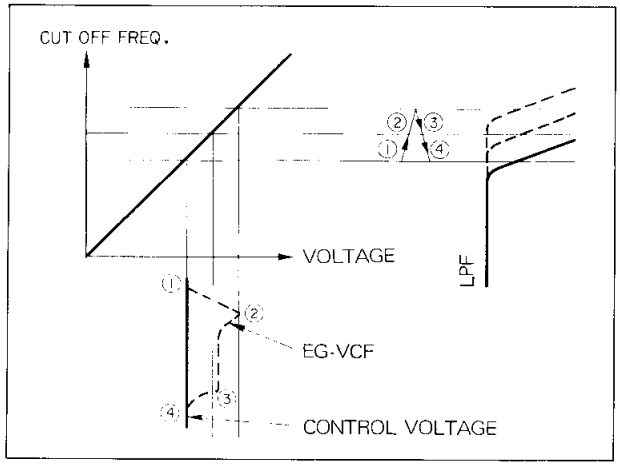



- **VCF (Voltage controlled filter)**

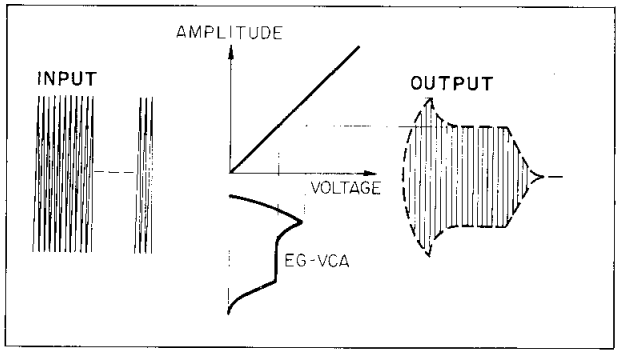
  The VCF, which might be called the heart of the synthesizer, alters the tone from the VCO by cutting or emphasizing the harmonic structure of the waveform. Therefore, an infinite variety of tonal (harmonic) variations are possible by using the VCF to alter the sound source from the VCO (those which are rich in harmonics, the sawtooth and square for example).

  *Note: Since the sine wave is a pure waveform containing no harmonics, the VCF has no effect on this waveform.

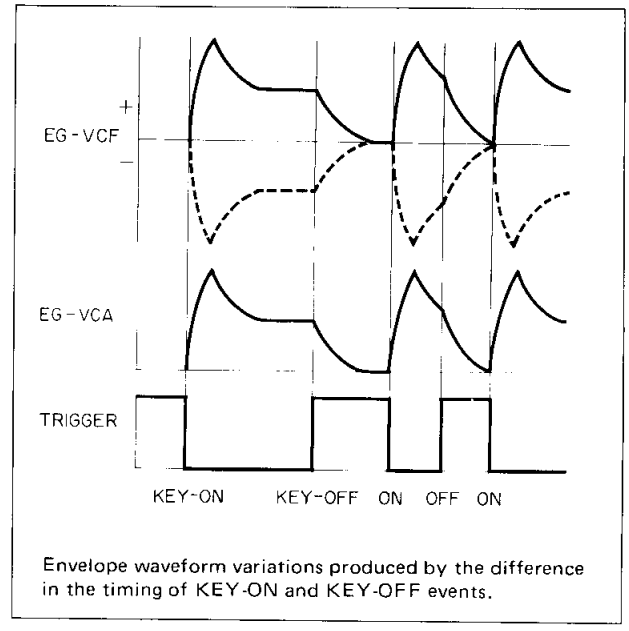
The VCF alters the tone by changing the cut-off frequency (The point at which harmonics contained in the waveform source are either passed or rejected. All harmonics above this point are eliminated, all below are allowed to pass). To compensate for any deviation of harmonic structure caused by the difference in intervals from the keyboard control voltage to the VCO, a circuit (KEYBOARD FOLLOW) is introduced so that the cut-off frequency will shift along with the shift in the interval. This is accomplished by adding the CONTROL VOLTAGE of the keyboard circuit to the DC voltage genetated by the VCF keyboard follow control. In addition to the above, the tone (harmonic structure) can be modulated by adding to the existing voltages a voltage from the LFO or a transient voltage from the EG.
The drawing described below illustrates the condition in which the cut-off frequency of the LPF (low-pass filter) is controlled by the EG.




- **VCA (Voltage controlled amplifier)**
  The VCA is an amplifier block whose amplification degree is varied by the control voltage.
  The drawing described below shows a case in which the amplification degree of the amplifier is controlled by the EG voltage to give a transient variation (envelop) to the volume, from the point at which the sound begins to the point at which it fades away. Naturally, as in the cases of the VCO and VCF, it is possible to add a voltage from the LFO to the EG voltage and use the resulting voltage as the VCA's control voltage.




- **EG (Envelope generator)**
  The EG produces a transient voltage which creates the envelope (how the sound characteristic changes over a period of time) to control the sound desired. The TRIGGER signal from the keyboard circuit initiates the beginning and the end of the envelope. This envelope can be used as a control signal for the VCO, VCF, VCA, etc.




Envelope waveform variations produced by the difference in the timing of KEY-ON and KEY-OFF events.

In addition to all the elements described above, the synthesizer contains other controls such as the LFO (low frequency oscillator), that produces an AC voltage to provide periodical variations resulting in such effects as VIBRATO, TRILLS, TREMOLO, etc., and controls which provide versitility for the user during live performance such as a PITCH BENDING WHEEL, SUSTAIN, PORTAMENTO, GLISSANDO, etc.

In summary, any parameter of the synthesizer can be controlled or changed by changing and periodically varying the voltages. Therefore, since all controls in a synthesizer are effected by using the power of voltage control, the synthesizer is capable of producing an infinite variety of sounds and events with ease, never before possible with any existing instrument. In this regard, the synthesizer is a new and exciting instrument with a place of its own in the musical world.

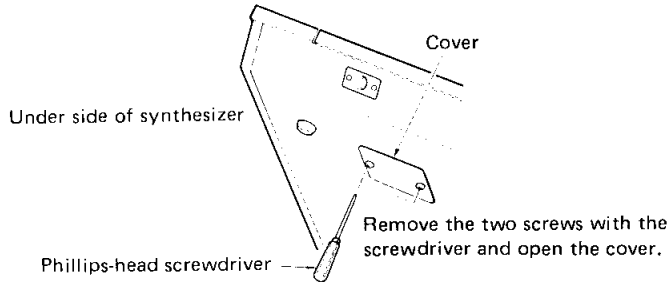
# BEFORE MAKING CONNECTIONS

Before connecting the synthesizer, the following operations should be carried out.

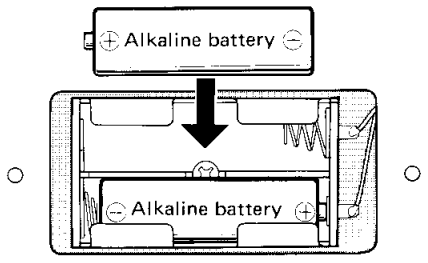
**1. Load the batteries.**

In order to prevent the programs from being erased when the power switch is switched off, the CS-20M and CS-40M are equipped with back-up batteries for the RAM. Load the back-up batteries before any connections are made and before performing programming operations.

**Loading of batteries**




Insert the two standard-accessory alkaline batteries, placing them in proper polarities (+, –), and then close the cover.

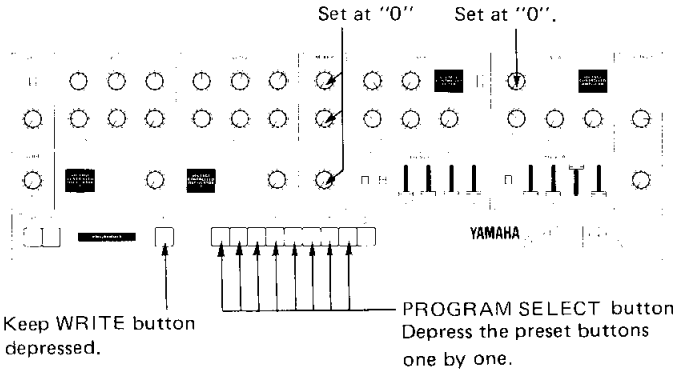


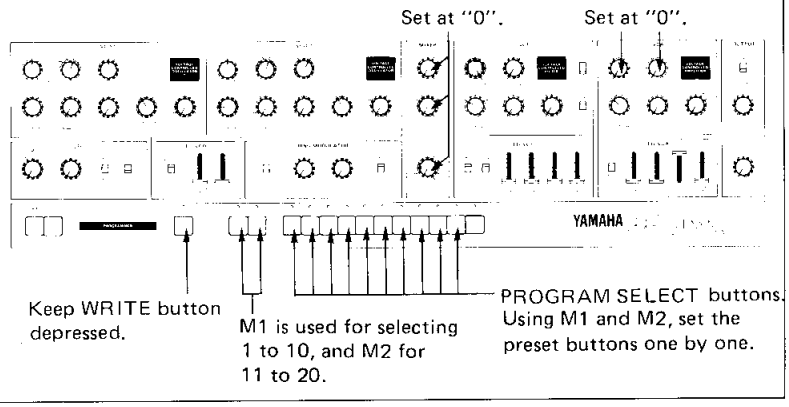

- The batteries have a service life of about 2 years. If the batteries are kept inside the synthesizer after the life period has expired, liquid may leak out from the batteries and damage the unit. Therefore, they should be replaced before they reach their life span.
- When replacing the batteries, use alkaline batteries (Size: AA). Always replace both batteries.
- To avoid damaging the synthesizer's circuitry, temporarily disconnect all cords before replacing the batteries.

**2. Perform the following operations.**

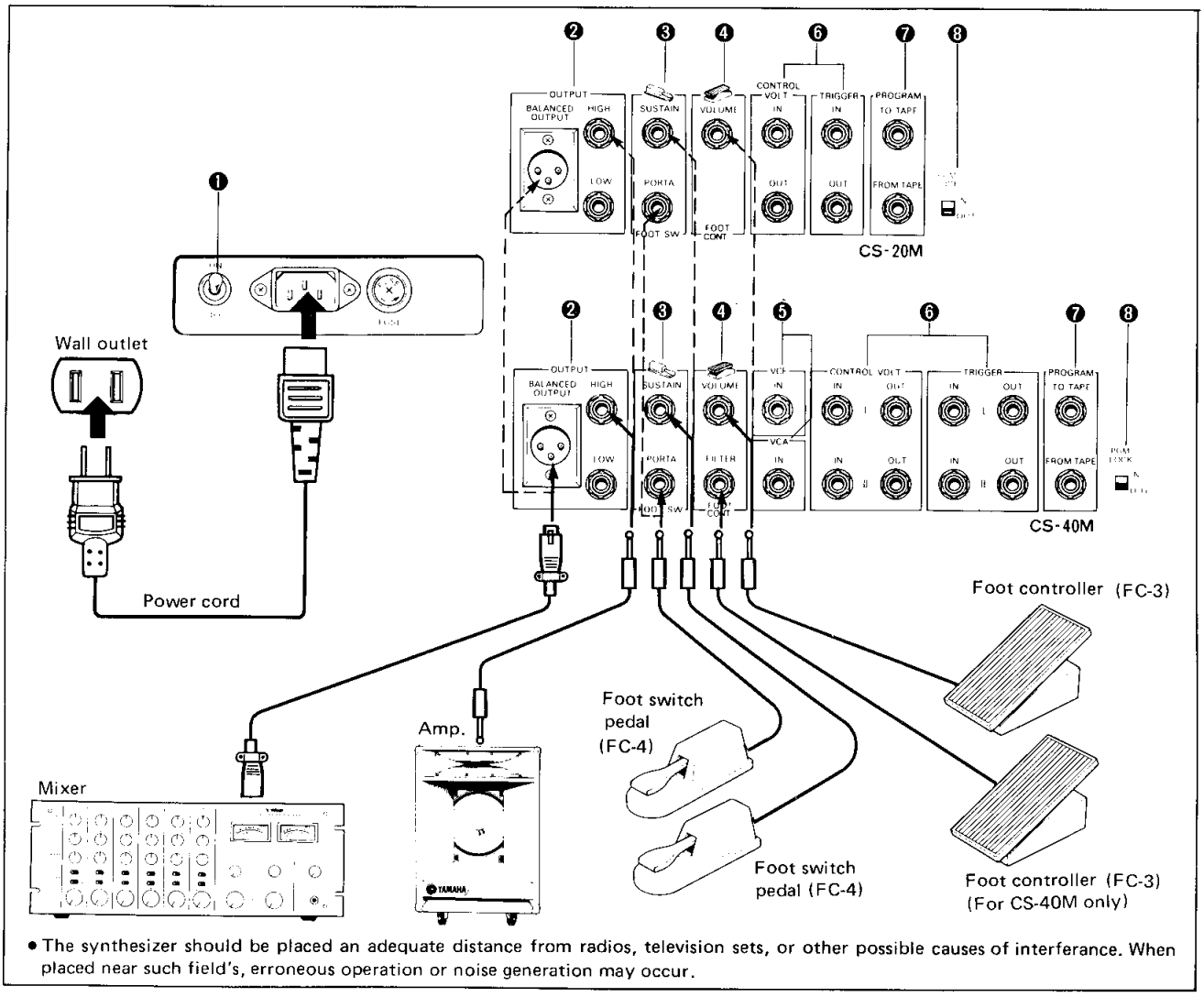
The first operations to be performed after loading the batteries are carried out for stabilizing the programmer. This is attained by setting the synthesizer to a condition where no sound will be produced.

1) Refer to "CONNECTIONS (Page 7)" and connect the power cord and set the POWER switch to the "ON" position.
2) Turn VCO1, VCO2 and NOISE controls in the MIXER block, and ∿ 1 and ∿ 2 in the VCA block counterclockwise as far as they will go. (Control ∿ 2 is provided for the CS-40M only.)
3) While depressing the WRITE button of the PROGRAMMER block, push down the preset buttons. (In the CS-40M, the M1 button is used for selecting 1 ~ 10 and M2 button for 11 ~ 20.)



# CONNECTIONS···Part 1




• The synthesizer should be placed an adequate distance from radios, television sets, or other possible causes of interferance. When placed near such field's, erroneous operation or noise generation may occur.

**❶ POWER**
After connecting the power cord as shown in the connection diagram, switch on the POWER switch.

**❷ OUTPUT**
Output terminals used for connecting an amplifier, or the like.
- **BALANCED OUTPUT:**
A balanced-type cannon-type connector output terminal.
- **OUTPUT-HIGH:**
An unbalanced phone-jack type high-level output terminal.
- **OUTPUT-LOW:**
An unbalanced phone-jack type low-level output terminal.

* The HIGH and LOW terminals should be used in compliance with the input sensitivity of the amplifier to be connected.

* When connecting to such equipment as an amplifier, pay special attention to the level setting of the synthesizer and amplifier.

**❸ FOOT SW.**
Connector terminals for the foot switch pedal. Enables SUSTAIN and PORTAMENTO effects to be turned ON and OFF.

**❹ FOOT CONT.**
The connector terminals for the foot controller.
- **VOLUME:** Enables volume control.
- **FILTER (For CS-40M only):** Enables control of VCF cut-off frequency. Useful for WAH effects.

**❺ VCF IN and VCA IN (For CS-40M only)**
Input terminals used for controlling the VCF and VCA externally. For further details, refer to page 20.

**❻ CONTROL VOLT & TRIGGER**
Input/output terminals for the CONTROL VOLTAGE and TRIGGER. They enable this synthesizer to be used as a multiple-system synthesizer with another synthesizer having compatible input/output terminals. For further details, refer to page 19.

**❼ PROGRAM**
Input/output terminals used for STORE and LOAD operations performed with a cassette tape recorder connected to this unit. For further details, refer to page 23.

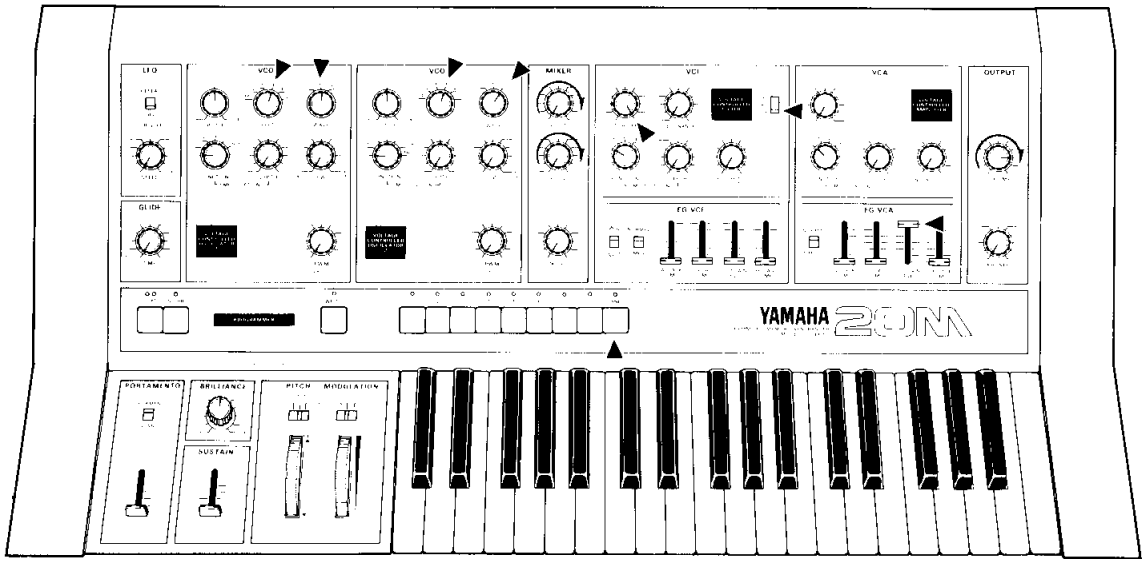
**❽ PGM LOCK IN/OUT**
This is a switch provided for the purpose of preventing program data to be erased by mistake. For futher details, please refer to page 22.

# FUNCTIONS···BASIC SETTING

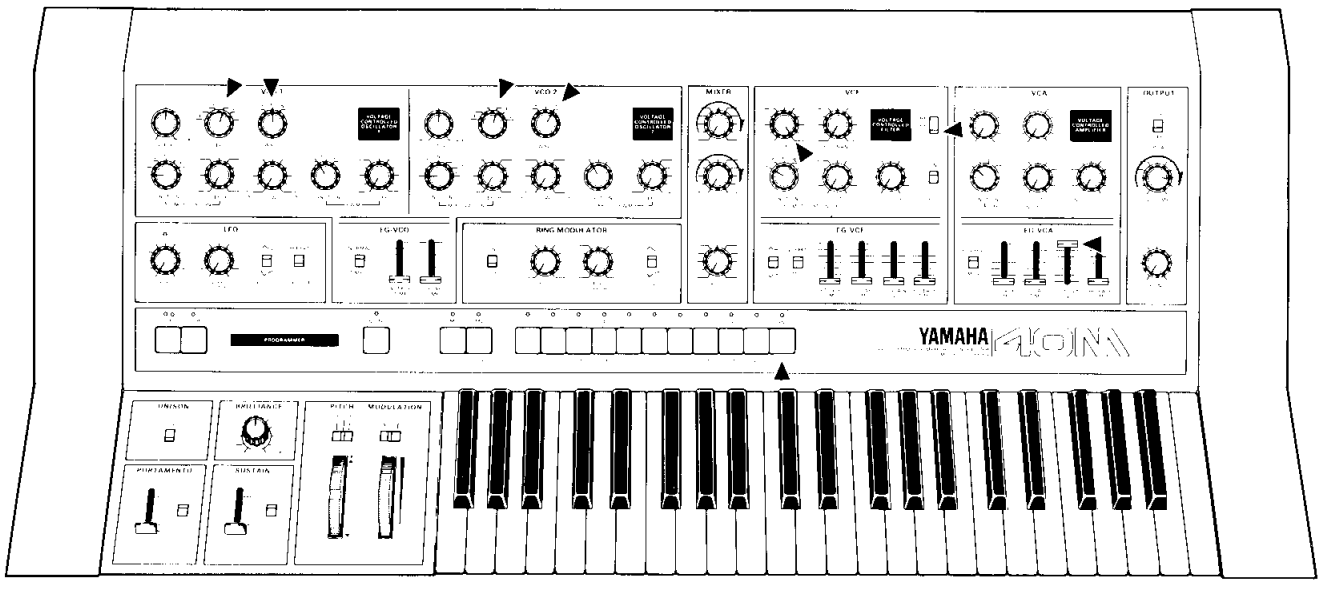
The functions of each section are described individually below. First, we shall show the basic setting, the pattern to be followed when you wish to produce sounds for the first time, or experimentally, to check the synthesizer, amplifier, etc.

1. Confirm illumination of the indicator located above the PANEL button of the PROGRAMMER block.
2. Referring to the drawing, set the respecitive knobs and switches. This is a setting that will cause sawtooth waves (⟍) to be fed out in their original form from the VCO1 and square waves (⊓) from the VCO2.
3. When the VCO1 control of the MIXER block is turned, it will cause ⟍ (sawtooth waves) to be fed out, whereas when the VCO2 control is turned, ⊓ (square waves) will be fed out. When both controls are turned together, mixed waves will be fed out.
4. VOLUME should be set to a position where an optimum volume is obtained.

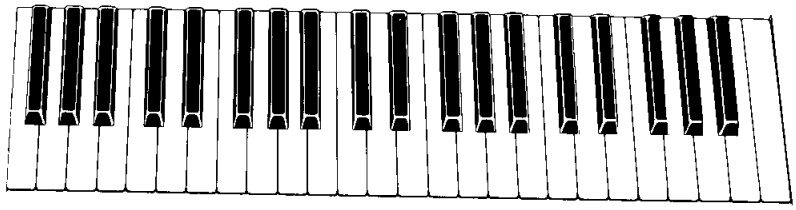
**Basic Setting for CS-20M**




**Basic Setting For CS-40M**

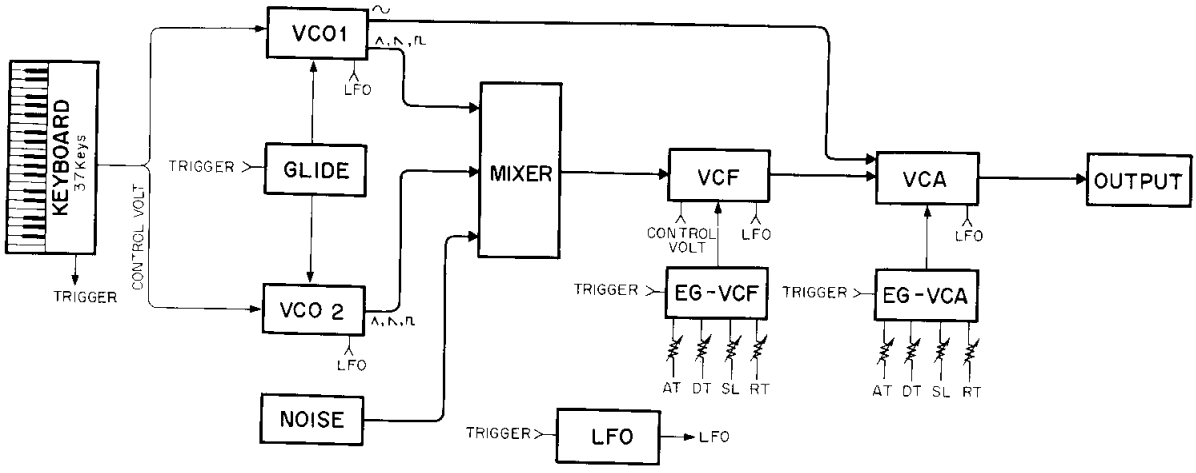


## KEYBOARD

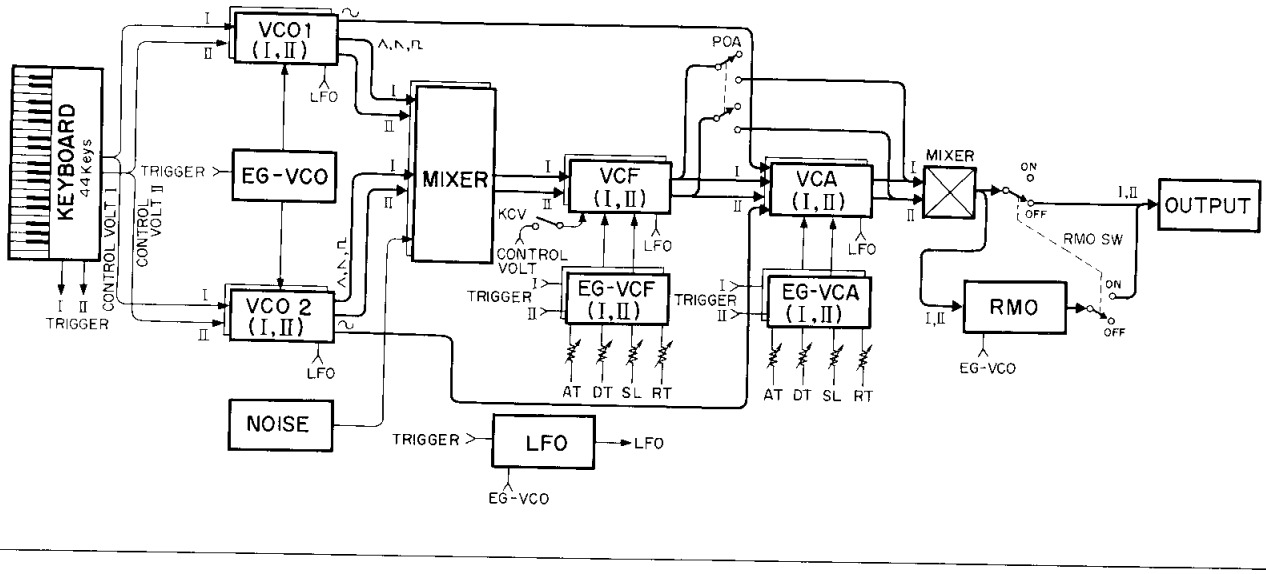


- The CS-20M is a monophonic synthesizer composed of 37 keys to cover 3 octaves. When two, or more, keys are depressed together, the one of the higher (highest) pitched key alone will be sounded.
- The CS-40M is a two-note synthesizer composed of 44 keys to cover 3-2/3 octaves. When three, or more keys are depressed together, the notes of the highest-pitched and lowest-pitched keys (of all the depressed keys) will be sounded.

**Basic Block Diagram of CS-20M**



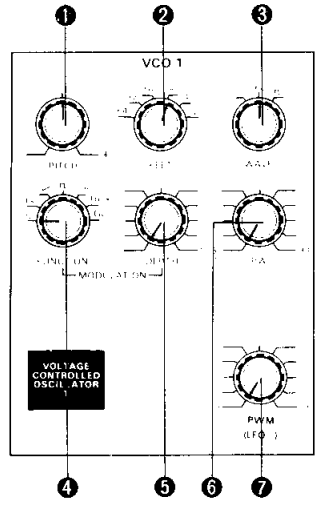

**Basic Block Diagram of CS-40M**



## VCO1 & VCO2

As the VCO1 block and VCO2 block are of the same composition, we shall limit our description to the VCO1 block.

CS-20M




### ❶ PITCH

This is a control used for adjusting the pitch, which has a variable range of approximately −500 to +700 cents. (1,200 cents = 1 octave)

- As it takes about 15 minutes for the pitch to reach a stabilized state after the synthesizer has been switched on, tuning should be performed after more than 15 minutes have passed following switch-on.

### ❷ FEET

This control enables the sound range covered by the keyboard to be shifted in units of octaves.

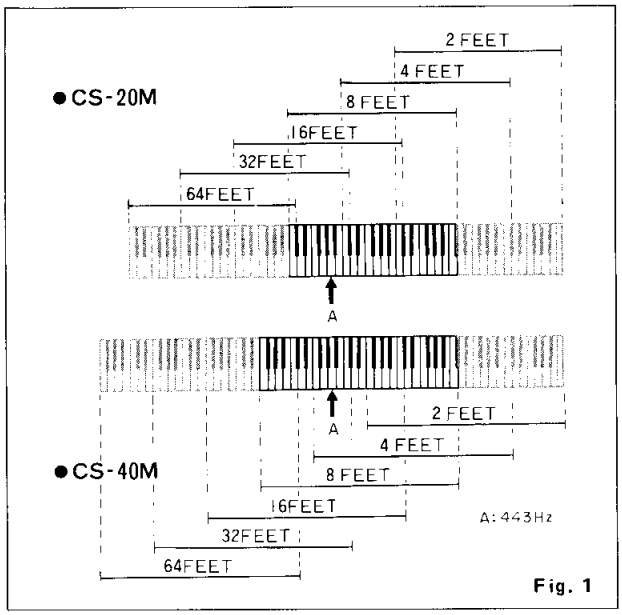
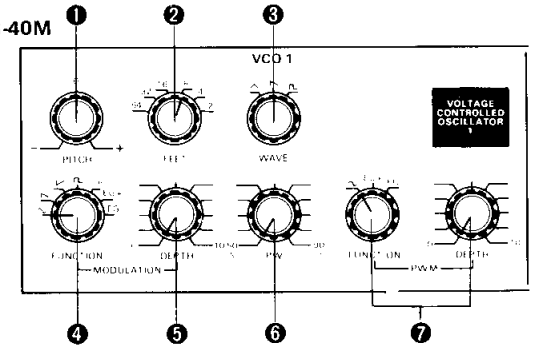



Fig. 1

### ❸ WAVE

This is a switch used for selecting the sound source waveform.

CS-40M




- ∧ : Triangular wave
  Although this waveform contains odd-number harmonics, mellow sounds similar to a sine wave are produced as few harmonics are present. Flute-like tones can be obtained using this waveform.
- ◺ : Sawtooth wave
  Contains harmonics of an integer order. Compared with triangular waves and square waves, it is richer in harmonics. Thus, it is generally used as a sound source for producing imitative sounds of such brass instruments as the trumpet, or string instruments such as the violin.
- ⊓ : Square wave
  Symmetrical square waves have harmonics of an odd-number order and resemble the spectrum of closed wood wind instruments such as clarinets. Since it is possible to vary the harmonic structure of square waves with the PW control and PWM control, the square wave is a useful sound source for producing those sounds distincly characteristic of synthesizers.

### ❹ MODULATION-FUNCTION

Used for selecting the waveform that creates a MODULATION effect (pitch modulation) to the VCO.

- ∿ : Sine wave
  Repeats the effect in which the pitch rises and falls in a smooth manner.
- ◺ : Sawtooth wave
  Repeats the effect in which the pitch suddenly rises and then gradually falls.
- ◿ : Inversed sawtooth wave
  Repeats the effect in which the pitch suddenly falls and then rises gradually.
- ⊓ : Square wave
  Repeats the effect in which the pitch rises and falls.
  * The above four types of waveforms are obtained from the LFO. The speed at which the effect is to be repeated is determined with the LFO SPEED control.
- **S/H:** Sample-and-hold
  Repeats the effect in which the pitch is changed in a random manner.
  * S/H is obtained by randomly extracting (sampling) a value from the noise generator as a certain moment and then holding this value up to the moment the next one is sampled.

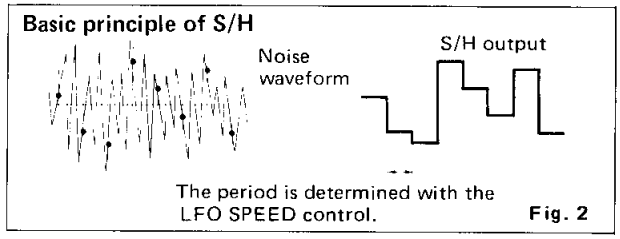


Fig. 2

- **GL– & GL+ (For CS-20M only)**
  Produces GLIDE effects (this functions by changing the pitch of the deparessed note and gradually, at a speed set with the GL time control, returning to the pitch of the depressed key.)
  **GL+** : The sound will start from a pitch higher than that of the depressed key and will finally return to normal.
  **GL–**: Contrary to GL+, the sound will start at a pitch lower than that of the depressed key, and will finally return to normal.
  * The time that it takes to reach the pitch of the depressed key is determined with the use of the GLIDE TIME control.

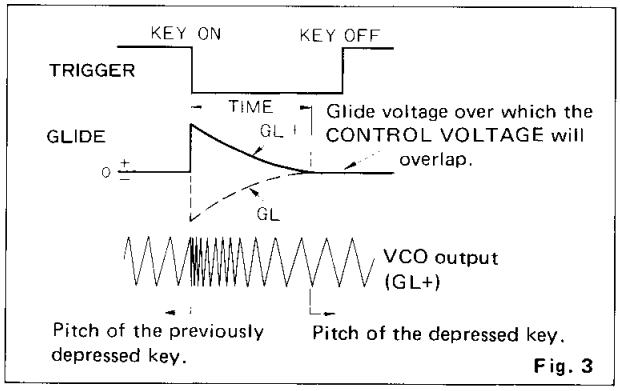


Fig. 3

- **EG+ & EG– (For CS-40M only)**
  This control varies the pitch of the depressed key over a period of time.
  **EG+**: The pitch is changed by using the positive envelope ( ⌒ ) of the EG-VCO.
  **EG–**: The pitch is changed by using the negative envelope ( ⌒ ) of the EG-VCO.

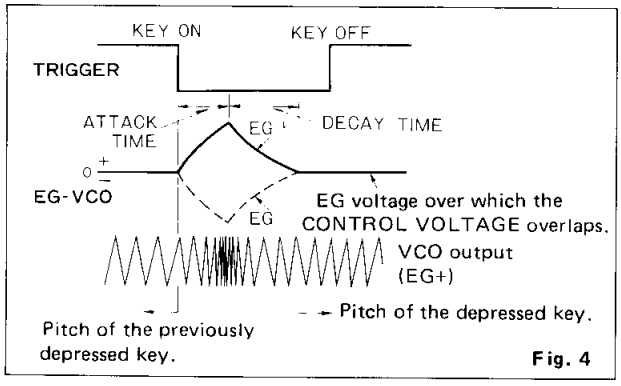


Fig. 4

**❺ MODULATION- DEPTH**
Used for adjusting the depth of pitch modulation. Modulation will get deeper, by increasing the control from "0" to "10".

**❻ PW**
By using this control, it is possible to change the pulse width of the square wave ( ⊓ ) by somewhere between 50% (symmetric square wave) and 90%. Since the harmonic structure of the square wave can be changed by changing the pulse width, the square wave as a sound source lends itself to a vast range of applications.

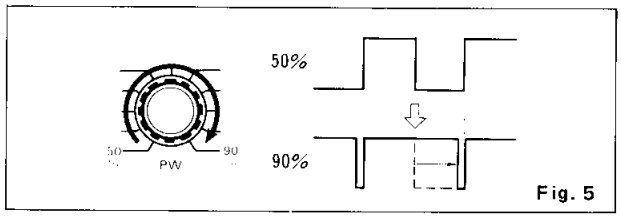


Fig. 5

**❼ PWM**
This control enables the pulse width of the square wave ( ⊓ ) to be modulated by using the sine wave ( ∿ ) of the LFO, or the envelope of the EG-VCO (for CS-40M only).

- **PWM** (For CS-20M only)
  Used for adjusting the depth to which the pulse width is to be modulated with the use of the LFO sine wave ( ∿ ). Modulation will get deeper, the more the control is turned from "0" to "10".
- **PWM-FUNCTION** (For CS-40M only )
  Used for selecting the waveform with which the pulse width is to be modulated.
  ∿ : Sine wave of LFO.
  EG+ : Positive envelope ( ⌒ ) of EG-VCO.
  EG– : Negative envelope ( ⌒ ) of EG-VCO.
- **PWM-DEPTH** (For CS-40M only)
  Used for adjusting the depth of pulse-width modulation. Modulation gets deeper, the more the control is turned from "0" to "10".

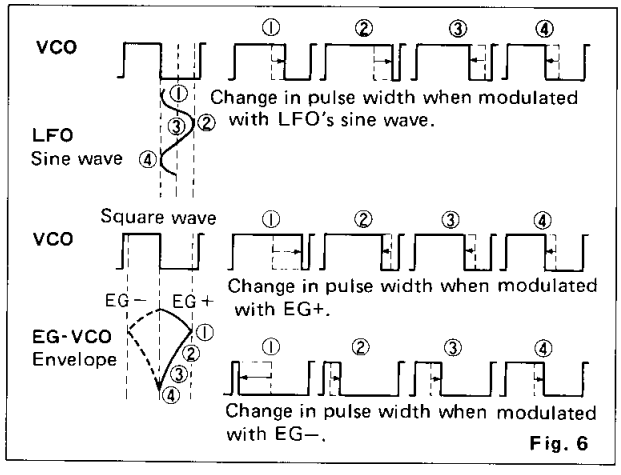
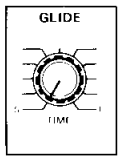


Fig. 6

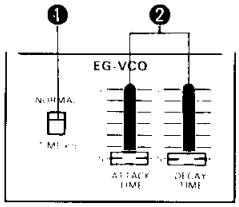
## GLIDE (For CS-20M only )




When the MODULATION-FUNCTION switch of the VCO block is set to either GL+, or GL–, it will cause a GLIDE effect in which the pitch (of the VCO) will change at the starting portion of the pitch of the depressed key.

- **GLIDE TIME**
  Used for adjusting the duration of the GLIDE effect (time required from KEY-ON to the point the pitch returns to the pitch of the depressed key). The GLIDE TIME will be longer, the more the control is turned from "S" to "L". (Fig. 3, Page 11)

## EG-VCO (For CS-40M only )




When the MODULATION-FUNCTION switch of the VCO block is set to either EG+, or EG–, it will cause an envelope curve to be produced. This envelope curve is used to give a temporal change to the pitch of the VCO. It is also used to give a temporal change to the speed of the PWM, LFO and RING MODULATOR. The EG is triggered by the TRIGGER signals.

**❶ NORMAL/TIME x 5**
When the switch is switched over to the "TIME x 5" position, it will cause the duration of the ATTACK TIME and DECAY TIME to increase to 5 times the normal time.

**❷ ATTACK TIME/DECAY TIME**

- **ATTACK TIME**
  Adjusts the time starting from the instant the key is depressed up to the point where it reaches peak variation. The time will get longer, the more the lever is moved from "S" to "L".
- **DECAY TIME**
  Adjusts the time from the point of peak variation (following KEY-ON) to where the sound reaches a stable state after decaying. The DECAY TIME will get longer, the more the level is moved from "S" to "L".

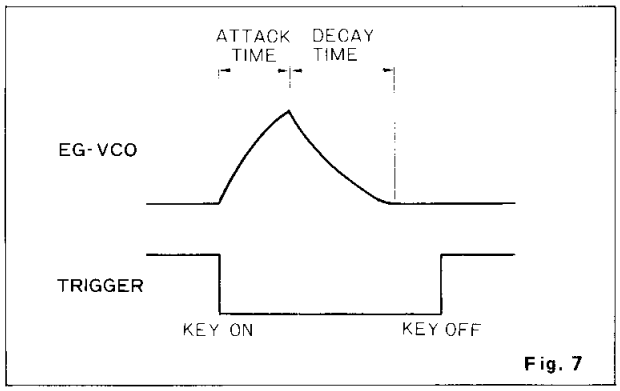
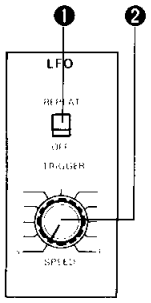
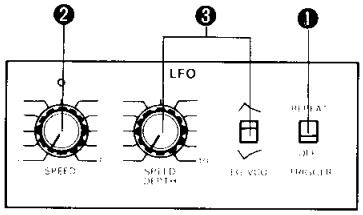



Fig. 7

## LFO




CS-20M




CS-40M

The LFO block is a low-frequency oscillator block which produces a periodical variation to the pitch, tone and volume of the VCO, VCF and VCA blocks respectively. To send these LFO effects to each block, the waveform of the LFO is first selected by means of the MODULATION-FUNCTION switches of each block, and the MODULATION DEPTH control is adjusted to meet the preference of the performer.

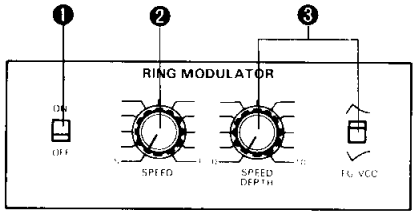
**❶ TRIGGER-REPEAT / OFF**
When this is set to the REPEAT position, it will cause a trigger to be applied with a timing equivalent to the LFO period, for the duration the key is being depressed. When set to the OFF side, TRIGGER will be applied by KEY-ON and KEY-OFF.

**❷ SPEED**
This control is used for adjusting the speed of the LFO. The variable range is from 10s to 10ms with the speed increasing the more the control is turned from "S" to "L". By changing the speed, effects of different nuances can be achieved.

**❸ SPEED DEPTH / EG-VCO (For CS-40M only)**
This control is used for giving a temporal change to the LFO speed, by making use of the envelope curve of the EG-VCO.

- **SPEED DEPTH**
  Adjusts the degree to which the LFO speed is to be varied over time. The variation will increase the more the control is turned from "0" to "10".
- **EG-VCO**
  Selects the polarities of the EG-VCO's envelope.
  ⌒ : Positive envelope curve
  ⌣ : Negative envelope curve

## RING MODULATOR (For CS-40M only)




With the CS-40M, it is possible to apply ring modulation to the output signals. Unique effects can be produced with ring modulation, as signals equivalent to the sum and difference of the signals fed out from the VCA and the low-frequency signals for modulation (0.5 to 500 Hz: Variable by means of the SPEED control) are extracted, bringing the frequency to one differing from that of the pitch of the key. By making use of the EG-VCO, it is also possible to vary the speed of ring modulation over time. Effects resembling gongs, bells, and other metallic sounds can be produced in this way.

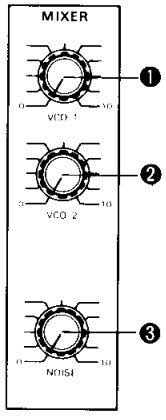
**❶ ON/OFF**
An ON/OFF switch for the RING MODULATION effect.

**❷ SPEED**
Control used for adjusting the speed of the RING MODULATION effect.

**❸ SPEED DEPTH / EG-VCO**
This control is used to give a temporal variation to the speed of the RING MODULATION effect, by making use of the EG-VCO's envelope curve.

- **SPEED DEPTH**
  Used for adjusting the depth to which the speed of the RING MODULATION effect is to be varied over time. The degree of variation will increase, the more this control is turned from "0" to "10".
- **EG-VCO**
  Used for selecting the polarities of the EG-VCO's envelope.
  ⌒ : Positive envelope curve
  ⌒ : Negative envelope curve

## MIXER



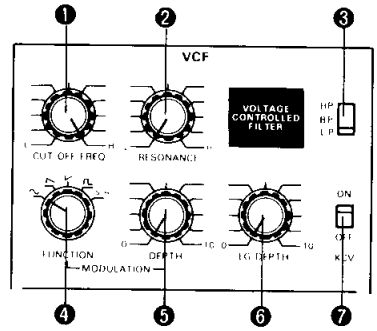

The MIXER's function is to adjust the levels of the sound-source signals produced by the VCO1, VCO2, and the NOISE source, and after mixing them together, to feed them to the VCF.

**❶ VCO 1**
Used for adjusting the level of the sound source signals produced by VCO1.

**❷ VCO 2**
Used for adjusting the level of the sound-source signals produced by VCO2.

**❸ NOISE**
Used for adjusting the level of the NOISE source signal.

## VCF




CS-40M

The VCF block is a voltage controlled filter whose function is to change the harmonic structure of the sound sources, or to give a variation to the tone by having the filter's cut-off frequency controlled by making use of such control voltages as the envelope voltage of the VCF block.

**❶ CUT OFF FREQ.**
Adjusts the cut-off frequency. The cut-off frequency will increase the more this control is turned from "L"towards "H". When creating sounds with the synthesizer, this section forms an important part in forming basic sounds.

- The cut-off frequency can also be controlled by means of the BRILLIANCE control.
- When the cut-off frequency is turned fully toward the "L" side, and at the same time, the filter selector is set to "LP", no sound is allowed to pass. This occurs because the cut-off frequency is set so as to

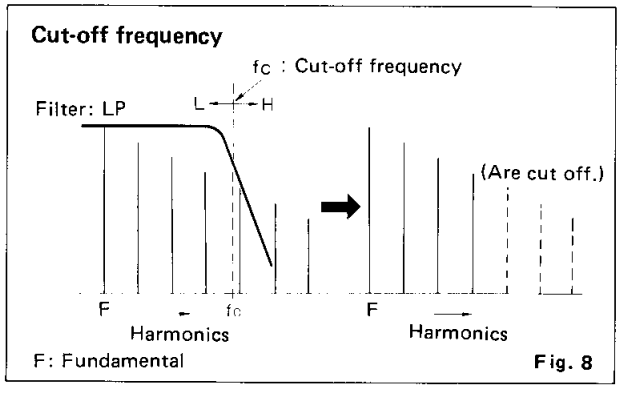



Fig. 8

cut off all the fundamental tone components and harmonic tone components of the sound source.

**❷ RESONANCE**
The more the RESONANCE control is turned from "L" toward "H", the tones in the neighborhood of the cut-off frequency will be emphasized.

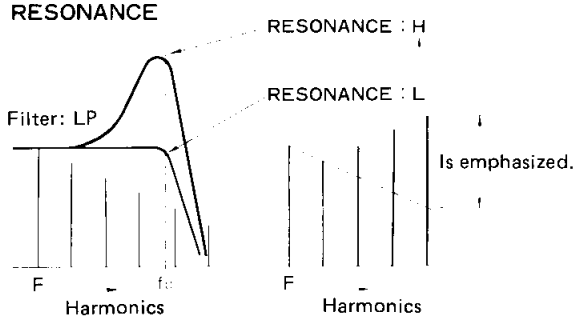


Fig. 9

**❸ HP/BP/LP**
A switch used for selecting the type of filter to be used.

**HP** : High-pass filter
Frequencies higher than the cut-off frequency set by the CUT OFF FREQ. knob are passed through.

**BP** : Band-pass filter
Frequencies occuring between the band width set by the CUT OFF FREQ. knob are passed through. The CUT OFF FREQ. knob is used to vary the width of the band of frequencies being passed, from narrow to wide.

**LP** : Low-pass filter
Frequencies lower than the cut-off frequency set by the CUT OFF FREQ. knob are passed through. This is the most common type of filter used in synthesizers.

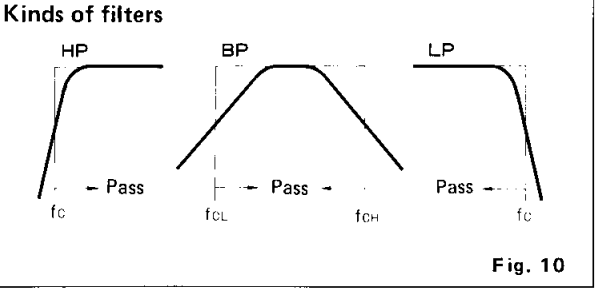


Fig. 10

**❹ MODULATION-FUNCTION**
Used for selecting wave forms to modulate the cut-off frequency of the VCF.

- ∿ : Sine wave
  Repeats the effect in which the cut-off frequency rises and falls in a smooth manner.
- ◺ : Sawtooth wave
  Repeats the effect in which the cut-off frequency suddenly rises and then gradually falls.
- ◿ : Inversed sawtooth wave
  Repeats the effect in which the cut-off frequency suddenly falls and then gradually rises.
- ⊓ : Square wave
  Repeats the effect in which the cut-off frequency rises and falls.
- **S/H:** Sample-and-hold
  The cut-off frequency repeatedly undergoes random changes.
  * The speed at which this is repeated is determined by the LFO SPEED control.

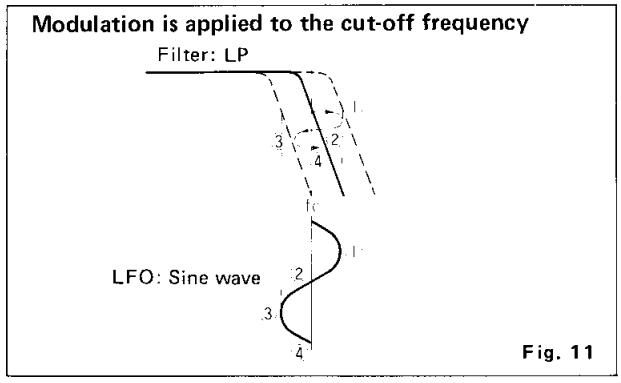


Fig. 11

**❺ MODULATION-DEPTH**
Adjusts the depth to which the cut-off frequency is to be modulated. Modulation becomes deeper, the more this control is turned from "0" to "10".

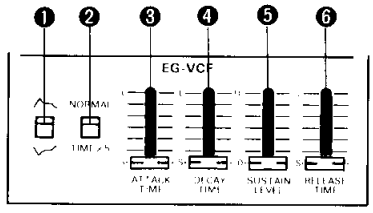
**❻ EG DEPTH**
This is a control used for adjusting the depth of the envelope set with the EG-VCF, which is to be applied to the VCF. The more the control is turned from "0" to "10", the deeper the envelope applied.

**❼ KCV-ON/OFF (For CS-40M only.)**
This is an ON-OFF switch for the keyboard follow function (Refer to Page 5, "Characteristic Points of a Synthesizer.) when switched to the "OFF" position, the control voltage applied from the keyboard block will be disconnected so that the "keyboard follow" function is cancelled.

## EG-VCF

The EG-VCF block produces an envelope curve which, when applied to the VCF, creates a temporal variation of tone (harmonic structure). This variation is governed by four parameters. ATTACK TIME (rise time), DECAY TIME (attenuating time), SUSTAIN LEVEL, and RELEASE TIME. The EG-VCF envelope curve is initiated by the TRIGGER signal from the keyboard circuitry. The depth of the envelope applied to the

VCF is governed by the EG DEPTH control in the VCF block.




❶ ∧ / ∨
Used for selecting the polarities of the envelope.
- ∧ : Positive envelope curve
- ∨ : Negative envelope curve

❷ NORMAL/TIME x 5
When the control is switched to the "TIME x 5" position, it will cause the setting of the ATTACK TIME, DECAY TIME, and RELEASE TIME to become 5 times the normal time.

❸ ATTACK TIME
This control is used for adjusting the attack time from the instant of KEY-ON to the point it reaches peak variation. The ATTACK TIME will become longer, the farther this control is moved from "S" to "L".

**Envelope curve of EG-VCF**

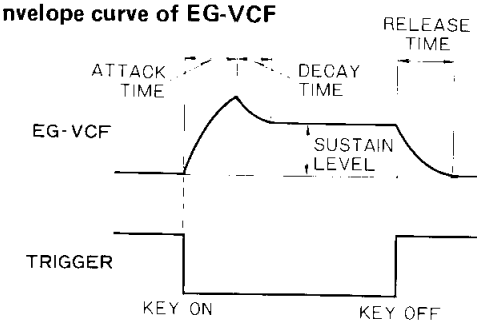
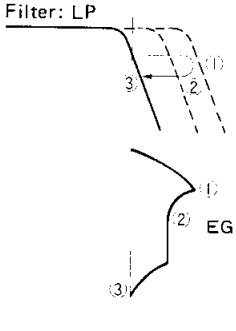



Fig. 12

**When EG-VCF acts upon VCF**




The EG-VCF will cause a temporal variation of the filter's cut-off frequency. Thus, the tone, in turn, is caused to vary over time.

Fig. 13

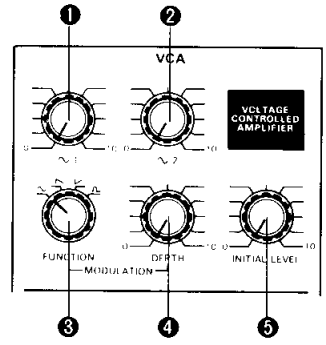
❹ DECAY TIME
Used for adjusting the time it takes for the sound to decay, starting from the point the sound starts to decay from peak variation (in the initial portion of the sound) up to the point it stabilizes and settles down to the level set with the SUSTAIN LEVEL control. The DECAY TIME will become longer, the more this control is moved from "S" to "L".

❺ SUSTAIN LEVEL
Used for adjusting the level of the stabilized state (that follows completion of variations made with ATTACK and DECAY TIME) and which is sustained up to the point the key is released. The SUSTAIN LEVEL will increase progressively, the more this control is moved from "0" to "10".

❻ RELEASE TIME
Used to adjust the RELEASE TIME. In other words, the time it takes for the sound to die away after the key is released. The RELEASE TIME will increase progressively, the more this control is moved from "S" to "L".

## VCA

The VCA block is a voltage controlled amplifier which, when controlled by the VCA-EG, will produce a temporal variation of the amplitude of the sound source from the VCO-VCF blocks.




CS-40M

❶ ∿ 1
This is a control used for adjusting the level of the sine wave ( ∿ ) that is fed into the VCA directly from the VCO1.

❷ ∿ 2 (For CS-40M only)
This is a control used for adjusting the sine wave ( ∿ ) that is fed into VCA directly from the VCO2.

❸ MODULATION-FUNCTION
This control selects the waveform desired to modulate the VCA, in other words, the volume or amplitude of the sound source.

- ∿ : Sine wave
  Repeats the effect in which the volume rises and falls in a smooth manner.
- ◺ : Sawtooth wave
  Repeats the effect in which the volume suddenly rises and then falls gradually.
- ◿ : Inversed sawtooth wave
  Repeats the effect in which the volume suddenly falls and then gradually rises.
- ⊓ : Square wave
  Repeats the effect in which the volume rises and falls.

  * The four waveforms described above are obtained from the LFO. The speed at which the effects are repeated is determined by means of the LFO SPEED control.

**❹ MODULATION-DEPTH**
Adjusts the depth to which the volume is to be adjusted. Modulation becomes deeper, the more this control is moved from "0" to "10".

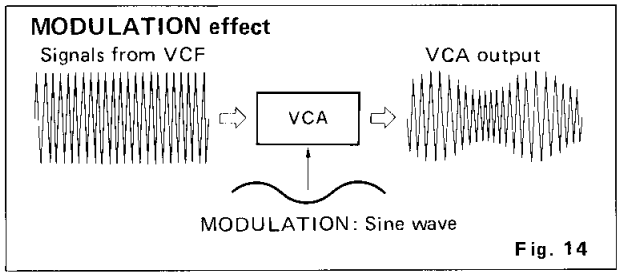


Fig. 14

**❺ INITIAL LEVEL**
Adjusts the level (initial level) of the volume that is fed out from the VCA when the key is not depressed. When this control is turned counterclockwise to "0", the volume will be determined by the set value of the EG-VCA.

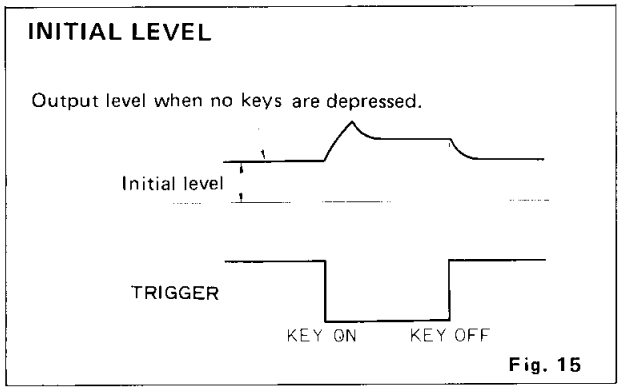
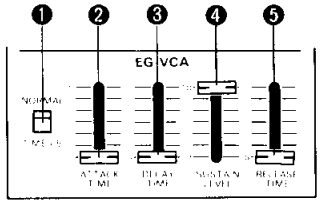


Fig. 15

## EG-VCA

The EG-VCA block produces an envelope curve which when applied to the VCA creates a temporal variation of amplitude. This variation is governed by four parameters: ATTACK TIME, DECAY TIME, SUSTAIN LEVEL, and RELEASE TIME.




**❶ NORMAL/TIME x 5**
When the switch is set to the "TIME x 5" position, the set time for ATTACK TIME, DECAY TIME and RELEASE TIME will become 5 times the normal time.

**❷ ATTACK TIME**
Used for adjusting the attack time, starting from the instant the key is depressed, up to the point of peak variation. The ATTACK TIME will become longer, the more this control is moved from "S" to "L".

**❸ DECAY TIME**
Used for adjusting the decay time, starting from the point of peak variation (the starting portion of the sound) up to the point it settles down to the stabilized state, the level set with the SUSTAIN LEVEL control. The DECAY TIME gets longer, the more this control is moved from "S" to "L".

**❹ SUSTAIN LEVEL**
Used for adjusting the volume level that is to be sustained (after variations in the ATTACK and DECAY TIME modes are completed) up to the point the key is released.

**❺ RELEASE TIME**
Used to adjust the RELEASE TIME, in other words the time it takes for the sound to die away after the key is released. The RELEASE TIME will increase progressively the more the control is moved from "S" to "L".

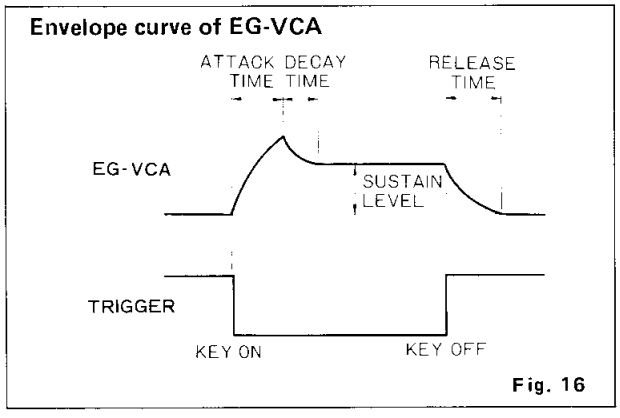


Fig. 16

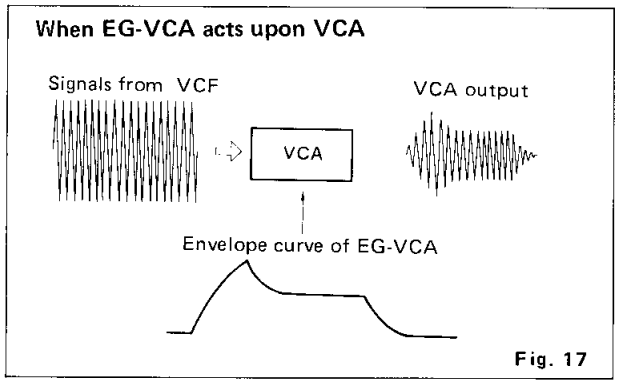


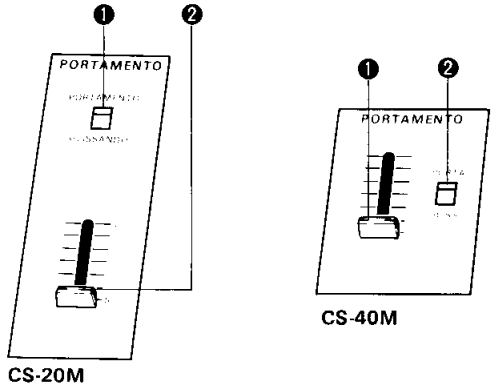
Fig. 17

## EFFECTS BLOCK

The EFFECTS BLOCK is a block which contains functions that provide variation for performances by temporarily controlling the pitch and tone.

## PORTAMENTO

The PORTAMENTO block produces two effects, PORTAMENTO and GLISSANDO.



CS-20M CS-40M

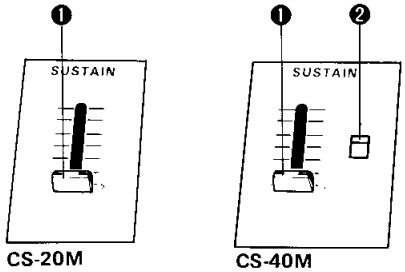
❶ PORTAMENTO/GLISSANDO
This switch is used for selecting either the PORTAMENTO effects, or GLISSANDO effects.

- PORTAMENTO
  When a one key is depressed and then another key of a different pitch is depressed, the pitch will shift from the first one to the second one in a continuous glide.
- GLISSANDO
  The pitch shifts from one to another, moving in a series of rapid semi-note steps.

❷ PORTAMENTO
This is a lever used for adjusting the speed at which the pitch-shifting of the PORTAMENTO effects and GLISSANDO effects occur. The more this lever is moved from "S" to "L", the longer it takes for the effect to complete it's cycle.

## SUSTAIN

This control alters the original RELEASE TIME set with the RELEASE TIME lever of the VCA block.



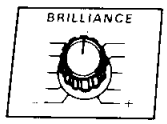
CS-20M CS-40M

❶ SUSTAIN
This lever is used for controlling the duration of SUSTAIN. SUSTAIN will be longer the more this lever is moved from "S" to "L".

❷ I / II **(For CS-40M only )**

- When two keys of different pitches are depressed with this switch positioned to the "I" side, SUSTAIN effects will be applied to both notes. However, when the third key is depressed, it will cause the first note to disappear, and SUSTAIN effects will be applied to the third note instead.
  * In this case, no PITCH effect from the EFFECT block will work while the key is being depressed.
- When the switch is positioned to the "II" side, the first note will shift into the pitch of the second note and SUSTAIN effects will be applied to the latter.

## BRILLIANCE



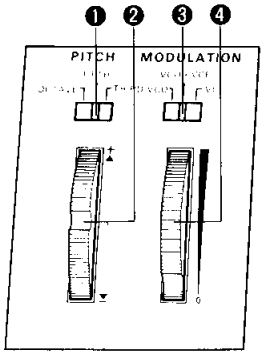

This control varies the cut-off frequency initially set on the VCF. The performer can therefore vary the BRILLIANCE of the programmed or panel sound to suit taste. At the "0" position (center click) the tone will be that set at the VCF block. When the control is turned toward the "+" side, it will cause the cut-off frequency to become higher and when turned towerd the "−" side, it will cause the frequency to drop.

- Be sure to set this control to the "0" position during tone-setting operations at the VCF block.
- In some cases, depending on such factors as the type of filter used in the VCF block and the position of the CUT OFF FREQ. control, no sound will be produced when the BRILLIANCE control is turned. This is the result of cutting off all fundamental tones and harmonics of the sound source waveform.

## PITCH / MODULATION

### PITCH

To be used when the performer wishes to change the pitch during a performance temporarily.




**❶ OCTAVE / FIFTH / THIRD**

This is a switch that selects the variable range for the pitch.

- **OCTAVE** : The pitch is variable within the range of ±1,200 cents.
- **FIFTH** : The pitch is variable within the range of ±700 cents.
- **THIRD** : The pitch is variable within the range of ±400 cents.

**❷ PITCH**

When the wheel is turned to the "+" side, the pitch will rise by the range selected with the switch. On the other hand, when turned to the "—" side, the pitch will drop. When at the "0" position (center click), the pitch will be equivalent to that set at the VCO block.

### MODULATION

Increases the depth of modulation applied to the VCO, VCF, and VCA blocks.

**❸ VCO / VCO + VCF / VCF**

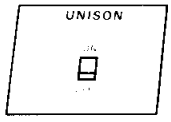
This switch routes the modulation control voltage depth to the block selected by this switch.

- VCO : Enables the depth of the MODULATION EFFECTS of the VCO block to be changed.
- VCO + VCF : Enables the depth of the MODULATION EFFECTS of the VCO and VCF blocks to be changed.
- VCF : Enables the depth of the MODULATION EFFECTS of the VCF block to be changed.

**❹ MODULATION**

Deeper MODULATION EFFECTS will be achieved, the more the wheel is turned from front to rear.

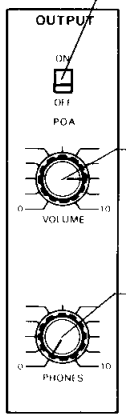
## UNISON (For CS-40M only.)




The UNISON switch will convert the CS-40M from a two voice (two VCO per note) synthesizer to a monophonic synthesizer in which all four VCOs are assigned to one note. In this mode, priority is given to the highest note depressed.

## OUTPUT

The function of the OUTPUT block is overall volume adjustment. The VOLUME control of the amplifier-block should be fixed at an optimum position.




**❶ POA (Pass Over VCA)-ON / OFF (For CS-40M only)**

When this switch is turned on, the output of the VCF will be fed out directly, without passing through the VCA.

**❷ VOLUME**

This control is used for adjusting the final volume of the signals that are fed out from the OUTPUT terminal.

**❸ PHONES**

This control is used for adjusting the volume of the signals fed out from the PHONES terminal. Operation of this control will not cause any change in the level of the OUTPUT terminal.

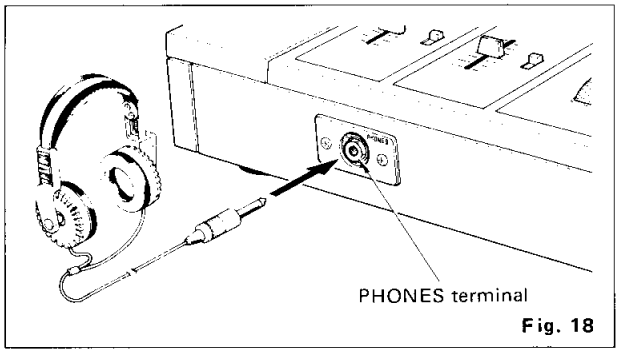



Fig. 18

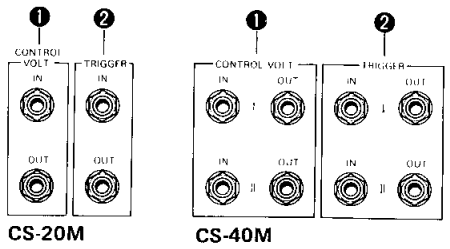
# CONNECTIONS···Part 2

## HOW TO CONNECT TWO SYNTHESIZER UNITS

This CS-20M and CS-40M are provided with input/output terminals for the CONTROL VOLTAGES that correspond to the pitches of the keys and for the TRIGGER signals which are used for controlling such sections as the EG. The terminals make it possible to add this data to another synthesizer equipped with similar terminals, or conversely, to have such data fed in from another synthesizer. Consequently, the CS-20M and CS-40M can both be used as multiple system synthesizers.

* CS-10, CS-30 & CS-30L: KEY VOLT & TRIGGER terminals
CS-5 & CS-15: CONTROL VOLT & TRIGGER terminals
CS-30: SEQUENCER-CONTROL VOLT & TRIGGER terminals

- Input and output of the CONTROL VOLT and TRIGGER can be carried out independent of each other.
  * Since the CS-40M is a two-voice synthesizer, the CONTROL VOLT and TRIGGER terminals consist of two systems (I and II), "I" being used for control of the VCO, VCF and VCA of System I, and "II" for those of System II.
- Regarding the master-and-subordinate relationship, please refer to the block diagram shown on Page 36 (CS-20M), or that shown on Page 37 (CS-40M).



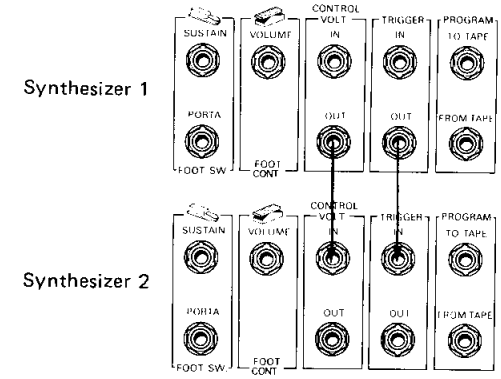

**❶ CONTROL VOLT – IN/OUT**
INPUT and OUTPUT terminals for the pitch data of the keyboard, which are used for controlling, the pitch of the VCO.

**❷ TRIGGER – IN/OUT**
INPUT and OUTPUT terminals for the timing data indicating KEY-ON and KEY-OFF, which are used for controlling the EG, etc.
* In the CS-40M, System I and System II will feed out the same data when the UNISON switch is switched on.

### Typical Example of Connection

- Fig. 19 shows typical examples of connections in which two CS-20Ms and two CS-40Ms are connected. By applying the CONTROL VOLTs and TRIGGERs of Synthesizer 1 to Synthesizer 2, it is possible to control the VCO1, VCO2, VCF and VCA of each unit with the keyboard of Synthesizer 1.

**• Typical example of connecting 2 CS-20Ms**




**• Typical example of connecting 2 CS-40Ms**

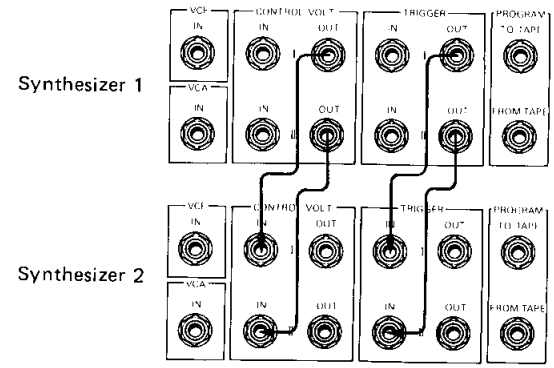



Fig. 19

- Fig. 20 shows an example in which the sequencer data of the CS-30 has been applied to the CS-20M.

**• A typical example in which the sequencer data of the CS-30 is applied to the CS-20M**

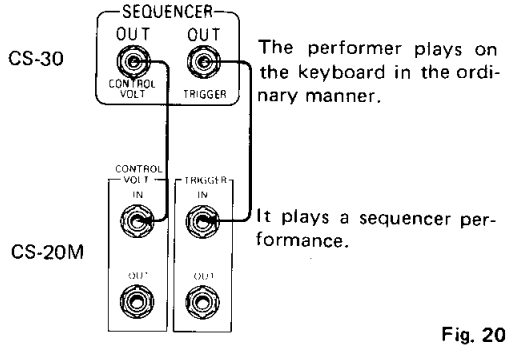


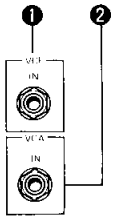

Fig. 20

This combination enables one to perform in a normal manner using the keyboard, while the CS-20M is playing a sequencer performance. In this case, the outputs from both synthesizers are present.

- Make sure all connections are properly made. If, for example, the CONTROL VOLTAGE is connected to the TRIGGER, or two outputs are connected together, the desired functions will not be acheived.

## VCF IN/VCA IN (For CS-40M only.)

The VCF and VCA can be controlled by connecting the VCA IN and VCF IN terminals to another synthesizer having an EG-OUT terminal, or an EG.




❶ **VCF IN**

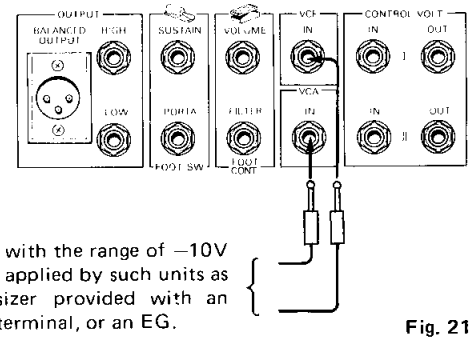
The cut-off frequency can be controlled by inputing an appropriate voltage (−10V ~ 10V) from another source such as a synthesizer or sequencer.

❷ **VCA IN**

The volume can be controlled by inputing an appropriate voltage, (−10V ~ 10V) from another source such as a synthesizer or sequencer.

**CONNECTION**

**CS-40M**




A voltage with the range of −10V to 10V is applied by such units as a synthesizer provided with an EG-OUT terminal, or an EG.

Fig. 21

The appeal of the synthesizer results from the flexibility the user has to create an infinite uariety of original and unique sounds, the rich power of expression that synthesizers possess is inimitable and cannot be acheived by any other musical instrument. If these original voices can be preset and freely selected as needed, the synthesizer as a performance instrument would be substantially improved. The CS-20M and CS-40M are therefore an exciting new generation of performance orientated synthesizers, as they include a programmer as well as a back-up cassette interface to store previously created programs.

## PROGRAMMER

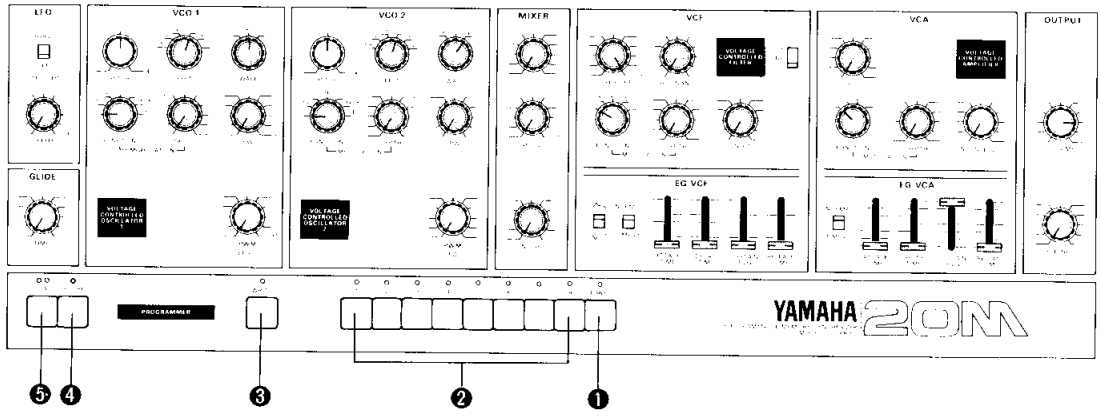
Controls (parameters) that are capable of being stored in a program are set on the control panel. In other words, the task of creating original voices using the control panel, can be stored indefinately in a program.

Each parameter, at the panel-operation stage, is a control voltage that is converted into a digital voltage in order to transfer it into data for memory into the RAM. This operation is known as "WRITE" and implies that the original voices have been programmed. Next, when the PROGRAM SELECT button is depressed, the programmed data,i.e., the original voices, will be fed into the VCO, VCF and VCA, and the original voice will be re-created. Now, with programming completed, you can play the synthesider using the original voices that have been programmed.

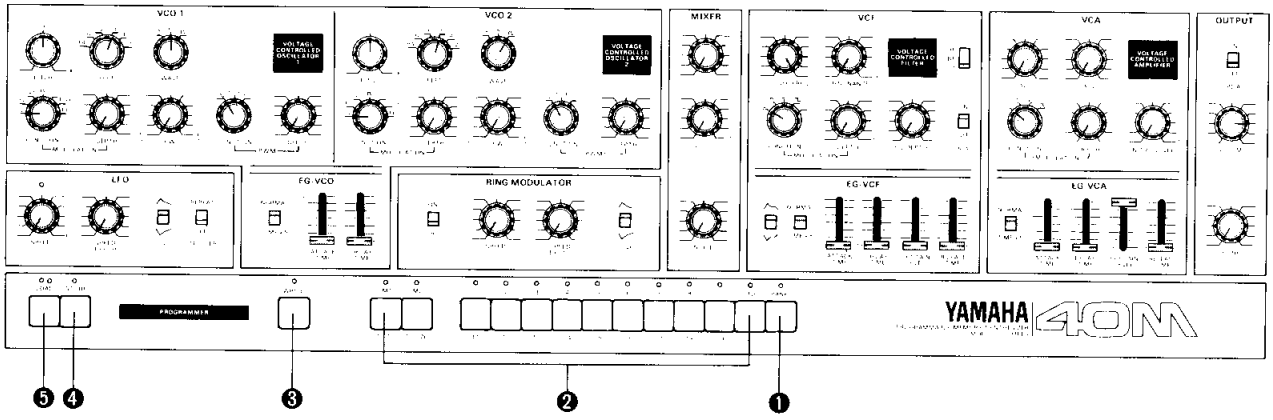
For the CS-20M, 8 voices can be programmed with 32 parameters, while for the CS-40M, 20 voices can be programmed with 50 parameters. By connectiong a tape recorder, it is possible to "STORE (record)" all the data that has been memorized by the RAM, or to "LOAD (have the RAM memorize)" all the stored program data.

- The yellow controls (the parts indicated as  in the drawing) are parameters capable of being stored in a program. Controls other than these cannot be memorized in a program.

**Parameters of CS-20M**




**Parameters of CS-40M**




**❶ PANEL**

When this button is depressed, the indicators will light up, making it possible to operate all PANEL controls.

- When creating original voices, depress this button and confirm that the indicator is illuminated.

* When the POWER switch is "ON", the programmer will be automatically set to "PANEL".

**❷ PROGRAM SELECT Buttons**

Used in programming operations, or when playing the synthesizer using the programmed voices.

- **M1 & M2** (the latter, for CS-40M only)

These buttons are used for selecting Program Nos. 1 through 10 and 11 through 20. When M1 is depressed, the indicators will light up, so that selection of Nos. 1 through 10 is possible. When M2 is depressed, the indicators will light up, so that selection of Nos. 11 through 20 is possible.

**❸ WRITE**

When storing or loading programs, this button is to be depressed together with the PRESET, STORE or LOAD button.

**❹ STORE**

To be depressed together with the WRITE button when storing the program data on to cassette tape.

- The indicator located above the button, when illuminated, indicates that the programmer is in the STORE mode. (STORE INDICATOR)

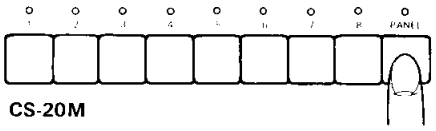
**❺ LOAD**

To be depressed together with WRITE when program data from cassette tape is being loaded.

- The indicator on the upper left side of the button, indicates the input level from the tape recorder. (LOAD LEVEL INDICATOR)
- The indicator located on the upper right side of the button indicates that the programmer is in the LOAD mode. (LOAD INDICATOR)

## PRAGRAMMING Procedure

1. Depress the PANEL button and confirm lighting of PANEL indicator.

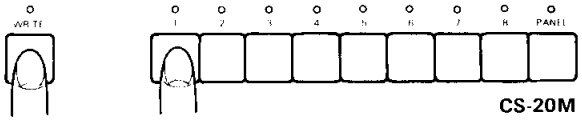



CS-20M

2. Using the control panel, set-up the original voices.

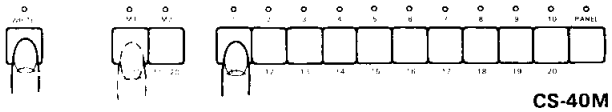
- At this point, you should remember which controls are parameters which are capable of being programmed and which are not. When voices that have been programmed are to be readjusted later, the sound must be recreated from the first step.
- Sometimes, noise will be generated when the controls that are capable of being programmed are operated. This state is not to be mistaken as a failure of the product. The noise will disappear when this setting has been programmed. The programmable memory mechanism is a digital system, in which the control voltage obtained through the operation of the control will vary in steps. Noise is generated when the control is positioned to the middle of the step. Therefore try to use the desired control in a range suitable for creating the sound so that noise is not apparent.

3. Simultaneously depress the WRITE button with the PROGRAM SELECT button. (Confirm that the PGM LOCK IN/OUT switch on the rear panel is switched over to the OUT side. ) Select the desired program number to position the sound where it is required for performance. Once this operation is completed, one voice has been stored in the memory position selected.




CS-20M

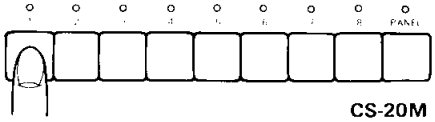
- If new voice data is programmed over previously recorded data, the previously programmed voice will be erased.
- Concerning the CS-40M, be sure to note whether you are programming a sound into M1 or M2 so that previously recorded sounds are not erased by mistake.



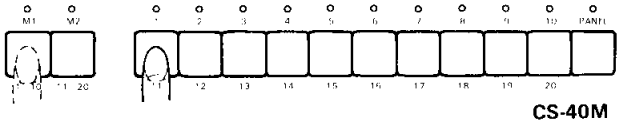
CS-40M

- After completing the programming of one voice, prepare a memo of the panel setting. (Recopy the SOUND MEMO shown on Pages 28 to 33 and use it for this purpose.) It will be invaluable when reproducing the voices on the panel.

4. Depress the PANEL button and LOAD the next original voice, programming it into a vacant number.
5. Continue programming all the program numbers by repeating the above operations. Now, the performer can select each original voice with the PROGRAM SELECT buttons.

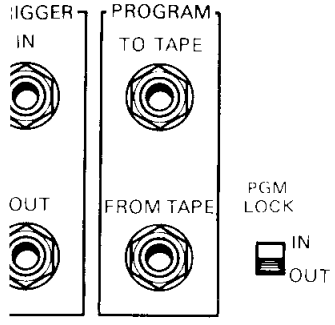



CS-20M




CS-40M

6. **PGM LOCK IN/OUT switch**
When this switch is positioned to "IN", the previously programmed data will not be cancelled even when PROGRAMMING operations are carried out (i.e., when the WRITE button is depressed simultaneously with the PROGRAM SELECT button).
Meanwhile, when positioned to "OUT", new program data will be stored into the memory when PROGRAMMING operations are performed. Therefore, do not forget to set the switch to "OUT" in the case of PROGRAMMING.



# STORE / LOAD

### Before Programming the original voices

Although original voices can be programmed following the procedure just described, to acquire the skill of operation, practice programming with the basic setting.

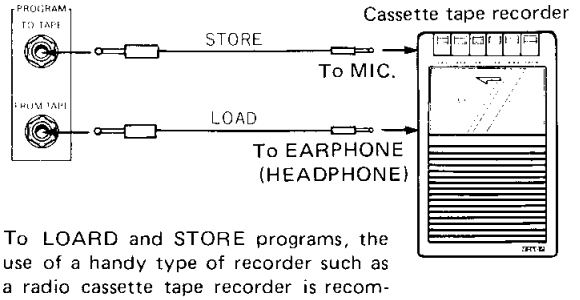
1) With the control panel preset to the basic setting shown on Page 8, turn the VCO1 of the MIXER block and adjust it to a setting where sawtooth waves will be provided.
2) Program the voices, using the first half of the PROGRAM SELECT buttons (Nos. 1 through 4 for CS-20M and Nos. 1 through 10 for CS-40M).
3) Then, with the VCO1 control of the MIXER block turned down, set the VCO2 control to the position where square waves will be provided.
4) Program the original voices using the second half of the PROGRAM SELECT buttons (Nos. 5 through 8 for CS-20M and Nos. 11 through 20 for CS-40M).
5) With the synthesizer in this condition, confirm that the LOAD level matches the tape recorder being used, by referring to the sections describing STORE and LOAD operations.

### STORE & LOAD Procedures

Since the programmer incorporates a cassette interface, program data can be stored and loaded by connecting a cassette tape recorder to the PROGRAM terminal of the rear panel.

- As the record and playback levels of tape recorders differ substantially depending on the type of tape recorder being used, it is recommended that the same tape recorder be used for both STORE and LOAD operations.
- During STORE & LOAD operations, do not use wireless equipment such as a transceiver, as it may cause erroneous operations. Be sure to keep wireless equipment separated from the synthesizer.

**Connecting Method**




To LOARD and STORE programs, the use of a handy type of recorder such as a radio cassette tape recorder is recommended.

**Fig. 22**

1. To STORE, connect the TO TAPE terminal to the MIC terminal of the tape recorder.
2. To LOAD, connect the FROM TAPE terminal to the EARPHONE (HEADPHONE) terminal of the tape recorder.

### STORE Procedure

1. Connect the cassette tape recorder.
   (TO TAPE terminal ↔ MIC terminal)
2. Put the tape recorder into the recording mode.
- In this case, as the TO TAPE terminal will be constantly feeding out pilot signals (reference signals for level setting), those tape recorders provided with a RECORD volume control should be set so that the control will be at the position where the level meter indicates 0VU (or 0dB). As for those sets provided with an automatic level control (ALC) instead of a RECORD volume control, the recording level will be set to an optimum level automatically.

3. In this condition, record the pilot signals for a duration of 10 to 15 seconds. (Setting of the LOAD level will be easier, the longer this recording is continued and the LOAD level is confirmed.)
4. Depress the STORE button together with the WRITE button. The STORE indicator will illuminate and the programmer will be put into the STORE mode.

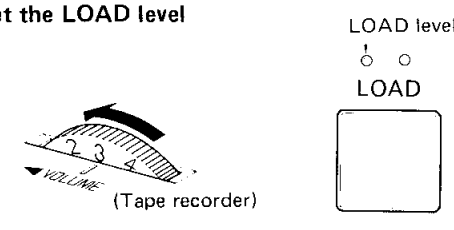



5. For the CS-20M, it will take about 32 seconds to STORE all the programs, while it will take about 2 minutes for the CS-40M.
6. On completion of STORE operations, the STORE indicator will go out, and the PANEL indicator will light up.

### LOAD Procedure

1. Connect the tape recorder.
   (FROM TAPE terminal ↔ EARPHONE/HEADPHONE terminal)
2. Play back the cassette tape that carries the program to be loaded.
3. Set the LOAD level. Raise the volume of the tape recorder one scale gradation from the position where the LOAD level indicator lights up.

**Set the LOAD level**




Raise the volume of the tape recorder one scale gradation from the position where the LOAD level indicator lights up.

**Fig. 23**

- Setting of the LOAD level should be performed while the pilot signals (which precede the program data) are being played back.

4. Depress the LOAD button together with the WRITE button. This will cause the LOAD indicator to light up, setting the programmer into the LOAD mode.




5 The CS-20M will load all the programs in about 32 seconds and the CS-40M in about 2 minutes.

- If the LOAD indicator goes out druring the load operation, it implies that the LOAD level is inadequate. Rewind the cassette tape and start loading again with the volume of the tape recorder increased accordingly.

6. The optimum level differs depending on the type of tape recorder and cassette tape. In the event that loading is not possible, find the LOAD level that matches the tape recorder by readjusting the volume of the tape recorder and repeating loading operations until the right level is obtained.

- Sounds cannot be produced during STORE and LOAD operations. If, by mistake, a STORE operation has been carried out, the synthesizer can be returned back to the PANEL mode by switching off the power switch and then turning it on again. When LOAD operations are to be discontinued, stop the tape recorder. Operation will be suspended, causing the synthesizer to return to the PANEL mode. In this case, normal voices cannot be programmed as incomplete data have been memorized by the RAM. It is, therefore, necessary to carry out LOAD operations all over again by rewinding the tape to the starting position.

### When a stereo cassette deck is used

When a stereo cassette deck is a model that does not permit the output level to be adjusted during playback, it will be impossible, sometimes, to carry out normal LOAD operations of the program data, due to the fact that an optimum level for playback (LOAD) cannot be obtained even though recording (STORE) has been performed at an optimum level (0VU). If this is the case, the unit must be reset paying special attention to the points described below.

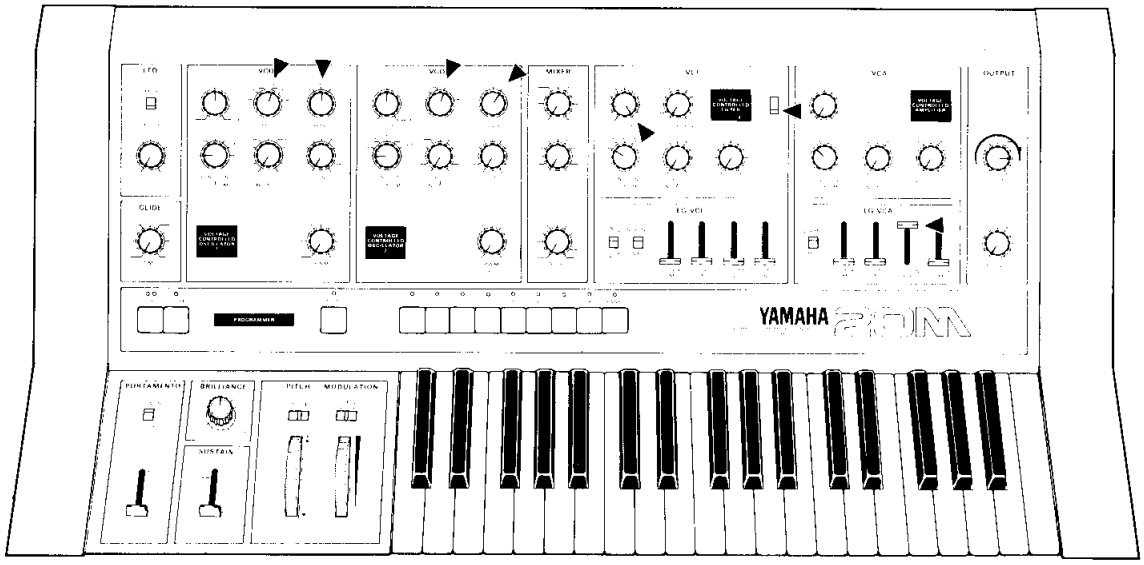
- For STORE (record) operations, use the L-channel of the MIC. (or LINE IN) terminal and for LOAD operations, use the HEADPHONE terminal.
- Normally, the optimum record level during STORE operations is set to the level where the level meter reads 0VU (0dB) when the pilot signal (See Page 23.) is present. However, when a deck that goes not permit adjustment of the HEADPHONE output is used, the optimum level that will enable LOAD operations must be located, by adjusting the recording level during STORE.
- When normal LOAD (playback) operations still cannot be carried out, disconnect the recording signal cable (the TO TAPE → MIC./LINE IN cable) and carry out LOAD operations again.

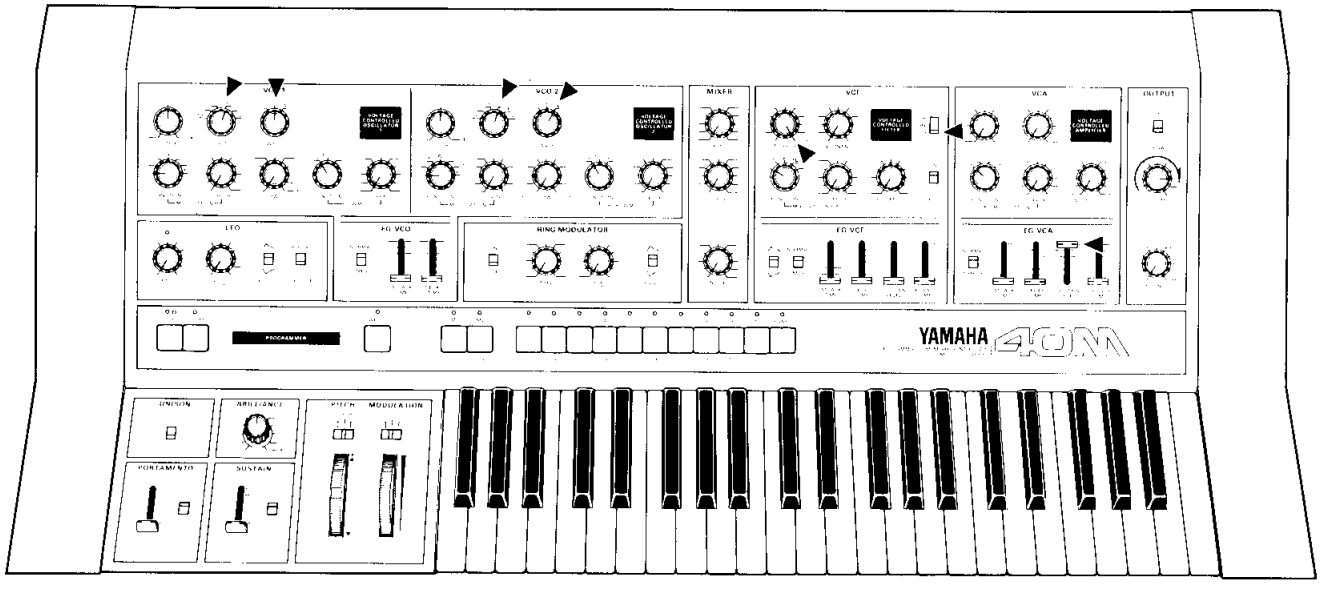
### To ensure proper operation of Programmer

- The CS-20M and CS-40M adopt the same systems for STORE and LOAD operations. However, since they differ in the number of programming parameters and of voices that can be programmed, no interchangeability exists between the two, regarding STORE and LOAD. Therefore, the program data of the CS-20M cannot be transferred to the CS-40M, or vice-versa.
- Program data memorized in the RAM is stored (recorded) onto the cassette tape, after being converted to signals in the audio frequency band (3kHz toneburst signals). Consequently, in some cases, musical signals are loaded, too. Therefore, to prevent erroneous operations when the tape is to be used again, it is recommended that the recorded tape be carefully erased prior to storage. Furthermore, as a convenient means for ensuring accurate LOAD operations, it is recommended that the tape recorder's counter be used to locate the starting point of each program.

# CREATING SOUNDS-PROCEDURES AND IMPORTANT POINTS

CS-20M




SETTING

1. Set the synthesizer, referring to "CONNECTIONS" (Pages 7, 19 and 20).
2. Turn on the POWER switch of the synthesizer and amplifier. Set the VOLUME switch of the amplifier to an optimum position.

CREATING SOUNDS

1. Before playing the synthesizer, you must first create your own original voices.
2. The signals, from the left side of the control panel to the right, are controlled by means of the respective controls.
3. When a key is depressed, a signal corresponding to the pitch of that key is produced at the VCO block. Set the controls of the VCF and VCA blocks as shown in the above drawing so that these sound-source signals will be produced in their original form (without being altered by the VCF and VCA blocks). (The setting is the same as the Basic Setting shown on Page 8.)
4. **VCO Block (VCO1 & VCO2)**

- Using the WAVE switch, select the sound-source waveform desired.

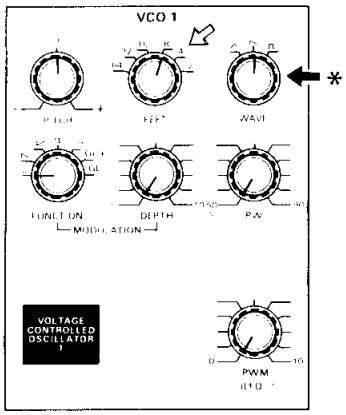
* **Waveform selection**

The most basic waveform is the sawtooth wave ( ◺ ), which produces tones resembling those of brass instruments such as the trumpet and string instruments such as the violin. The square wave lends ( ⊓ ) itself to an extensive range of applications, as it permits the tone (harmonic com-

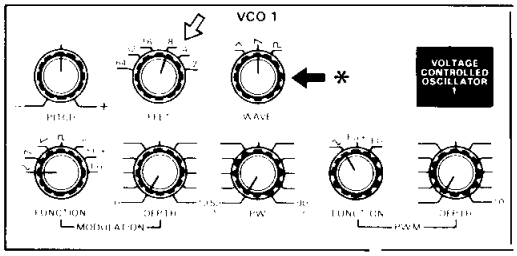
ponents) to be changed in various ways by changing the pulse width. For example, when the pulse width is 50%, the tone will resemble that of a clarinet. In the range between 60 and 70%, it will sound like the tone of a saxphone. Furthermore, when in the range between 80 and 90%, it will resemble the nasal tones of such instruments as the oboe, or the bassoon. Therefore, the square wave is ideal for producing tones of reed instruments. In addition, as it is possible to vary the component harmonic structure with the use of the PWM control, the square wave can be used as a sound source for creating sounds distinctly characteristic of synthesizers. In contrast to the square wave, the triangle wave which contains harmonics similar to the square, produces a soft flute-like tone similar to a sine wave, as it contains fewer harmonics than the square wave.

- The keyboard's pitch range is determined with the FEET switch.

**CS-20M**




**CS-40M**




**Spectrum of trianglar wave**

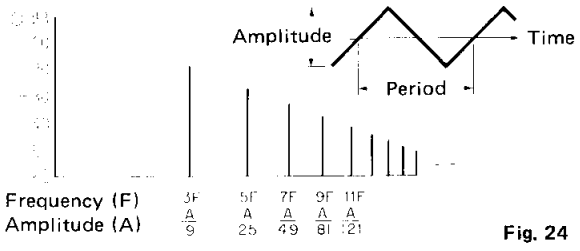



Fig. 24

**Spectrum of saw-tooth wave**

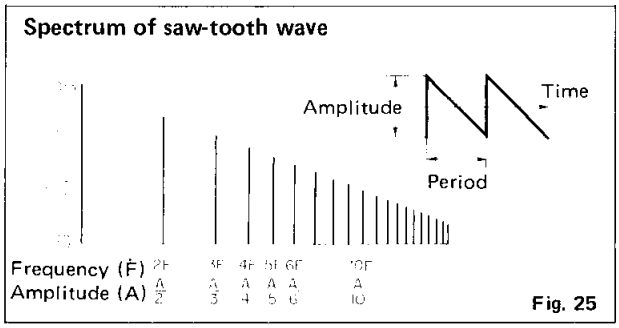



Fig. 25

**Spectrum of symmetrical square wave**

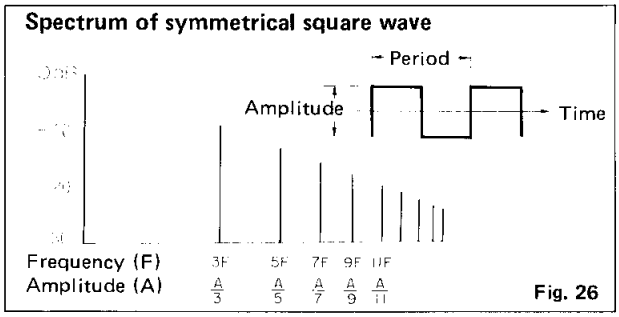
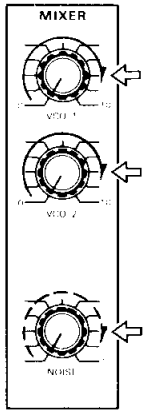


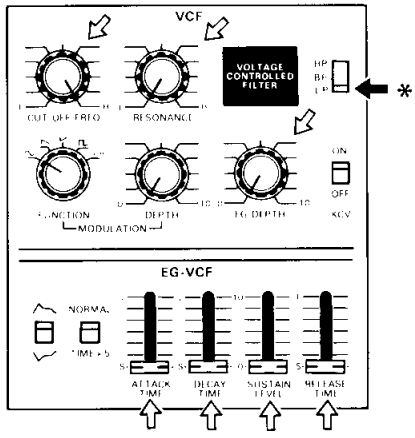

Fig. 26

## 5. MIXER Block




- The MIXER block is used to mix and balance the sound sources present, (VCO1, VCO2, and NOISE) to the desired proportions.
- Sounds will occur when the keys are depressed.

**CS-40M**




## 6. VCF Block

- The function of the VCF block is to shape the harmonic structure of the sound source from the VCO. First, the filter to be used is selected by using either the HP, BP, or LP switch. This is followed by altering the harmonics structure with the CUT OFF FREQ. and RESONANCE controls.

* **Filter selection**

The role of the filter is to alter the harmonics of the sound-source waveform to create the desired tone.

The filter has three modes, the HP (high pass filter), BP (band pass filter) and LP (low pass filter).

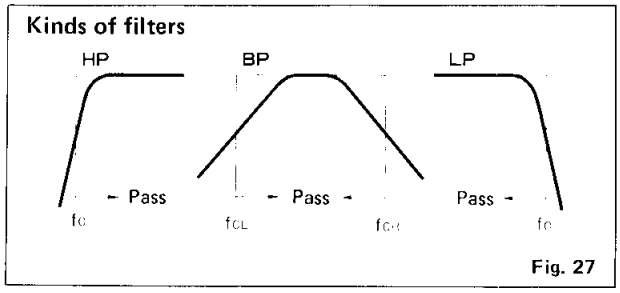


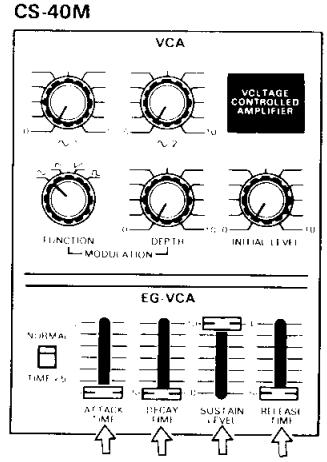
Fig. 27

The HPF cuts off harmonics below the cut-off frequency, allowing only the high harmonics (treble) to pass. The BPF cuts out the lower and upper harmonics passing a narrow band of frequencies determined by the cut-off frequency setting. When trying to recreate the sounds of musical instruments, the LPF is usually incorporated. This is because the LPF maintains the fundamental tone while controlling harmonics. To obtain a lighter tone, or to cut-off the bass section, the BPF is used. To create musical instruments such as the cymbal and similar voices, the HPF is used since only the highest harmonics are passed.

- Once the filter is set the EG is added to provide temporal variation of tone.
  Set the EG-VCF block (ATTACK TIME, DECAY TIME, SUSTAIN LEVEL, RELEASE TIME, etc.) Then, using the EG-DEPTH control of the VCF block, adjust the depth to the desired proportion.

7. VCA Block

CS-40M




Using the controls of the EG-VCA (ATTACK TIME, DECAY TIME, SUSTAIN LEVEL, RELEASE TIME), create a temporal variation to the volume of the sounds, from the starting point up to the point they fade away.

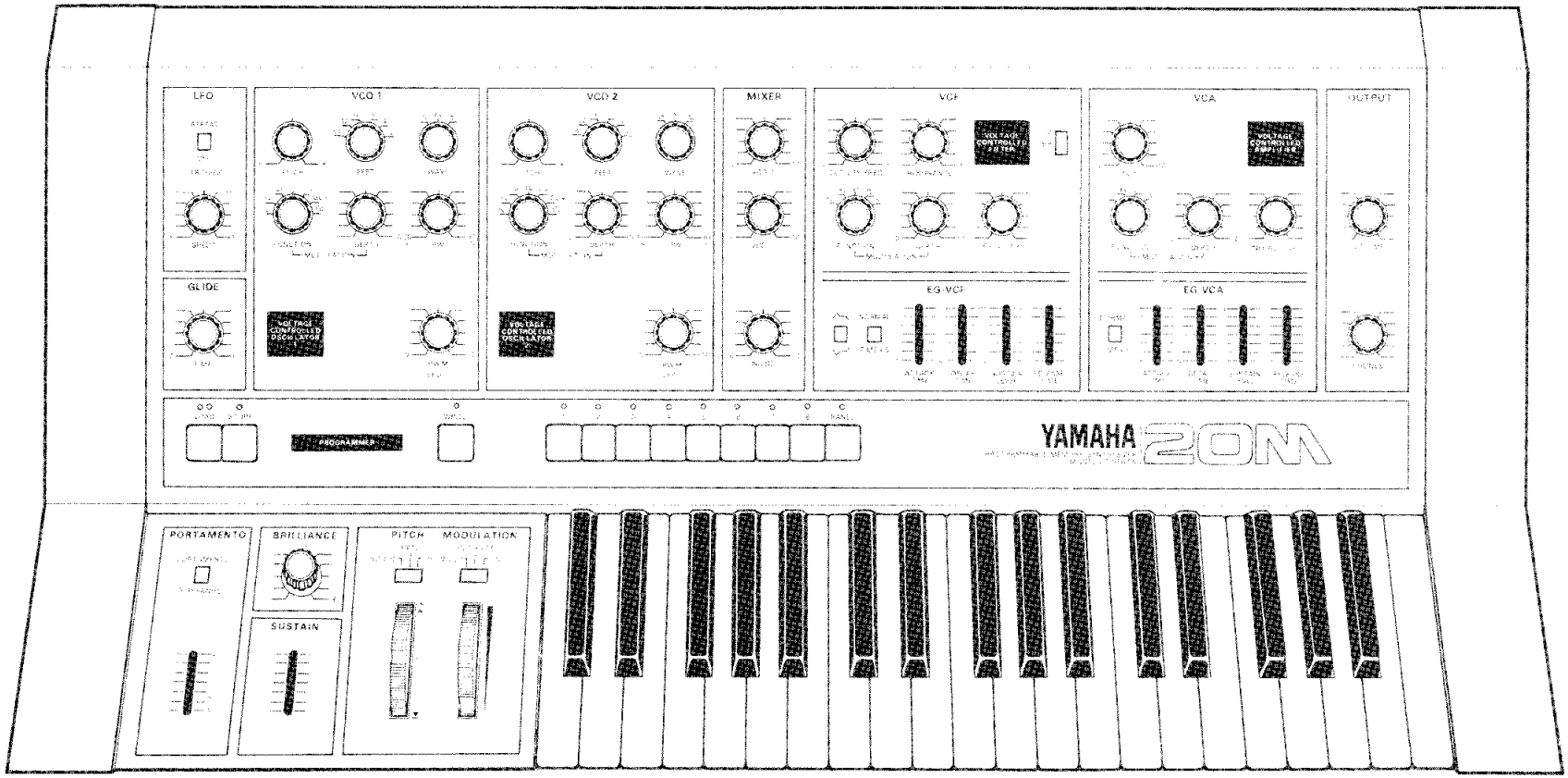
8. MODULATION/EFFECTS

- Apply MODULATION EFFECTS and RING MODULATION EFFECTS (For CS-40M only) to the VCO, VCF and VCA as desired and adjust the speed to suit taste.
- During performance, vary the sound by using such effect levers as "PORTAMENTO" and "PITCH".

■ Steps 4 through 8 constitute the basic procedures used to create a sound. Therefore, in order to create the sounds you have in mind, it will be necessary to readjust each control, while listening to the sound, until you succeed in obtaining the sound desired.

■ Program your original voices into the programmer so that they may be reproduced whenever you wish to select them.

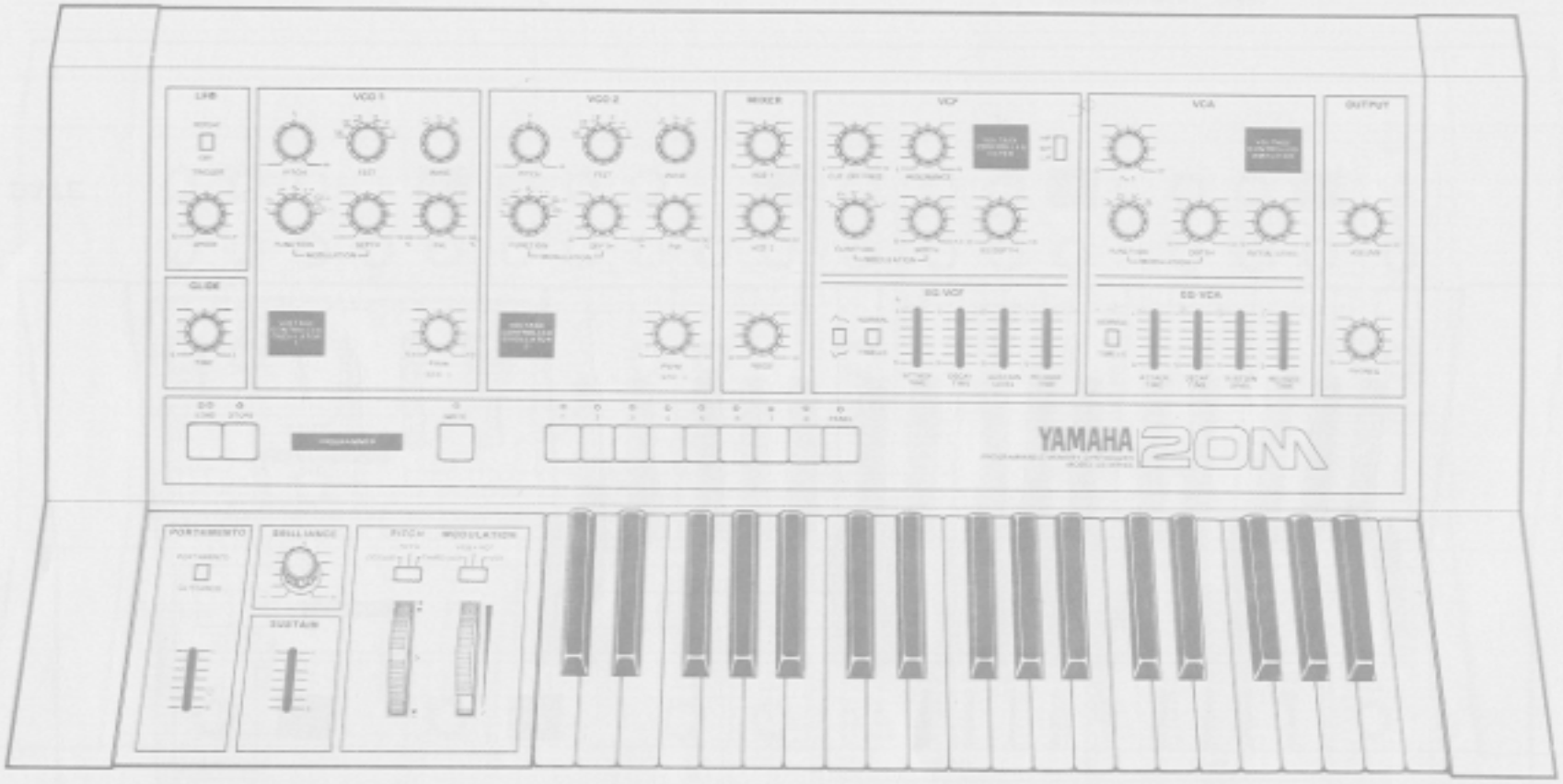
SOUND NAME _____ MEMORY No. _____




DATE : / /

SOUND NAME

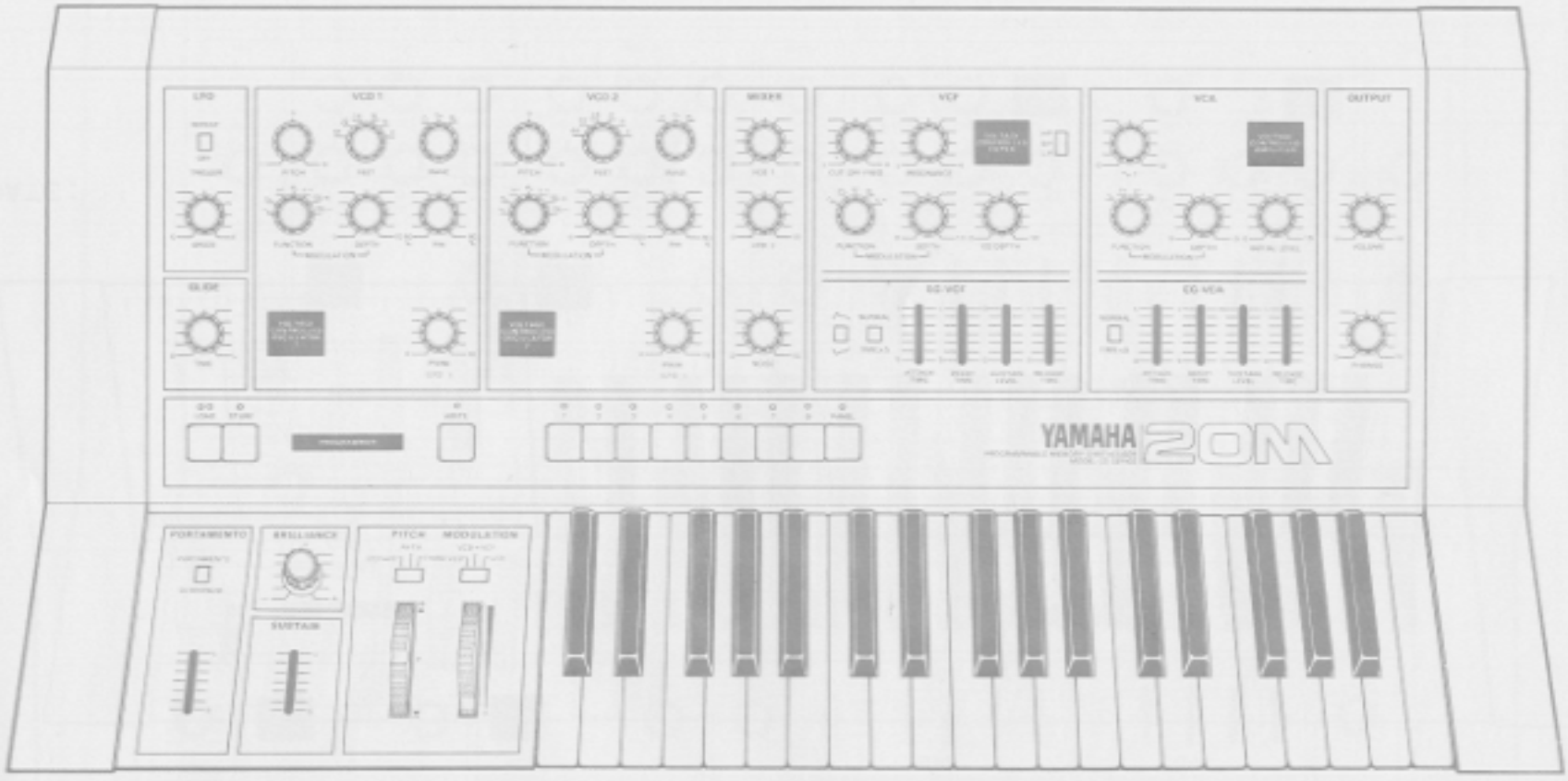
MEMORY No.




DATE : / /

SOUND NAME

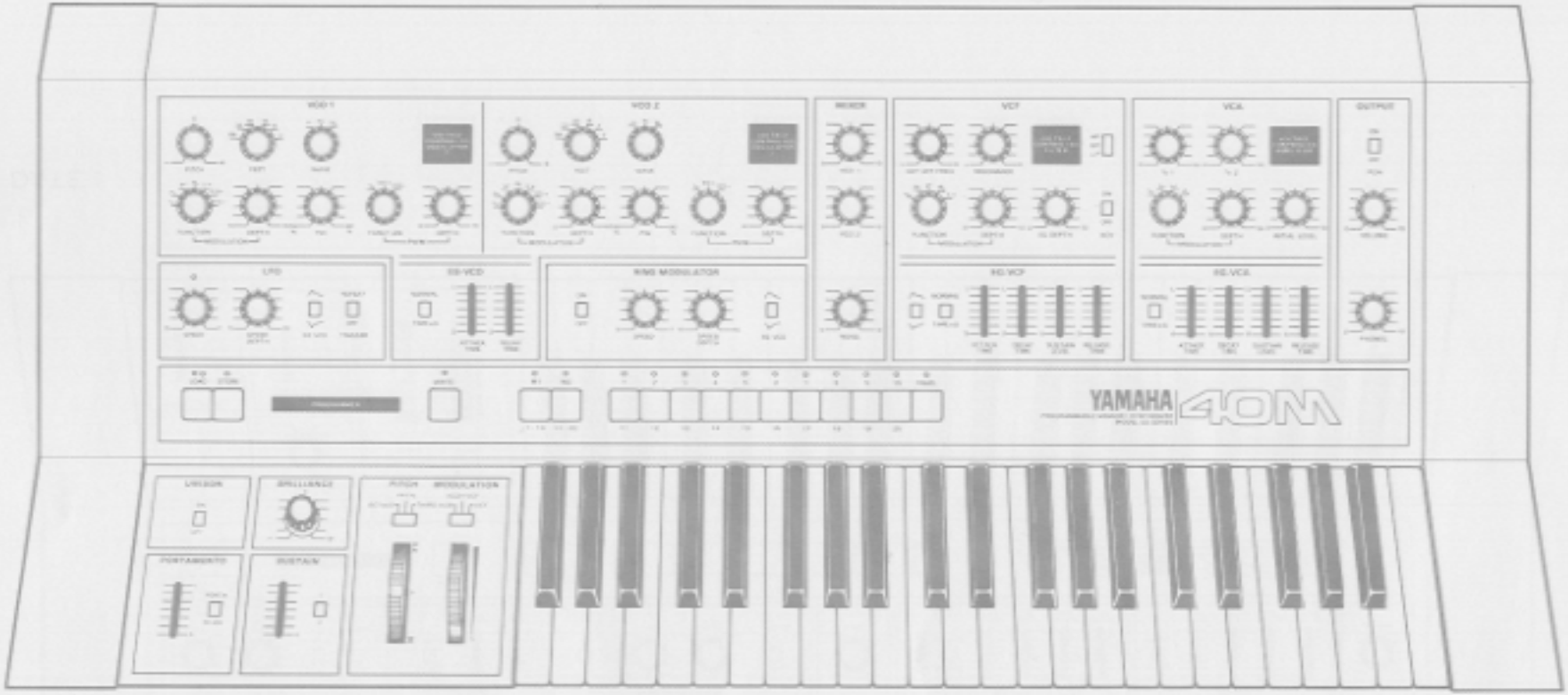
MEMORY No.




DATE : / /

SOUND NAME

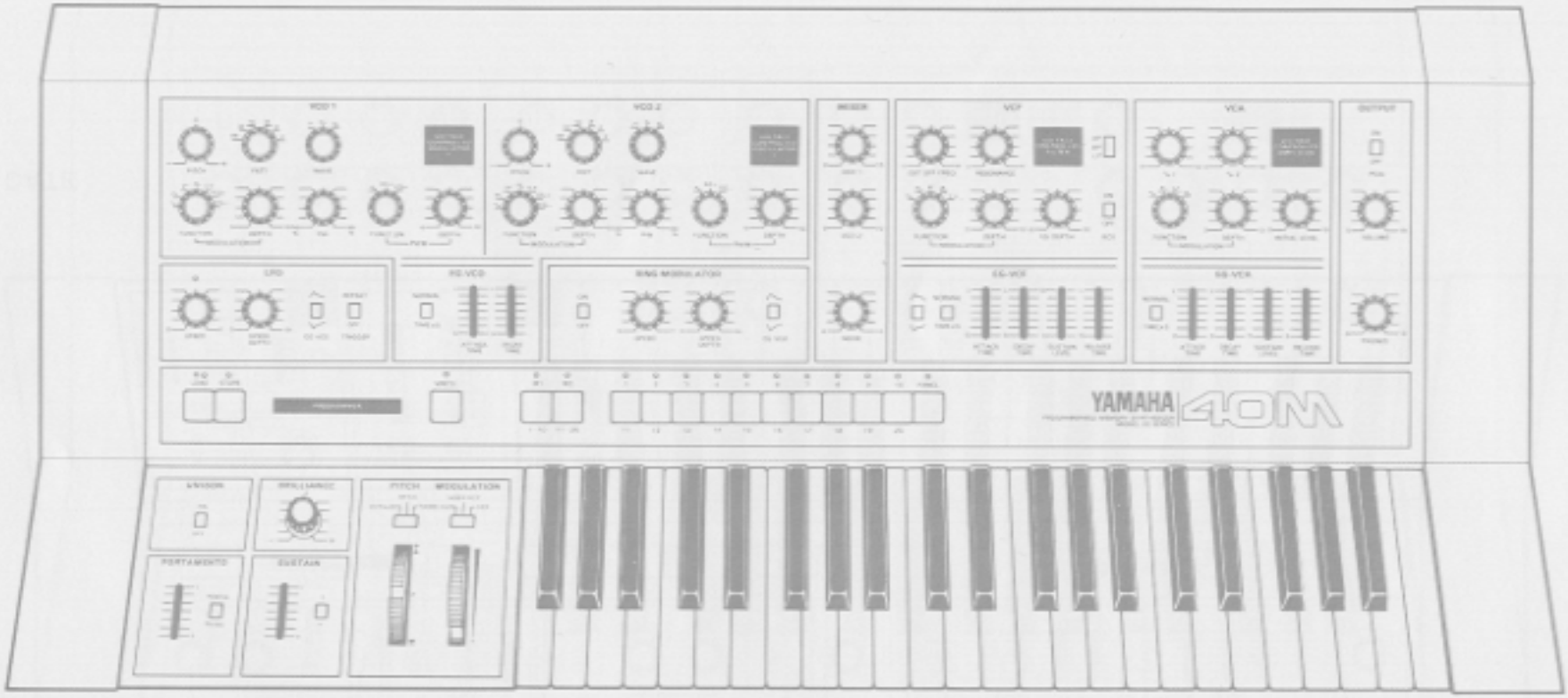
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DATE : / /

SOUND NAME

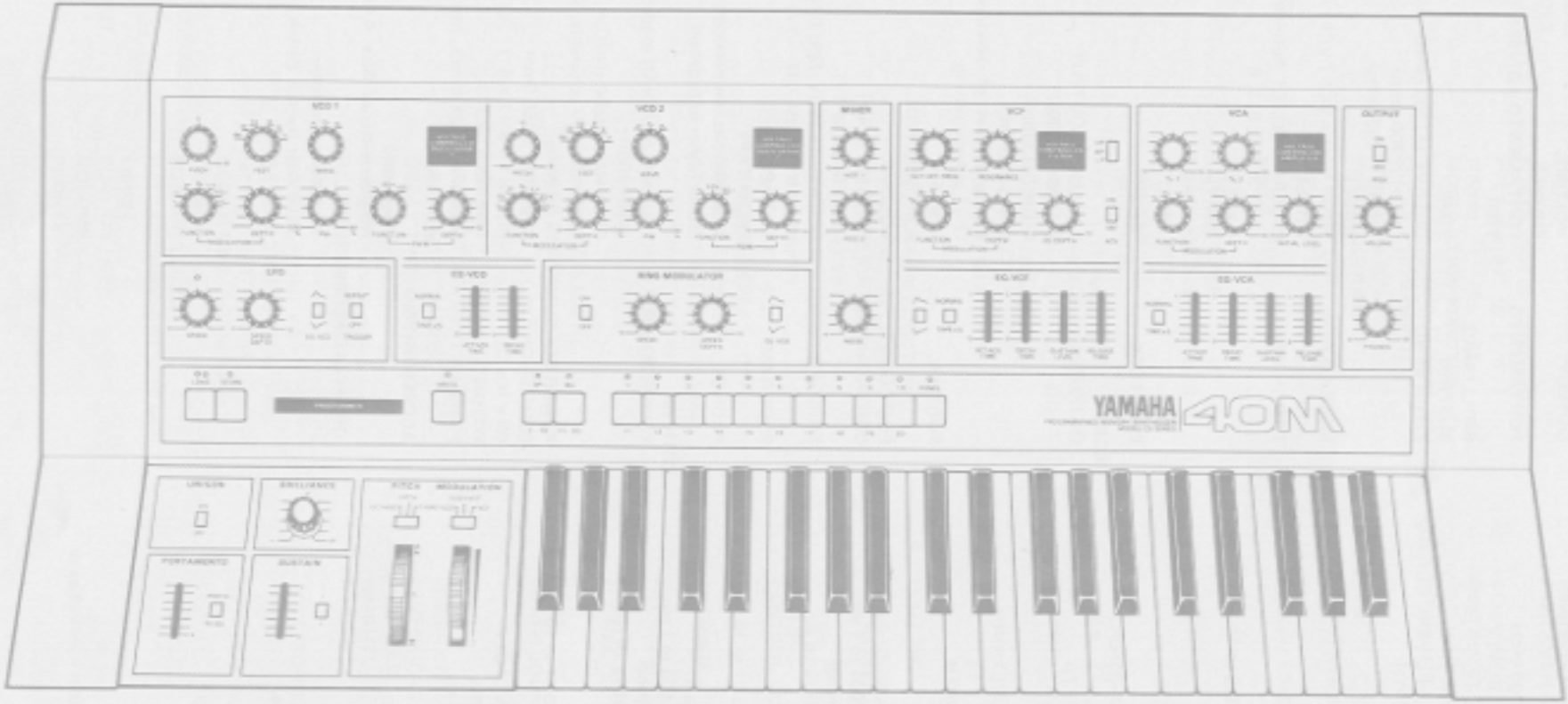
MEMORY No.




DATE : / /

SOUND NAME

MEMORY No.




DATE : / /

# SPECIFICATIONS···CS-20M

**KEYBOARD** . . . . . 37 keys, c1 through c4 (3 octaves)

**CONTROLS**

VCO 1, VCO 2 . . . . PITCH: −500 to +700 cents
FEET: 64', 32', 16', 8', 4', 2'
WAVE: ⩚, ◺, ⊓
MODULATION FUNCTION:
∿, ◺, ◿, ⊓, S/H, GL+, GL−
MODULATION DEPTH
PW: 50% to 90%
PWM ( LFO ∿ )

MIXER. . . . . VCO 1
VCO 2
NOISE

VCF . . . . . CUT OFF FREQ.
RESONANCE: Q= 0.5 to 10
HP/BP/LP
HP:12dB/oct.
BP: ±6dB/oct.
LP: −12dB/oct.
MODULATION FUNCTION:
∿, ◺, ◿, ⊓, S/H
MODULATION DEPTH
EG DEPTH

VCA . . . . . ∿ 1
MODULATION FUNCTION:
∿, ◺, ◿, ⊓
MODULATION DEPTH
INITIAL LEVEL

EG-VCF . . . . . ⌒ / ⌣
NORMAL / TIME x 5
ATTACK TIME: 0.001 to 1 sec.
(at "NORMAL" setting)
DECAY TIME: 0.01 to 10 sec.
( ditto )
SUSTAIN LEVEL
RELEASE TIME: 0.01 to 10 sec.
( ditto )

EG-VCA . . . . . NORMAL / TIME x 5
ATTACK TIME: 0.001 to 1 sec.
(at "NORMAL" setting)
DECAY TIME: 0.01 to 10 sec.
( ditto )
SUSTAIN LEVEL
RELEASE TIME: 0.01 to 10 sec.
( ditto )

LFO . . . . . TRIGGER: REPEAT / OFF
SPEED: 0.1 to 100Hz

GLIDE . . . . . TIME: 0.015 to 15 sec.

OUTPUT. . . . . VOLUME
PHONES

PORTAMENTO. . . . PORTAMENTO / GLISSANDO
TIME

BRILLIANCE

SUSTAIN . . . . . TIME

PITCH BEND . . . . . OCTAVE (±1200 cents)
FIFTH (±700 cents)
THIRD (±400 cents)
WHEEL

MODULATION. . . . VCO / VCO + VCF / VCF
WHEEL

PROGRAMMER . . . PROGRAM SELECT Buttons
1, 2, 3, 4, 5, 6, 7, 8
PANEL
WRITE
STORE
LOAD

PGM LOCK . . . . . IN/OUT

**JACKS**

OUTPUT. . . . . BALANCED OUTPUT
(−16dBm / 600Ω)
HIGH (−13dBm)
LOW (−32dBm)
During output of sawtooth wave
( ◺ ) at basic setting.

FOOT SW. . . . . SUSTAIN
PORTAMENTO

FOOT CONT. . . . . VOLUME

CONTROL VOLT . . IN ( 0.125 to 4V)
OUT ( 0.125 to 4V)

TRIGGER . . . . . IN (OFF: 15 to 3V, ON: 0 to −10V)
OUT: (OFF: 3V, ON: −7V)

PROGRAM . . . . . TO TAPE
FROM TAPE

PHONES. . . . . 24.5 millivolts rms nominal
(8Ω or higher impedance)

**OTHERS**

POWER SOURCE. . . U.S. and CANADIAN models:
120V, 60Hz
GENERAL model:
220V or 240V selectable, 50/60Hz

POWER CONSUMPTION: 28 Watts

DIMENSIONS. . . . 849 x 177 x 455.5mm
(W x H x D) (33-3/8 x 7 x 17-7/8")

WEIGHT . . . . . 16kg (35.3 lbs.)

FINISH. . . . . Semi-gloss black panels, rosewood-grain cabinet

ACCESSORIES:
Power cord
Alkaline batteries (Size: AA) x 2

OPTIONAL ACCESSORIES:
FC-3 Foot Controller
FC-4 Foot Switch Pedal

**Specifications subject to change without notice.**

# SPECIFICATIONS···CS-40M

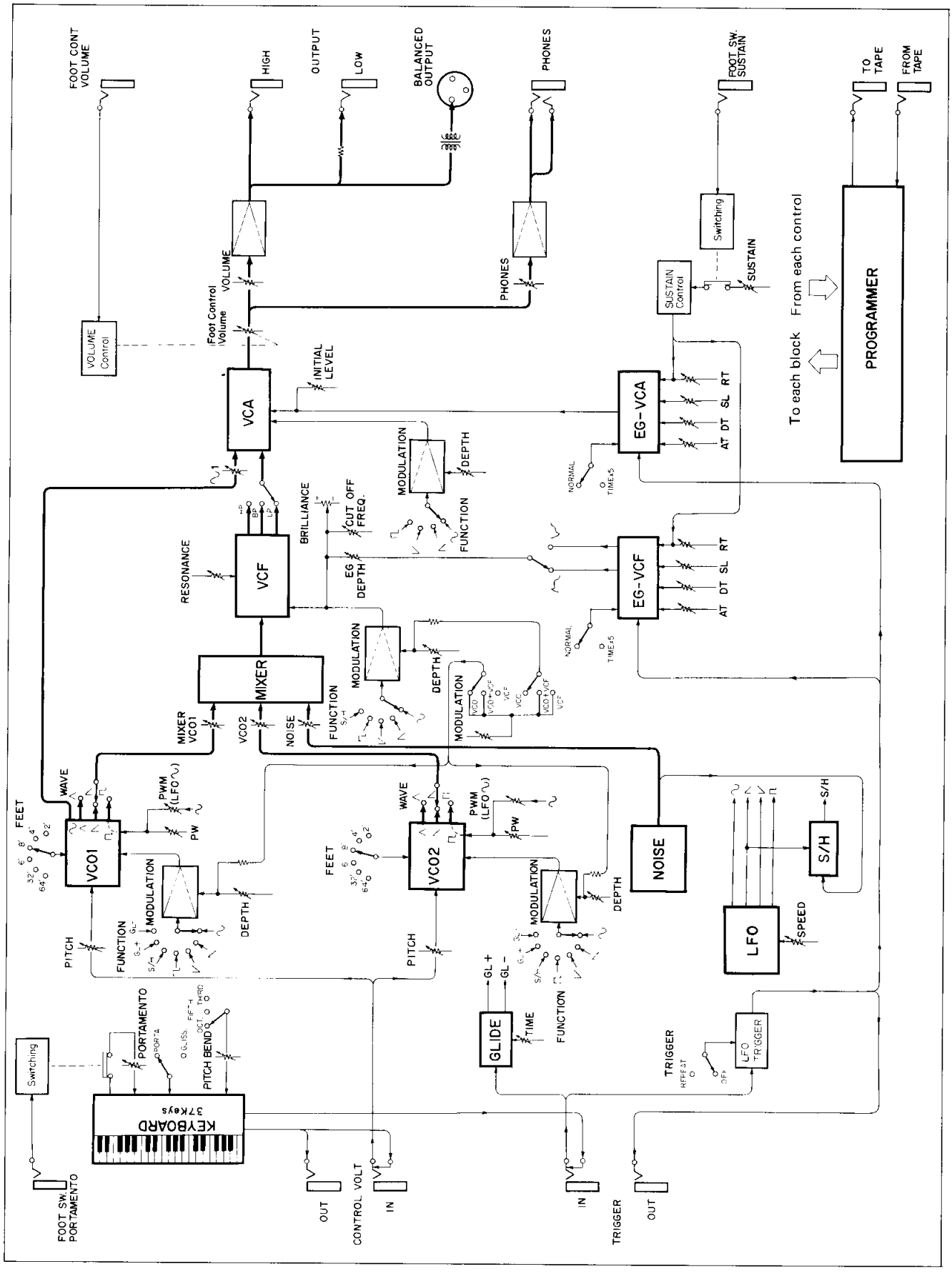
**KEYBOARD** . . . . . 44 keys, f to c4 (3-2/3 octaves)
**CONTROLS**
VCO 1, VCO 2 . . . . PITCH: −500 to + 700 cents
FEET: 64', 32', 16', 8', 4', 2'
WAVE: ∿, ⋀, ⊓
MODULATION FUNCTION:
∿, ⋀, ◿, ⊓, S/H, EG+, EG−
MODULATION DEPTH
PW: 50% to 90%
PWM FUNCTION
∿, EG+, EG−
PWM DEPTH
MIXER. . . . . VCO 1
VCO 2
NOISE
VCF . . . . . CUT OFF FREQ.
RESONANCE: Q= 0.5 to 10
HP / BP / LP
HP: 12dB/oct.
BP: ±6dB/oct.
LP: −12dB/oct.
MODULATION FUNCTION:
∿, ⋀, ◿, ⊓, S/H
MODULATION DEPTH
EG DEPTH
KCV: ON / OFF
VCA . . . . . ∿ 1
∿ 2
MODULATION FUNCTION:
∿, ⋀, ◿, ⊓
MODULATION DEPTH
INITIAL LEVEL
LFO . . . . . SPEED: 0.1 to 100Hz
SPEED DEPTH
EG-VCO: ⋀ / ◿
TRIGGER: REPEAT / OFF
EG-VCO . . . . . NORMAL / TIME x 5
ATTACK TIME: 0.001 to 1 sec.
(at "NORMAL" setting)
DECAY TIME: 0.01 to 10 sec.
( ditto )
RING MODULATOR. . ON / OFF
SPEED: 0.5 to 500 Hz
SPEED DEPTH
EG-VCO: ⋀ / ◿
EG-VCF . . . . . ⋀ / ◿
NORMAL / TIME x 5
ATTACK TIME: 0.001 to 1 sec.
(at "NORMAL" setting)
DECAY TIME: 0.01 to 10 sec.
( ditto )
SUSTAIN LEVEL
RELEASE TIME: 0.01 to 10 sec.
( ditto )
EG-VCA . . . . . NORMAL / TIME x 5
ATTACK TIME: 0.001 to 1 sec.
(at "NORMAL" setting)
DECAY TIME: 0.01 to 10 sec.
( ditto )
SUSTAIN LEVEL
RELEASE TIME: 0.01 to 10 sec.
( ditto )
OUTPUT. . . . . POA: ON / OFF
VOLUME
PHONES
UNISON . . . . . ON / OFF
PORTAMENTO. . . . PORTAMENTO / GLISSANDO
TIME
BLILLIANCE
SUSTAIN . . . . . SUSTAIN I / SUSTAIN II
TIME
PITCH BEND . . . . . OCTAVE (±1200 cents)
FIFTH (±700 cents)
THIRD (±400 cents)
WHEEL
MODULATION . . . . VCO / VCO + VCF / VCF
WHEEL
PROGRAMMER . . . PROGRAM SELECT Buttons
M1 (1, 2, 3, 4, 5, 6, 7, 8, 9, 10)
M2 (11, 12, 13, 14, 15, 16, 17,18, 19, 20)
PANEL
WRITE
STORE
LOAD
PGM LOCK . . . . . IN OUT

**JACKS**
OUTPUT. . . . . BALANCED OUTPUT
(−16dBm/600Ω)
HIGH (−13dBm)
LOW (−32dBm)
During output of sawtooth wave
(⋀) at basic setting.
FOOT SW. . . . . SUSTAIN
PORTAMENTO
FOOT CONT. . . . . VOLUME
FILTER
VCF IN. . . . . −10 to 10V
VCA IN . . . . . −10 to 10V
CONTROL VOLT I / II:
IN ( 0.0835 to 4V)
OUT ( 0.0835 to 4V)
TRIGGER I / II . . . IN (OFF: 15 to 3V,ON: 0 to −10V)
OUT (OFF: 3V, ON: −7V)
PROGRAM . . . . . TO TAPE
FROM TAPE
PHONES . . . . . 24.5 millivolts rms nominal
( 8Ω or higer impedance)

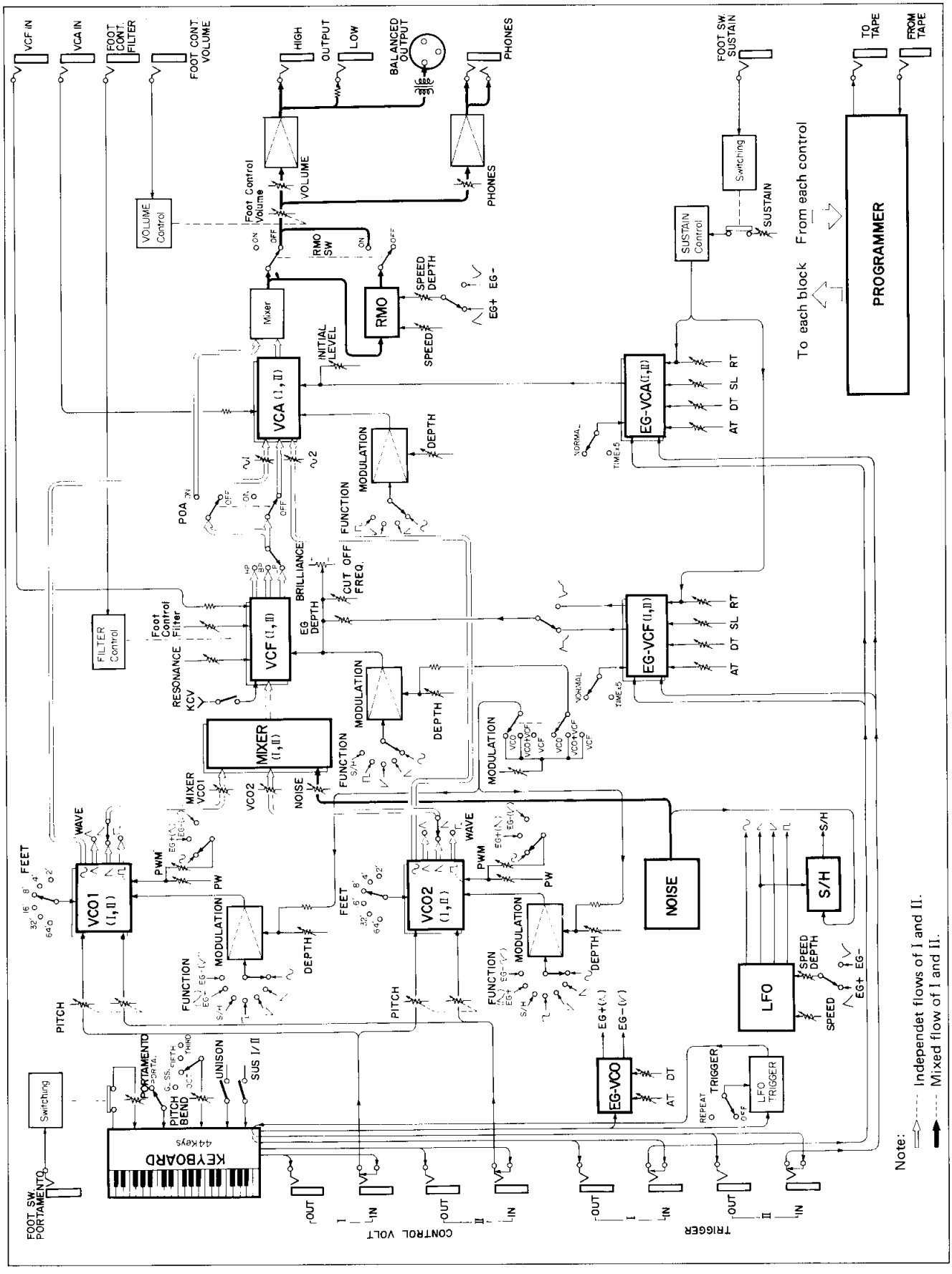
**OTHERS**
POWER SOURCE. . . U.S. and CANADIAN models:
120V,60Hz
GENERAL model
220V or 240V selectable, 50/60Hz
POWER CONSUMPTION: 40 Watts
DIMENSIONS. . . . . 988 x 177 x 470.5mm
( W x H x D ) (38-7/8 x 7 x 18-1/2")
WEIGHT . . . . . 21 kg (46.3 lbs.)
FINISH. . . . . Semi-gloss black panels, rosewood-grain cabinet
ACCESSORIES:
Power cord
Alkaline batteries (Size: AA) x 2
OPTIONAL ACCESSORIES:
FC-3 Foot Controller
FC-4 Foot Swich Pedal

**Specifications subject to change without notice.**

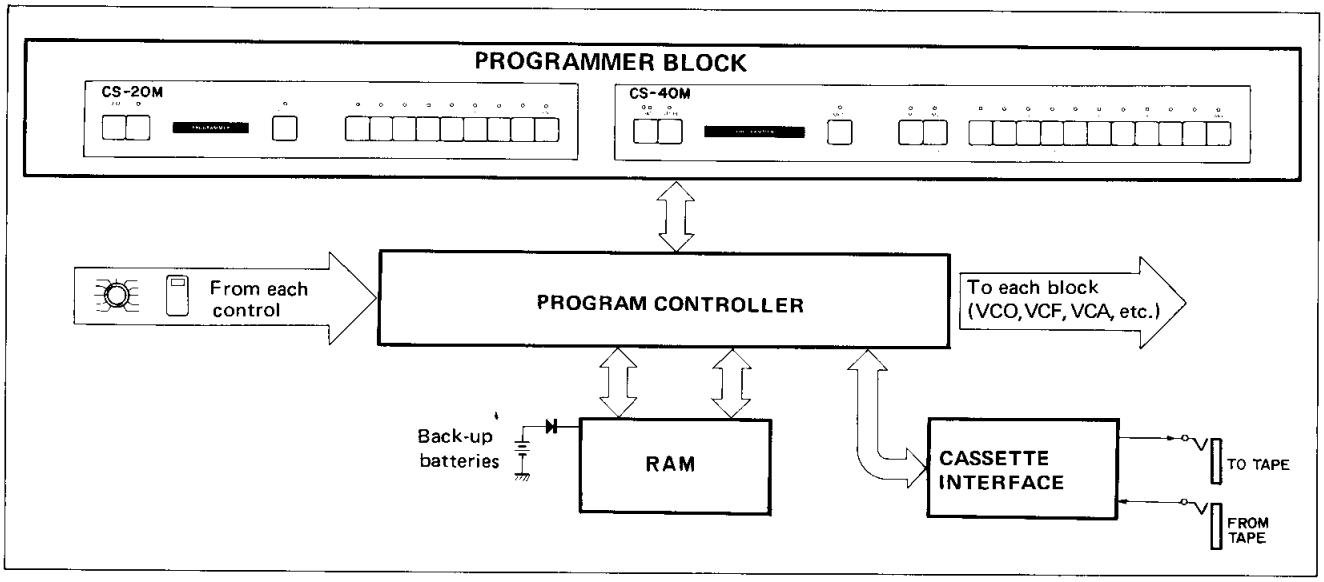
# BLOCK DIAGRAM···CS-20M



# BLOCK DIAGRAM···CS-40M



# BLOCK DIAGRAM···PROGRAMMER




## TROUBLESHOOTING

**OPERATES BUT NOT IN A NORMAL MANNER**

**Faint sounds (Volume will not increase.)**

Are the VOLUME controls of the synthesizer and amplifier properly set?

Is the amplifier's sensitivity and output properly set?

Is the setting of the EG-VCA selected by the VCA set effectively?

The volume will change depending upon the VCA envelope settings.

The volume will change even if it is adjusted with CUT OFF FREQ. knob and BRILLIANCE knob. In particular, in BP and HP, if the cut-off frequency is set too high, faint volume occurs.

**Sounds come out but are not normal.**

If sounds have been normal at the basic setting shown on page 8, then the trouble is due to the mis-operation of controls.

If setting of AT and DT of EG-VCF is too low and EG DEPTH is set too deep, a click will be heard.

**Other controls do not work**

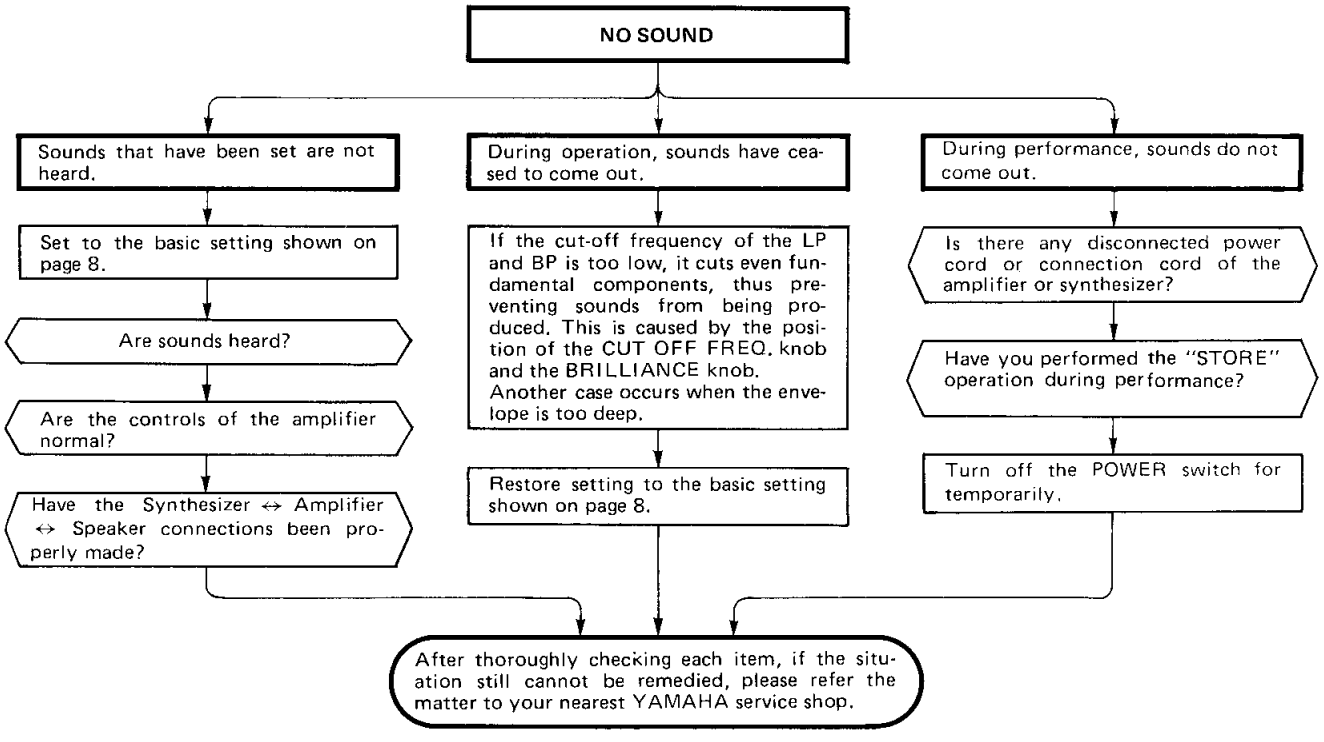
Isn't it playing the programmed voices?

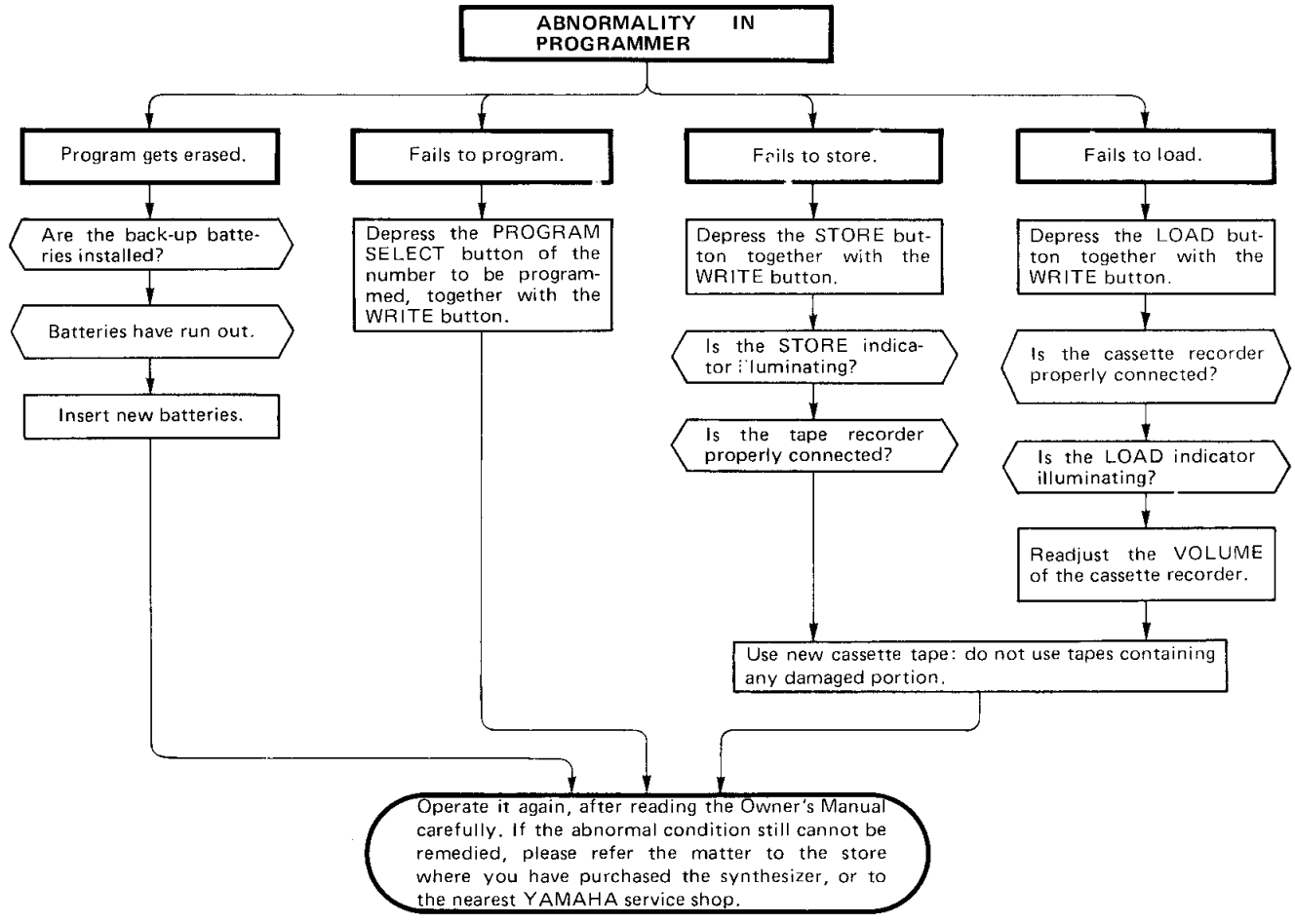
While playing the memorized voices, the parameters of the control panel will become inoperable.

Please read the contents of the Owner's Manual carefully to understand the functions of respective controls and switches to ensure proper operation.

When you find it difficult to remedy your trouble after checking each point mentioned above, please consult with your dealer or nearest YAMAHA service shop.

# TROUBLESHOOTING



SINCE 1887 YAMAHA

NIPPON GAKKI CO., LTD. HAMAMATSU, JAPAN

# YAMAHA
# PROGRAMMABLE MEMORY
# SYNTHESIZER
# CS-20M/40M

OMD-5 BWGB.0.OR Printed in Japan