KAWAI

SX-240

8-VOICE
PROGRAMMABLE
POLYPHONIC
SYNTHESIZER

OWNER'S MANUAL

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Thank you for purchasing the KAWAI SX-240 8-VOICE PROGRAMMABLE POLYPHONIC SYNTHESIZER. We are sure that it will give you many years of musical excitement.

This Manual contains operating instructions for all features and controls on your new synthesizer. Thorough study of this Manual will better acquaint you with the instrument and enable you to derive the maximum benefit from its advanced features. By way of introduction, however, we ask that you observe a few simple rules designed to protect the instrument and keep it in top condition:

■ **Automatic Reset**

The heart of the SX-240 consists of two high-speed microprocessors which are extremely sensitve to power line noise, voltage transients, and static electricity. A reset feature is provided, but this feature should only be used as a last resort. After using reset, you will have to reload the programs into memory, so be sure to have your programs backed up on cassettes.

To reset the processors, shut off the main power, wait a few seconds, and reapply the power. They should then function normally once more.

■ **Battery Backup**

The tone memory and sequencer programs are electronically maintained by a built-in battery. This battery is automatically recharged whenever the instrument is in use. It is recommended that the SX-240 be turned on for a few hours every two months to maintain this battery charge. KAWAI also recommends charging the backup battery upon first unpacking your new SX-240 – by leaving the synthesizer "ON" for 3 ~ 4 hours.

■ **Handle Carefully**

Your synthesizer is designed for long life and durability. However, like any other electronic instrument, certain precautions must be taken. Protect the SX-240 from heavy shocks, direct sunlight, high temperatures, high humidity, and dust.

■ **Cleaning**

Always wipe your synthesizer with a soft, dry cloth. Never use paint thinner or other harsh chemical solvents.

■ **Repairs**

Should your synthesizer ever need servicing, always contact your nearest authorized KAWAI dealer or service technician.

1. MAIN FEATURES

1.1 Programming Capabilities

* The KAWAI SX-240 offers eight independent programming channels (or "tones"), each with its own DCO-VCF-VCF·EG-VCA-VCA·EG sequence.
* The KAWAI SX-240 uses digitally controlled oscillators (DCOs) – for utmost pitch accuracy.
* The interval between the two DCO's may be chosen anywhere in a range of up to two octaves.
* Each programmed sound is stored under an 8-digit name which appears in an LED display labbled "IDENTIFIER" on the panel.

1.2 Ease of Operation

* Parameter selection during programming is a simple matter of moving a cursor (lighted LED) through the parameter block until the name of the desired parameter appears in the IDENTIFIER section of the panel together with its current value. Rotating the INCREMENT knob then changes the parameter value or turns it ON and OFF.

1.3 Playing the Synthesizer

* In addition to the "NORMAL" mode of operation (one sound for the entire keyboard range), the SX-240 can be played in either "SPLIT" or "DUAL" mode. The "SPLIT" mode allows for two different sounds to be played on two different sections of the keyboard. The "DUAL" mode allows two different sounds to be played together.
* The bender function provides control over the digitally controlled oscillators (DCO) and voltage controlled filters (VCF). The bender amount can be programmed differently for each tone program.
* The synthesizer provides PORTAMENTO and GLISSANDO effects which can be easily added and/or removed at any time.
* The foot switch allows the player to switch programmed tones without removing his hands from the keyboard.

1.4 Built-In Sequencer

* The built-in realtime sequencer is capable of recording up to approximately 1500 notes of an actual performance.
* Both recording and playback may be synchronized with an external clock signal or drum machine. The SX-240 clock setting is 24 pulses per quarter note.

1.5 Musical Instrument Digital Interface (MIDI)

* Three MIDI terminals – IN, OUT, and THRU – are provided. The SX-240 MIDI can transmit and receive keyboard, bender, program select, and release signals. It transmits only on MIDI Channel 1 but receives data on all 16 MIDI channels.

1.6 Memory Capacity

* The SX-240 is capable of storing 48 Tone Programs – in six banks (A through F) of eight patches each – as well as eight sets of sequencer data (for a total of 1500 notes).
* The synthesizer's edit and exchange functions simplify the tasks of creating new, complex tones and rearranging previously recorded ones.

1.7 Tape Interface

* Programmed tones and sets of sequencer data can be transferred from the memory to tape – to form a permanent library of virtually unlimited capacity.
* When this function is activated, the IDENTIFIER portion of the panel gives the procedure.

KEY TO DIAGRAM

① VOLUME slider –
Controls the total output.

② LOWER slider –
Controls the lower keyboard volume relative to the upper.

③ FAST/VIEW button –
Pressing this while turning the INCREMENT knob changes the parameter value in steps of 5 instead of one (FAST operation). Pressing it while a tone name is displayed lists the parameter values for four seconds.

④ CURSOR controls –
Shift between parameters

⑤ INCREMENT knob –
Changes the parameter value

⑥ UPPER/LOWER toggle –
Switches between keyboard in the "SPLIT" mode.

⑦ IDENTIFIER display –
- Normally shows name of programmed tone or stored sequence,
- Shows parameter name and value during programming,
- Gives instructions during auxiliary operations.

⑧ Keyboard names –
Indicate which keyboard halves are being programmed.

⑨ Key mode buttons –
Determine keyboard mode (NORMAL/SPLIT/DUAL)

⑩ Lower keyboard functions –
OCT UP, HOLD

⑪ Upper keyboard functions –
HOLD, PORTAMENTO, GLISSANDO

⑫ SPLIT ASSIGN function –
Controls distribution of DOCs to keyboard halves ("SPLIT" mode)

⑬ CHORD MEMORY function –
Allows storage of intervals (such as octaves or fifths) in the POLY-4 mode and allows up to eight different intervals at once in the MONO mode.

⑭ KEYBOARD ASSIGN function –
Controls the number of DCOs assgined to each key played (POLY-8, POLY-4, or MONO modes)

⑮ PORTAMENTO/GLISSANDO speed

⑯ Parameter block –
The LED currently lit indicates the parameter available for reprogramming.

⑰ Tone generator block

⑱ LFO block

⑲ VCF block

⑳ LFO trigger

㉑ VCA block –
Voltage-Controlled Amplifier

㉒ HPF High Pass Filter

㉓ ENSEMBLE switch –
Stereo chorus

㉔ Bender control

㉕ LFO DISABLE/START switches –
Temporarily suspend and initiate LFO modulation

㉖ Sequencer controls –
For functions: start, stop, break, repeat, offset, and link.

㉗ Split keyboard indicator

㉘ Letters, numerals, and symbols for forming names.

㉙ TEMPO –
Recording and palyback speed for sequencer.

BEAT –
Tming for sequencer recording.

㉚ Bank-Tone memory selectors –
Storage capacity for up to 48 (= 6 x 8) preprogrammed tones and 8 keyboard sequences available.

㉛ SAVE, LOAD, and VERIFY functions

㉜ MEMORY PROTECT switch –
When activated, this function blocks accidental erasure.

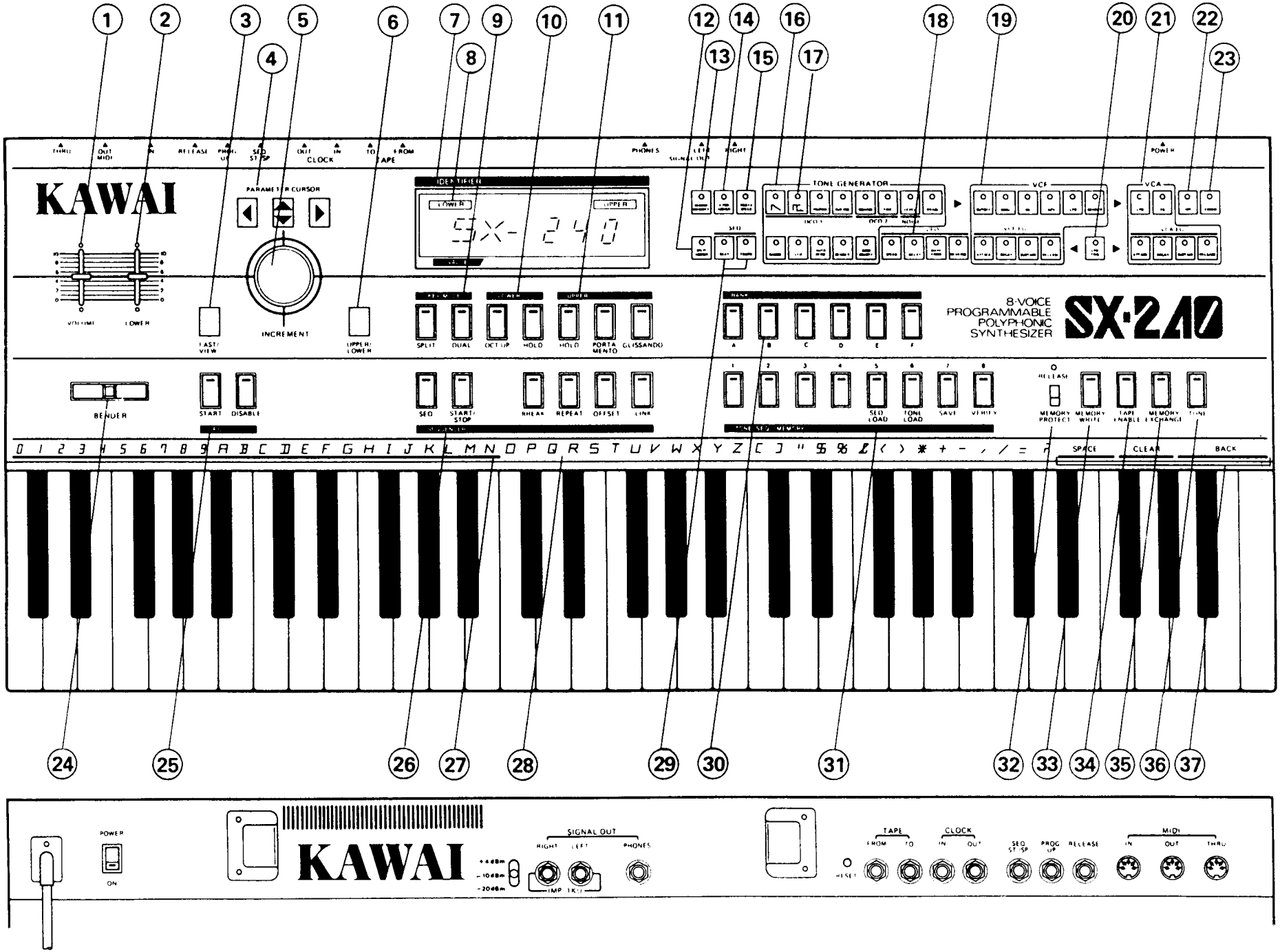
㉝ MEMORY WRITE –
Stores data.

㉞ TAPE ENABLE –
Activates tape interface.

㉟ MEMORY EXCHANGE –
Changes memory locations

㊱ TUNE –
When activated, this function permits tuning with the INCREMENT knob.

㊲ SPACE – Inserts space in name,
CLEAR – Erases entire name,
BACK (= Backspace) – Erases preceding letter.


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KAWAI
PARAMETER CURSOR
INCREMENT
IDENTIFIER
LOWER
UPPER
SX-240
TONE GENERATOR
VCF
VCA
8-VOICE
PROGRAMMABLE
POLYPHONIC
SYNTHESIZER
SX-240
BENDER
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POWER
SIGNAL OUT
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LEFT
PHONES
TAPE
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MIDI
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THRU

2. BASIC OPERATION

This Chapter explains the basic operation of your new synthesizer.

NOTE: In the following explanation, the symbols "#" and "##" appearing in parameter descriptions will stand for the numerical values of these parameters.

2.1 Setting Up

Connect the SX-240 following the procedure given in the preceding Chapter.

Turn on the power. If the instrument is functioning properly, the LEDs "A" and "1" in the BANK-TONE MEMORY section will light up, while the IDENTIFIER section displays the word "UPPER" and the name assigned to the A-1 tone.

Press the SPLIT key to divide the keyboard into two sections. The upper three octaves (the "upper keyboard") will then use the A-1 tone; the lower two (the "lower keyboard"), B-1.

Press a key on the upper keyboard and adjust the output level with the VOLUME slider.

Press a key on the lower keyboard and adjust the output balance with the LOWER slider.

Your SX-240 synthesizer comes complete with preprogrammed tones already stored in memory areas A-1 and B-1 so you are now ready to play.

NOTE: If it is necessary to tune your synthesizer to match another instrument,

1. Press the TUNE button. The LED in it will light and the IDENTIFIER section should read "0.TUNE" – indicating that the synthesizer is currently tuned to 440 Hz.
2. Turn the INCREMENT knob clockwise to raise the pitch and counterclockwise to lower it. The INDENTIFIER section will then display the relative pitch:

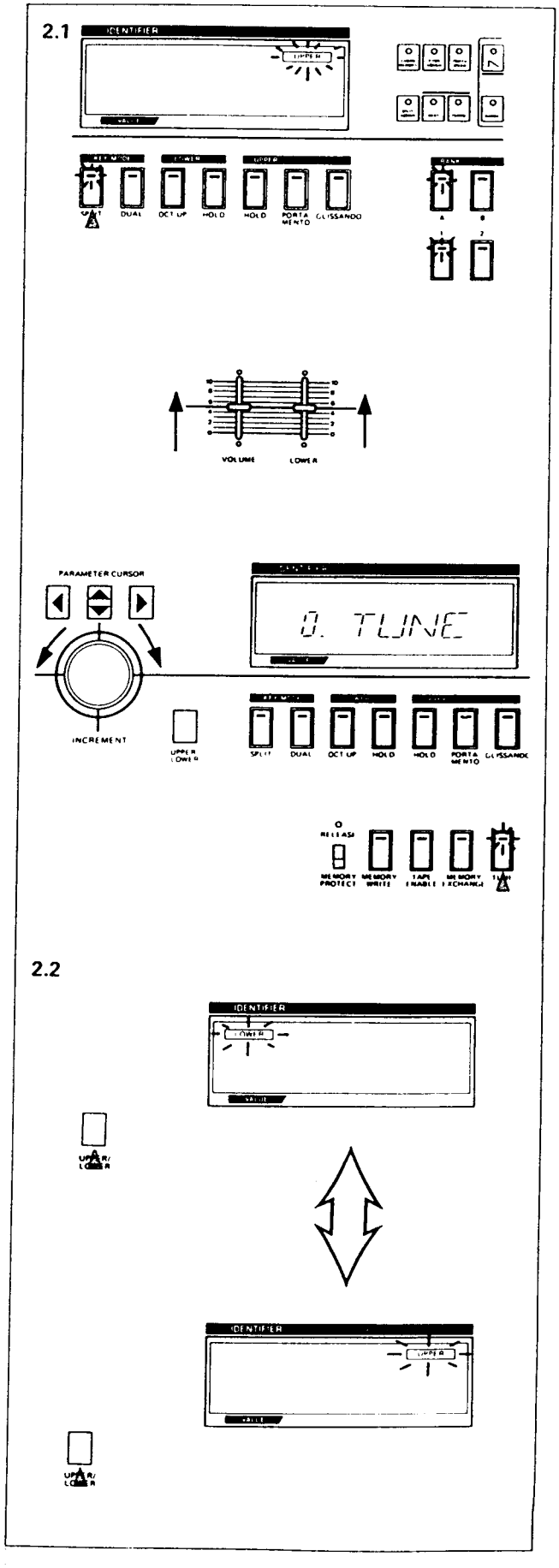
   ##.+ TUNE or ##.–TUNE.

2.2 Tones

To switch between preprogrammed tones, simply press one of the six bank switches (A-F) and one of the eight tone switches (1-8) in the BANK-TONE section. If a foot switch is connected to the PROG. UP jack, each press of the switch shifts to the next tone switch.

NOTE: The IDENTIFIER display will automatically change to show the name of the current tone.

The word "UPPER" or "LOWER" in the IDENTIFIER section indicates which half of the keyboard will used this tone. To switch between the two, press the UPPER/LOWER button next to this section.



2.3 Keyboard assignment

Your SX-240 synthesizer allows you to use the 5-octave keyboard in three different modes:

2.3.1 NORMAL

If both LEDs in the SPLIT and DUAL keys are out, the instrument is in the NORMAL mode – a single tone governs the output from all keys on the keyboard. (In this case, the word "UPPER" will appear in the IDENTIFIER section.)

2.3.2 SPLIT

Pressing the SPLIT button divides the keyboard in two: a three-octave upper keyboard and a two-octave lower keyboard, each governed by a separate preprogrammed tone. Pressing it a second time cancels the division, returning the keyboard to the NORMAL mode.

2.3.3 DUAL

Pressing the DUAL button does not split the keyboard; it permits the simultaneous use of two preprogrammed tones – but only for up to four notes at a time. Pressing it a second time returns the keyboard to the NORMAL mode.

2.3.4 SPLIT ASSIGN (SPLIT mode only)

This parameter controls the distribution of the eight digitally controlled oscillators (DCOs) available between the two halves of the keyboard. Shifting the cursor until the SPLIT ASSIGN LED lights, summons one of three displays to the IDENTIFIER section:

SPLIT 2-6
SPLIT 4-4
SPLIT 6-2

where the first number gives the number of DCOs assigned to the lower keyboard; the second, that assigned to the upper keyboard. To change the distribution, rotate the INCREMENT knob.

2.4 PORTAMENTO and GLISSANDO

These two effects, available only for the upper mode operation, join successive notes with glides – either continuously (PORTAMENTO) or in semitone steps (GLISSANDO).

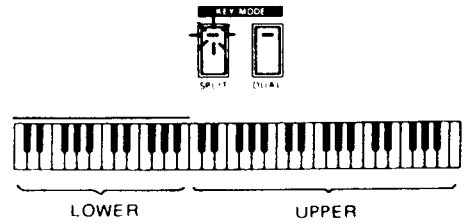
Certain of the tones programmed at the factory will not exhibit these effects until the parameter PORTA SPEED has been set to a non-zero value. Shift the cursor to the parameter and read the current value from the IDENTIFIER display:

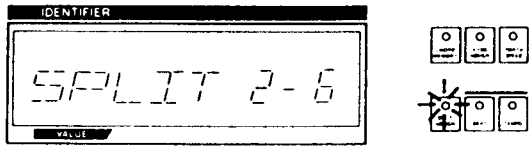
##. PORTA

If the current value is zero, rotate the INCREMENT knob to change it.

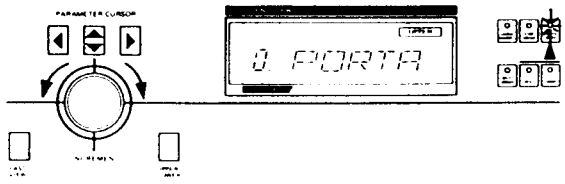
NOTE: The SX-240's Portamento/Glissando effect works only during "legato" style playing – playing a sequence of notes in a continuous or "connected" manner.

2.3





2.4



2.5 KYBD ASSIGN and CHORD MEMORY

The KYBD ASSIGN parameter specifies how many voices are to be devoted to generating the sound for each key pressed while the CHORD MEMORY feature determines the relative pitch assigned to each of the extra voices.

2.5.1 KYBD ASSIGN

Shifting the cursor to the KYBD ASSIGN parameter summons one of three possible displays to the IDENTIFIER section:

POLY-8
POLY-4
MONO

POLY-8 enables up to 8 independent voices to respond.
POLY-4 enables up to 4 independent voices to respond.
MONO enables 1 independent voice to respond.

Display	Channels/key	Max. No. of Keys	Max. Oscillators per Voice
POLY-8	1	8	2
POLY-4	2	4	4
MONO	8	1	16

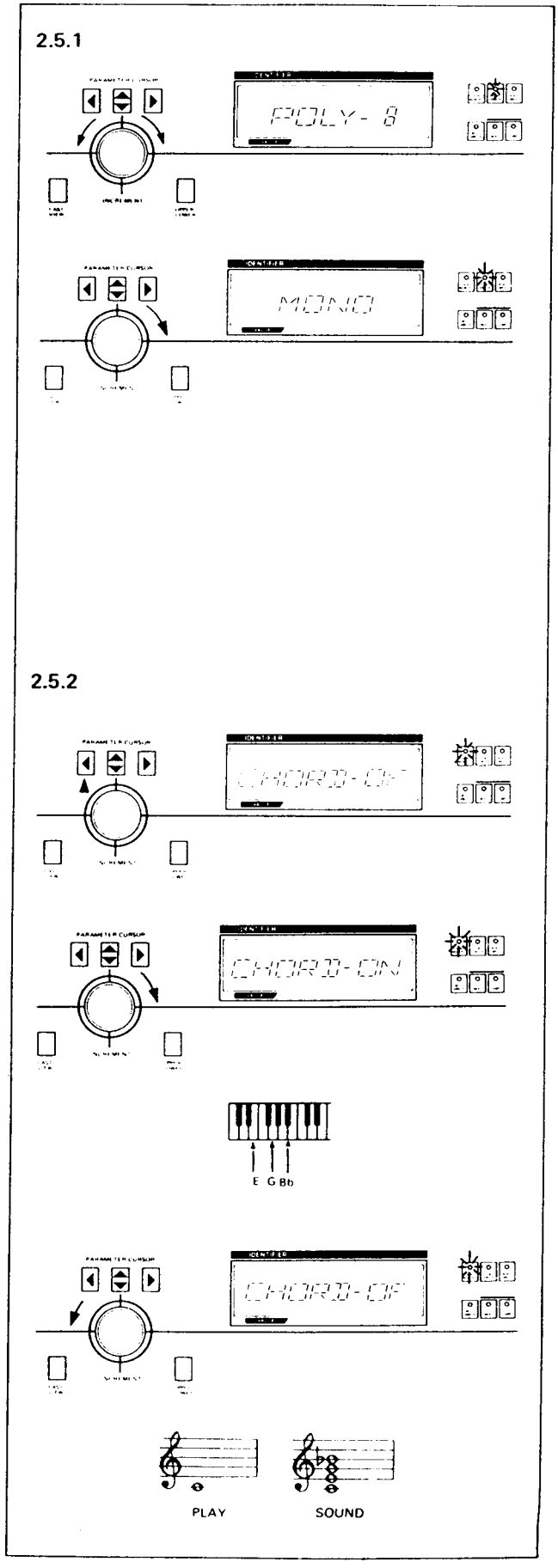
This voice assignment can be changed by rotating the INCREMENT knob.

2.5.2 CHORD INTERVAL MEMORY

NOTE: This feature enables you to assign the SX-240's oscillators in the POLY-4 and MONO playing modes. For POLY-8, the IDENTIFIER will always read CHORD-OF.

Shift the cursor to the CHORD MEMORY parameter so that the IDENTIFIER section reads CHORD-OF. Rotate the INCREMENT knob clockwise until the display changes to CHORD-ON, indicating that the synthesizer is ready to assign the oscillators.

The lowermost "C" is automatically included; play the remaining components one key at a time. When you reach the limit – one interval for POLY-4 and seven for MONO – the display will automatically rever to CHORD-OF, indicating that all oscillators have been assigned.



2.6 HOLD

When activated, the HOLD function will "hold" notes from the time they are released until others are selected. There are separate HOLD functions for each half of the keyboard.

2.7 OCTAVE UP

Activating the OCT UP button (pressing it so that its LED lights) shifts the entire lower keyboard up one octave. Pressing the button a second time deactivates it, turning out the LED.

2.8 LFO DISABLE/START

These two buttons temporarily cancel and restart LFO modulation – if the voice program contains such modulation.

Pressing the DISABLE button stops the modulation. A second stroke on the button restores it.

The LFO START button restores modulation – as long as you continue to press it. The LFO START button only functions when DISABLE is used.

2.9 BENDER

The BENDER shifts the pitch of the digitally controlled oscillator (DCO) and voltage controlled filter (VCF) outputs. It only operates, however, when the width of the pitch shift has been specified through the BENDER parameters in the tone generator (TG) and VCF blocks. To change the specified value, shift the cursor until the parameter appears in the IDENTIFIER section:

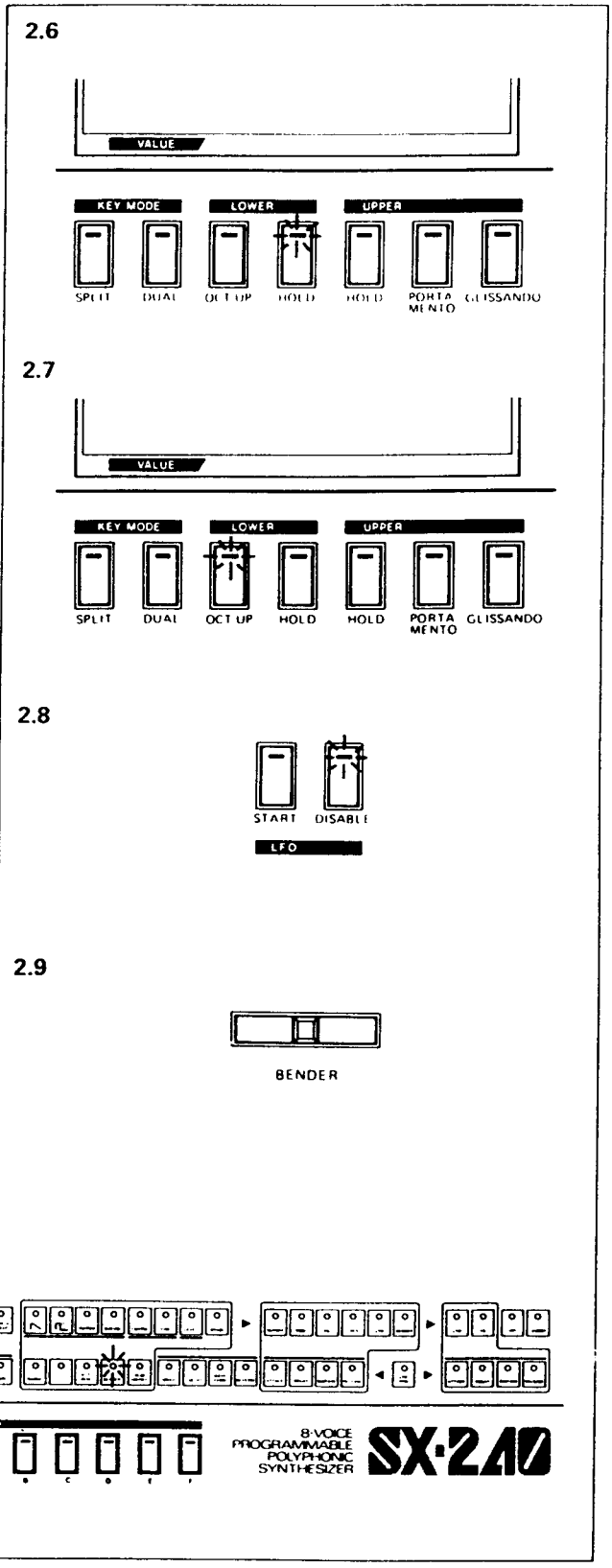
##.O-BEND – DCO BENDER

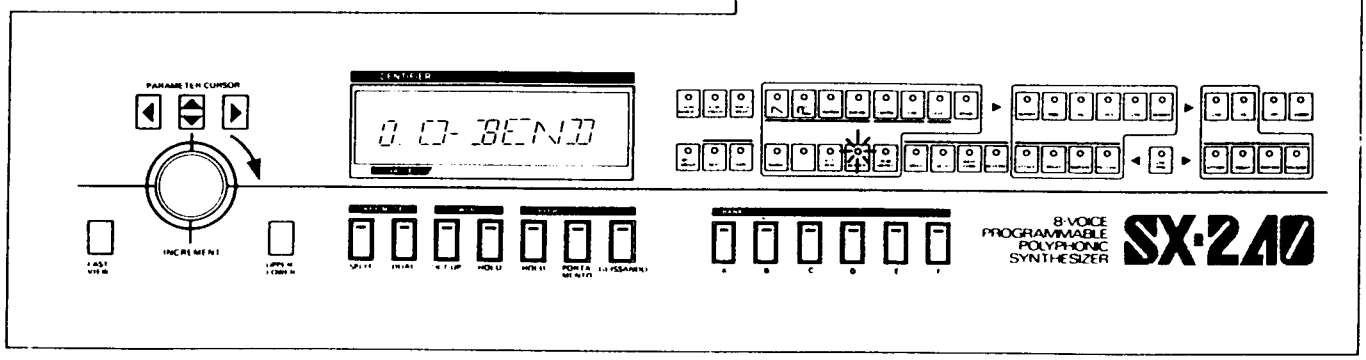
##.F-BEND – VCF BENDER

NOTE: These two functions cannot be used on both halves of a "SPLIT" keyboard simultaneously; they apply only to the half whose name appears in the IDENTIFIER section.

2.10 RELEASE

A foot switch attached to the RELEASE jack produces the same effect as the sustain pedal on a piano – a sustain effect that continues after the key is released.





3. SEQUENCER OPERATION

The sequencer in your SX-240 synthesizer allows you to record a sequence of notes, play it back, and add further accompaniment.

* In the "SPLIT" keyboard mode, the sequencer automatically plays on the lower keyboard, thereby freeing the upper one for live play.
* The storage capacity varies with the contents of the sequence, but a single sequence can run up to approximately 190 notes. The total memory available for all eight sequences is approximately 1500 notes.
* The built-in speaker provides a 1-, 3-, or 4-beat rhythm pattern to aid in recording. This is in addition to the synthesizer's ability to accept an external clock input – from a drum machine, for example. The SX-240's internal clock is set at 24 pulses per quarter note.
* A linking facility permits the recording of sequences into non-sequential memory locations – 1, 3, and 5, for example.
* Sotring a new sequence in the same memory area automatically destroys the previous one. The SX-240, however, has a built-in tape interface which enables you to save the sequencer data on tape.

3.1 Playback

Your SX-240 synthesizer is shipped from the factory with sequences already in its memory so the sequencer is ready for instant playback.

3.1.1 Basic Procedure

Before you can use the sequencer's playback function, you must specify which of the stored sequences you wish the synthesizer to use. Memory access is controlled by the SEQ button. When the LED in this button is off, the BANK-TONE memory buttons access the preprogrammed tone memory area. Pressing the SEQ button (and lighting the LED), on the other hand, accesses the sequence memory with the tone memory buttons 1–8.

Procedure

1. Press the SEQ button, the LED will light.
2. Press one of the SEQ. MEMORY buttons (1–8). That LED will light and the one in the SEQ button will go out.
3. Press the ST/SP button. That LED will light and the sequence will start.

When the sequencer reaches the end of the stored sequence, it will automatically stop and the ST/SP LED will go out.

NOTES:

(1) A foot switch connected to the SEQ ST/SP jack at the back of the instrument can be used in place of the ST/SP button.

(2) The playback speed is regulated by the parameter labelled TEMPO. Shifting the cursor to this parameter summons a display of the form ##. TEMPO to the IDENTIFIER section. The INCREMENT knob may then be used to change the value. Pressing the SEQ button automatically shifts the cursor to this parameter.

(3) Turning the INCREMENT knob fully counterclockwise yields the IDENTIFIER display EX.TEMPO. The "EX" stands for external. This setting tells the synthesizer to synchronize the playback with the signal input through the CLOCK IN jack.

(4) On a SPLIT keyboard, the synthesizer uses the LOWER tone for the playback.

3.1.2 BREAK

The BREAK function transfers sequencer control to the keyboard. When activated – that is, when the BREAK LED is lit – this function repeats the stored sequence as long as keys are being played; it returns to the beginning of the sequence each time a new key is played. To deactivate, press the BREAK button a second time.

3.1.3 REPEAT

When activated by pressing the REPEAT button, the REPEAT function continuously repeats the stored sequence until the REPEAT button is pressed a second time.

3.1.4 OFFSET

This feature, available only in the SPLIT mode, transposes the stored sequence to match the lowest key played on the lower half of the keyboard.

To activate, press the OFFSET button so that the LED lights. To deactivate, press the button a second time.

3.2 Linked Playback

The linking function of the sequencer permits you to freely select from all the sequences stored in the eight memory locations and combine them in any order.

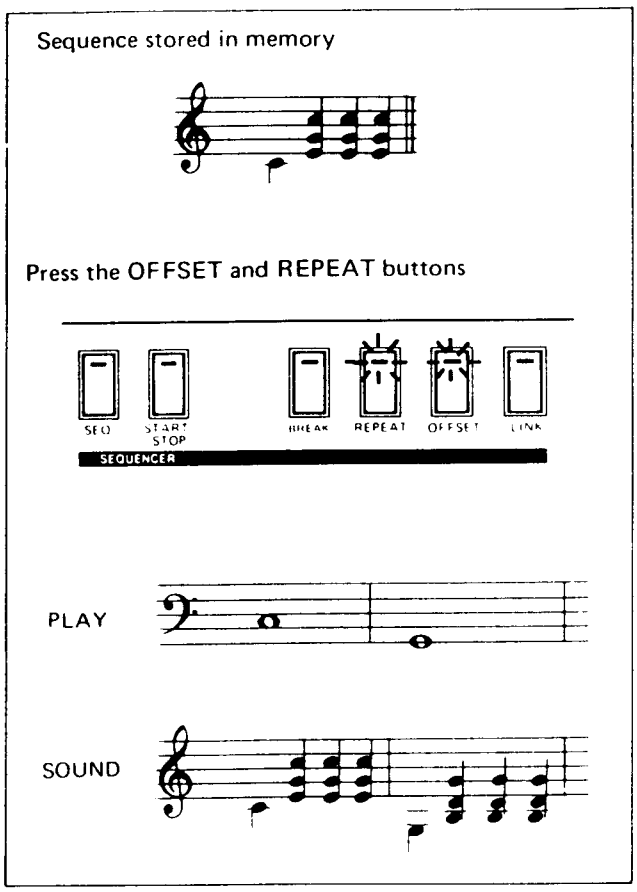
Demonstration:

Suppose ypu wanted to combine the sequences stored in memory locations 1, 2, and 4 in the order 1-4-2:

1. Shift the MEMORY PROTECT switch to the RELEASE position, lighting the LED.
2. Press the MEMORY WRITE button, lighting the LED.
3. Choose a name for the linked sequence – if desired. The IDENTIFIER section will display the prompt "NAME ?". Using the procedure outlined in Section 4.5, enter a name made up of the letters, numbers, and symbols appearing above the keys on the keyboard.
4. Press the LINK button, lighting the LED.
5. Press the SEQ button and then the SEQ MEMORY 1 button. The LED will start flashing.
6. Press the SEQ button and then the SEQ MEMORY 4 button. The LED will start flashing.
7. Press the SEQ button and then the SEQ MEMORY 2 button. The LED will start flashing.
8. Press the LINK or MEMORY WRITE button, turning off the LED.

   The above is all that is required to stored the linked sequence. To play it back:
9. Press the LINK button, lighting the LED. The IDENTIFIER section will display the name of the stored sequence. The LED of the last linked sequence will light.
10. Press the ST/SP button to initiate the playback of the specified sequences – in the specified order.

NOTE: If desired, the REPEAT, BREAK, and OFFSET functions just described may added as well.



3.3 Storing Sequences

The sequencer in your SX-240 faithfully records all notes played anywhere on the keyboard.

NOTE: Storing a new sequence automatically destroyes the old memory contents. You might, therefore, wish to save them on tape first. (See 7.1 "Saving Data")

3.3.1 General Procedure

1. Select a beat pattern.
2. Adjust the TEMPO.
3. Shift the MEMORY PROTECT switch to the RELEASE position, lighting the LED.
4. Press the MEMORY WRITE button, lighting the LED.
5. Choose a name for the stored sequence – if desired. The IDENTIFIER section will display the prompt "NAME ?". Using the procedure outlined in Section 4.5, enter a name made up of the letters, numbers, and symbols appearing above the keys on the keyboard.
6. Press the SEQ button, lighting the LED.
7. Press the SEQ MEMORY button (1–8) for the location which will hold the sequence.
   This completes the preparations. You are now ready to record.
8. Press the ST/SP button, lighting the LED. The selected beat pattern will then issue from the synthesizer.
9. Listen to the introduction carefully and then start to play something on the keyboard.

NOTE: The introduction is omitted when the sequencer is using an external clock – that is, operating in the EX.TEMPO mode.
If the sequence is longer than the memory space allotted for the selected location, the synthesizer will automatically transfer to the next one – to create what is termed a "chained" memory.

WARNING: Chaining automatically erases the entire contents of the sequencer memory location used next.

10. Press the ST/SP to mark the end of the sequence.

NOTE: The sequencer will automatically stop recording when the sequence exceeds the available memory capacity.

3.3.2 BEAT and TEMPO

In the recording mode, the sequencer issues a beat pattern through the built-in speaker to help you maintain rhythm and tempo.
Shifting the cursor to the BEAT parameter summons one of three messages to the IDENTIFIER display:

1 BEAT
3 BEAT
4 BEAT

Turn the INCREMENT knob until the name of the desired beat pattern appears in the IDENTIFIER section.

[1] 1-BEAT



[2] 3-BEAT



[3] 4-BEAT



Shifting the cursor to the TEMPO parameter summons a message of the form "##. TEMPO" to the IDENTIFIER display. Turn the INCREMENT knob to adjust the value.

NOTE: Turning the knob fully counterclockwise changes the message to "EX. TEMPO". This message indicates that the sequencer will synchronize the recording with an external clock signal.

3.3.3 CLOCK IN/OUT

Connecting the CLOCK OUT terminal of a rhythm machine or similar device to the synthesizer's CLOCK IN jack allows you to synchronize recording and playback with an external rhythm.
Shift the cursor to the TEMPO parameter and turn the INCREMENT knob counterclockwise until the IDENTIFIER display reads "EX. TEMPO", the abbreviation for external clock tempo.
Connecting the two devices the opposite way around – from the SX-240 CLOCK OUT to the rhythm machine CLOCK IN – allows you to synchronize the rhythm machine with your synthesizer.

4. PROGRAMMING

In demonstrating the basic operating procedures, we used the preprogrammed tones already in the SX-240 memory when it was shipped from the factory. Eventually, you will want to program your own. Before you can do that, however, you must become thoroughly familiar with the parameters and their effects – full discussion of which is contained in the next Chapter.

Since creating a new tone from scratch can be quite a long and difficult process, this Chapter starts with a discussion of the synthesizer's editing facilities. These facilities will allow you to experiment with "fine-tuning" the preprogrammed tones already in the memory. Should you happen upon a combination that you particularly like, jot down the values of the parameters so that you can recreate it whenever you want later. (The SX-240 also allows you to store it in the memory, but – since storing destroys the current memory contents – taking notes is perhaps safer for the first-time user.)

4.1 Editing

"Editing" simply means changing the current values of any of the parameters. The SX-240 is normally in the EDIT mode – even while you are playing. There are a lot of parameters in the parameter block, but you may start anywhere and change their values in any order.

4.1.1 Parameter Cursor and INCREMENT Knob

To be able to edit a parameter, you must have some way of pointing to it. The SX-240 uses two rows of LEDs, only one of which will light at any given time – a system which in computer technology is called a "cursor". Controlling this cursor are three buttons: the LEFT and RIGHT buttons which shift the cursor along a row and the UP/DOWN button which switches it between the two rows. A quick touch shifts the cursor one step. Continued pressing produces faster, repeated shifting.

Shifting the cursor not only changes the position of the lighted LED, it also displays the parameter and its current value in the IDENTIFIER section.

To change the value, rotate the INCREMENT knob. The effect depends on the type of parameter:

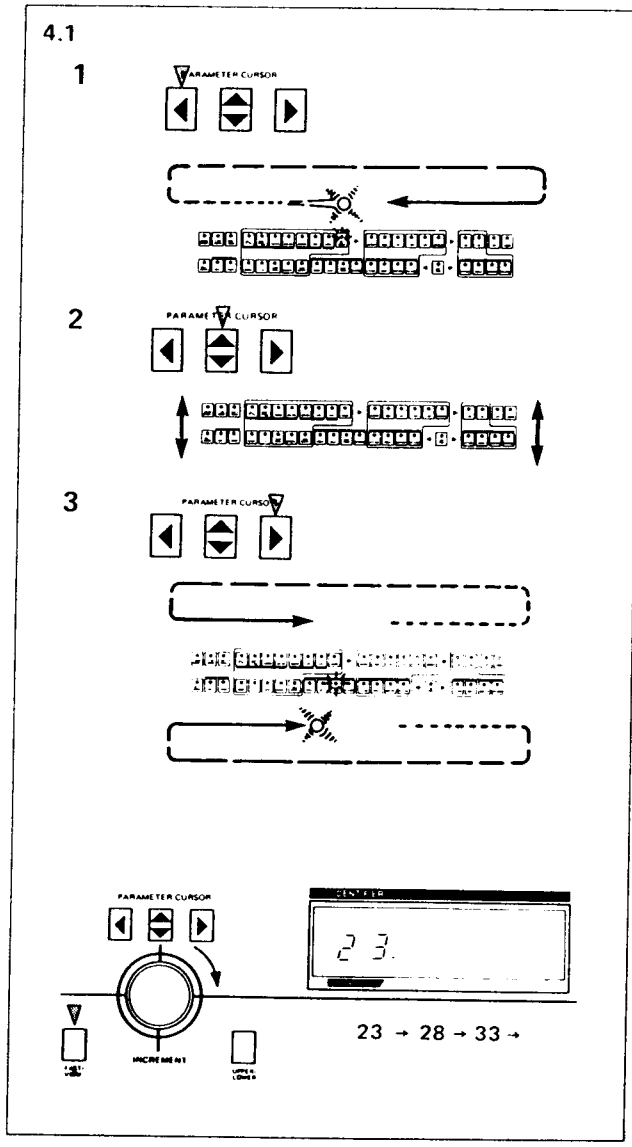
(1) If the parameter is *variable*, clockwise rotation increases the value, while counterclockwise rotation decreases it.

NOTE: Normally, the value changes one step at a time, but the rate of change can be multiplied by a factor of five by holding down the FAST/VIEW button at the same time.

(2) If the parameter is *digital* (ON-OFF), clockwise rotation sets the parameter "ON"; counterclockwise rotation, OFF.

(3) If the parameter is *selective*, the display rotates among the three available choices.

* For the definitions of the parameter types, see Chapter 5.



4.2 Ending the Edit

To cancel the results of the editing system, press one of the TONE MEMORY buttons to restore the original preprogrammed tone.

4.3 Sample Editing Session

The steps below demonstrate the procedures involved in a typical editing session.

4.3.1 RANGE

RANGE is a "selective" parameter, offering three choices:

16 FEET <--> 8 FEET <--> 4 FEET.

Shifting the cursor to this parameter will automatically summon one of these choices to the IDENTIFIER section. Clockwise rotation of the INCREMENT knob then halves the number; counterclockwise doubles it.

4.3.2 Waveforms

(1) Shifting the cursor to ◺ , a "digital" parameter, tells you whether the sawtooth waveform generator is ON or OFF:

SAW–ON <--> SAW–OFF

Rotating the INCREMENT knob clockwise the generator ON; rotating it counterclockwise, OFF.

(2) Shifting the cursor to ⊓⊔, a "selective" parameter, tells you if the pulse waveform generator is on and, if so, what type of pulse it is generating.

PULSE–OFF <--> PULS–PW <--> PULS–PWM

If the pulse generator is OFF, rotating the INCREMENT knob clockwise turns it ON. Rotating it even further changes to pulse width modulation.

4.3.3 Brilliance

Since this parameter is "variable", shifting the cursor to VCF CUTOFF produces a display of the form "##. CUTOFF", where "##" denotes a two-digit numerical value. Rotating the INCREMENT knob clockwise increases the value and adds brilliance; counterclockwise rotation produces the opposite effect. (Playing a note while turning the knob makes this adjustment easier.)

4.3.4 ATTACK

Shifting the cursor to the ATTACK parameter in the VCA-EG section yields a numerical display of the form "##.A-ATAK". The smaller the value, the shorter the attack time. Rotating the INCREMENT knob clockwise raises the number and increases the attack time.

4.4 Storing Programmed Tones

Once you have creasted a tone that you would like to safe for instant recall at a later date, you may store it the synthesizer's memory.

NOTE: Sotring a programmed tone automatically destroys the previous memory contents, so you may want to save the current contents on tape first.

1. Program the tone.
2. Shift the MEMORY PROTECT switch to the RELEASE position, lighting the LED.

NOTE: This switch is provided to reduce the risk of accidental erasures.

3. Press the MEMORY WRITE button, lighting the LED.
4. Choose a name for the programmed tone – if desired. The IDENTIFIER section will display the prompt "NAME ?". Using the procedure outlined in the next section, enter a name made up of the letters, numbers, and symbols appearing above the keys on the keyboard.
5. Specify the BANK-TONE memory location. The MEMORY WRITE LED will go out when the tone has been stored.
6. Do not forget to return the MEMORY PROTECT switch to the PROTECT position!

4.5 Adding Names

As an aid to recall, the SX-240 permits you to label all tones, sequences, and linked sequences with meaningful names. The name automatically appears in the IDENTIFIER area each time one of these three types of data is accessed to give you an instant means of verification. Whenever you press the MEMORY WRITE button, the IDENTIFIER display changes to the prompt "NAME ?", indicating that the synthesizer is waiting for the name to be input from the keyboard. (In this case, each key has the value written on the panel immediately above it.) You may skip this step by not inputting a name; the synthesizer will then use the old name.

At the right end of the keyboard are three sets of keys with special meanings:

SPACE–Inserts space in name

BACK (=Backspace) – Erases preceding letter (for correction)

CLEAR–Erases entire name (for totally new name)

NOTE: The tape interface also allows you to assign names to sets of data ("files") stored on tape. These names may then be used to specify specific files for the LOAD and VERIFY operations.

4.6 MEMORY EXCHANGE

The MEMORY EXCHANGE function allows you to re-araange the contents of the tone memories either two tones or two banks at a time:

4.6.1 Within the Same Bank

1. Press the button for the first TONE MEMORY – "5" for example – so that the LED lights.
2. Press the MEMORY EXCHANGE button, lighting that LED.
3. Press the button for the second TONE MEMORY – "2" for example – so that the LED lights.
   When the MEMORY EXCHANGE LED goes out the contents of tone memory locations "2" and "5" in that bank will have been switched.

4.6.2 Switching Entire Banks

1. Press the button for the first BANK – "E" for example – so that the LED lights.
2. Press the MEMORY EXCHANGE button, lighting that LED.
3. Press the button for the second BANK – "A" for example – so that the LED lights.
   When the MEMORY EXCHANGE LED goes out the contents of banks "E" and "A" will have been switched.

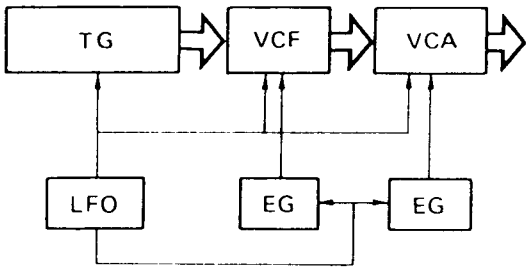
4.7 Linking Tone Data

Stored tone data for the upper and lower keyboards are linked. To demonstrate the procedure, let us link the upper data stored in Tone Memory A-2 with that for the lower keyboard stored in B-5:

1. Recall the tone data in A-2 for the upper keyboard.
2. Press the UPPER/LOWER button to change to the lower keyboard. Recall the data stored in B-5.
3. Switch back to the upper keyboard and complete the operation programming. After this procedure, selecting A-2 for the upper keyboard also automatically recalls B-5 for the lower one. You may, of course, recall other stored data for the lower keyboard at any time.

5. TONE PARAMETERS

(1) Each channel on the SX-240 combines four types of circuits so the parameters are arranged in four blocks:



TG = Tone generator – The source of the basic tone
VCF = Voltage controlled filter – Determines the timbre
VCA = Voltage controlled amplifier – Controls the volume
LFO-EG = Low-frequency oscillator & Envelope generator – Oscillators which modulate the output from the other three circuits.

(2) In the descriptions which follow, the parameters are classified into three general types with different colors for their LEDs:

D = Digital – Green LED
* The parameter has only two values: ON and OFF (sometimes abbreviated as "OF") – for example, the sawtooth waveform generator.

S = Selective – Yellow LED
* The parameter offers a choice of three settings – for example, RANGE.

V = Variable – Red LED
* The parameter offers a choice of 100 settings, from "0" to "99" (or sometimes from "–49" to "+50"). The parameter descriptions contained in this manual indicate this choice with the symbol "##".

NOTE: The interactions between parameters can be quite complex. For example, certain combinations make it impossible to generate tones. (For the original combinations stored in the memory at the factory, see the lists at the back of this Manual.)

(3) The descriptions which follow use a common format:

Parameter description	Type (D/S/V)	Name on panel	Name on IDENTIFIER screen

5.1 Tone Generator (TG)

This block controls the output from the tone generator, the source of all sound produced by the SX-240.

DCO 1 sawtooth	D	◺	SAW-OF SAW-ON

The most frequently used waveform, the sawtooth wave contains the fundamental frequency and all its overtones. it is used for simulating strings and brass instruments, for example.

DCO 1 pulse waveform	S	⊓	PULS-OFF PULSE-PW PULSE-PWM
Pulse width/Pulse width modulation	V	PW/PWM	##.PW/PWM

The width chosen for the pulse waveform has a great influence on the distribution of the overtones. Pulse width modulation uses the output of the low frequency oscillator (LFO) to vary the width and thus produce a continuously varying tone. The PW/PWM parameter controls the pulse width and the extent of the LFO modulating effect.

DCO 2 ⊓	D	DCO 2 ON/OFF	DCO-2 OF DCO-2 ON
Coarse tuning	V	COARSE	##. ±COARS
Fine tuning	V	FINE	##. ±FINE

The second oscillator, DCO 2, generates a square wave. Two tuning parameters, COARSE and FINE, adjust the interval between it and DCO 1. The former shifts the DCO 2 pitch – in steps of 50 cents – up to just over 2 octaves above or below the DCO 1 pitch. The latter shifts – in steps of 3 cents – over a range of a tone and a half on either side.

Subsidiary oscillator	D	SUB OSC	S-OSC-OF S-OSC-ON

When ON, the subsidiary oscillator generates a square wave signal with a pitch one octave lower than DCO 1.

Brass (Ring modulation)	D	BRASS	BRASS-OF BRASS-ON

When ON, the BRASS function combines the DCO 1 and DCO 2 outputs to produce a new tone source which then may be adjusted with the COARSE parameter. This is sometimes referred to as a "ring modulation" effect.

Noise level	V	NOISE LEVEL	##.NOISE

This parameter controls the amount of noise added to the tone.

Pitch range	S	RANGE	16 FEET 8 FEET 4 FEET

The SX-240 offers a choice of three pitch ranges, which together cover most of the piano's range.

LFO modulation	V	LFO	##.O-LFO

This parameter controls the amount by which the low frequency oscillator (LFO) output modulates that from the digitally controlled oscillators (DCOs). This function produces a frequency that varies cyclically.

Automatic bender	V	AUTO BEND	##.AUTBND

This parameter determines the interval which the synthesizer uses when it automatically applies the bender function. The timing is determined by the LFO DELAY parameter.

Manual bender	V	BENDER	##.O-BEND

This parameter determines the bender range for manual operation. This range can be a maximum of a fifth up or down.

5.2 Voltage Controlled Filter (VCF)

The VCF is a low pass filter that uses an input voltage to regulate the filtering of the higher frequencies and thus vary the timbre.

Cut off frequency	V	CUT OFF	##.CUTOFF

This parameter determines the dividing line for the filter. Increasing the value raises the number of overtones allowed through, increasing the tone brightness[?]. Lowering it beyond a certain point cuts out all frequencies entirely.

Resonance	V	RESO	##.RESONA

At all settings up to "98", this parameter creates a peak near the cutoff frequency – a high – frequency tone which adds a "sharpness" to the output tone. A setting of "99" yields the filter's resonating frequency.

EG modulation	V	EG	##.VCF-EG

This parameter controls modulation of the VCF output with the pattern specified in the envelope generator (VCF-EG) block.

KCV	V	KCV	##.F-KCV

The degree of key controlled voltage (KCV) modualtion normally depends on key pitch. Setting this parameter to "99" changes the modulation pattern to one that uses the same high relative pitch – for the same harmonics over the entire keyboard.

LFO modulation	V	LFO	##.F-LFO

This parameter regulates the amount by which the LFO output modulates the VCF output.

Bender	V	BENDER	##.F-BEND

This parameter determines the range for the manual bender.

5.3 Voltage Controlled Filter Envelope Generator (VCF-EG)

This circuit generates the envelopes which drive the voltage controlled filter. A new envelope is generated each time a key is pressed.

The envelope is built up using four parameters:

Attack time	V	ATTACK	##.F-ATAK
Decay time	V	DECAY	##.F-DCAY
Sustain level	V	SUSTAIN	##.F-SUST
Release time	V	RELEASE	##.F-RLS

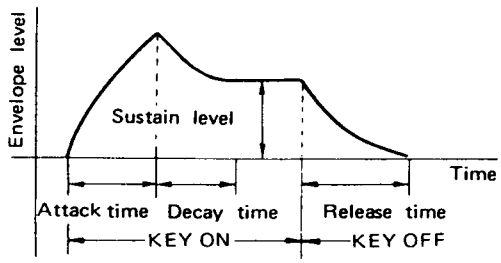
Attack time – the time taken for the envelope level to rise from the minimum to the maximum

Decay time – the time taken for the envelope level to drop from the maximum to the sustain level

Sustain level – the envelope level for the rest of the time that the key is pressed

Release time – the time taken for the envelope level to drop back to zero after the key is released

NOTE: The release time parameter is ignored when the sustain level is "0".



5.4 Voltage Controlled Amplifier (VCA)

The VCA is an amplifier which adjusts the output level in response to an input voltage – to produce a tone which varies in volume over its duration.

EG modulation	V	EG	##.VCA-EG

This parameter controls the amount by which the envelope generator (VCA-EG) modulates the VCA output.

LFO modulation	V	LFO	##.F0LFO

This parameter controls the amount by which the low frequency oscillator (LFO) modulates the VCF output.

5.5 Voltage Controlled Amplifier Envelope Generator (VCA-EG)

This circuit generates the envelopes which drive the voltage controlled amplifier. A new envelope is generated each time a key is pressed.

Attack time	V	ATTACK	##.A-ATAK
Decay time	V	DECAY	##.A-DCAY
Sustain level	V	SUSTAIN	##.A-SUST
Release time	V	RELEASE	##.A-RLS

The envelope is built up using the same four parameters used by the VCA-EG. (see Section 5.3)

5.6 LFO Trigger

When activated, the LFO synchronizes the envelope generator with low frequency oscillator – to produce an intermittent sound such as the one coming from a mandolin.

LFO trigger	D	LFO TRIG	L-TRG-OF L-TRG-ON

5.7 High Pass Filter (HPF)

The high pass filter is the opposite of the cutoff filter; it eliminates the lower frequencies to produce a more brittle sound.

High pass filter	V	HPF	##.HPF

The parameter determines the cutoff frequency.

5.8 Ensemble

Ensemble	D	ENSEM	ENSEM-OF ENSEM-ON

When activated, this function adds chorusing to the output – an effect which is even more pronounced when stereo reproduction is being used.

5.9 Low Frequency Oscillator (LFO)

This low-frequency oscillator is used to directly modulate the DCO, VCF, and VCA outputs and as a trigger for the envelope generator.

LFO Speed	V	SPEED	##.LFOSPD
Delay	V	DELAY	##.DELAY
Wave form	S	WAVE FORM	LFO-⊓⊓⊓⊓ LFO-/\/\/\ LFO-TRI
Reverse	D	REVERSE	REVSE-OF REVSE-ON

The output is built up from four parameters:

SPEED – The output frequency (1 Hz – 20 Hz)

DELAY – Time interval between the pressing of the key and the start of the modulation.

WAVE FORM – There are three waveforms available: Square, sawtooth, and triangular.

REVERSE – When activated, this function inverts the shape of the output.

5.10 Other, Miscellaneous Parameters

The remaining parameters have already been described in previous Chapters, so they appear here only in tabular form.

Keyboard assignment	S	KYBD ASSIGN	MONO POLY-4 POLY-8
Chord memory	D	CHORD MEMORY	CHORD-OF CHORD-ON
Portamento/Glissando speed	V	PORTA SPEED	##.PORTA
DCO split assignment	S	SPLIT ASSIGN	SPLIT6-2 SPLIT4-4 SPLIT2-6
Sequencer beat pattern	S	BEAT	1 BEAT 3 BEAT 4 BEAT
Recording and playback tempo	V	TEMPO	##.TEMPO
Tuning	V	TUNE	##±TUNE

6. MUSICAL INSTRUMENT DIGITAL INTERFACE (MIDI)

The Musical Instrument Digital Interface (MIDI) converts the electronic control signals required to operate an electronic instrument to and from an internationally recognized digital form for transmission purposes. While the scope of control information covered by the standard is quite broad, the SX240 has implemented four types:

* Keyboard ON/OFF
* Bender UP/DOWN
* Tone Change
* Release ON/OFF (from Serial Number K6897)

The SX-240 MIDI also recognizes clock START/STOP signals, which may be accessed with the EX.TEMPO mode.

NOTE: The EX.TEMPO mode accepts both an external clock signal and the MIDI clock signal but assign priority to the MIDI clock. Once it receives a MIDI clock signal, it no longer accepts the external clock. The only way to cancel this function and use an external clock signal is to switch to another TEMPO – 1.TEMPO, for example – and then back to EX.TEMPO.

6.1 Connecting Terminals

This interface uses three terminals:
MIDI IN – Accepts external control signals
MIDI OUT – Outputs SX-240 control signals
MIDI THRU – Outputs the same signal as received through MIDI IN

6.2 Linking Two SX-240s

1. Joint the MIDI OUT terminal of one SX-240 (the "Master") to the MIDI IN terminal of the other (the "Slave").
2. Set up both synthesizers so that they are ready to play.
3. Play something on the Master. The Slave will produce the same output.
4. Change the Master to a preprogrammed tone. The Slave will change to the same tone – which might have different contents.
5. Operate the Master's manual bender. The Slave's bender will operate as well.

NOTE: The programmed tone stored in the Master's memory must set the BENDER parameter(s) for this to happen.

NOTE: These three control links, tone change, bender and release can be cancelled. When first applying the power, hold down the "F" bank key to cancel the first, the "E" bank key to cancel the second and the "D" bank key to cancel the third.

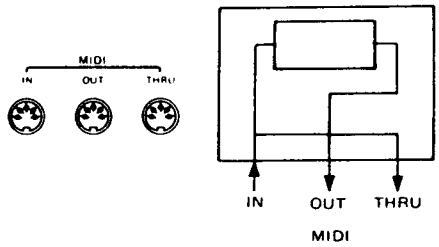
6.3 Linking Three SX-240s

1. Join the MIDI OUT terminal of the Master to the MIDI IN terminal of the first Slave.
2. Join the MIDI THRU terminal of the first Slave to the MIDI IN terminal of the second Slave.
3. Set up all three synthesizers so that they are ready to play.
4. Play something on the Master. The Slaves will produce the same output.

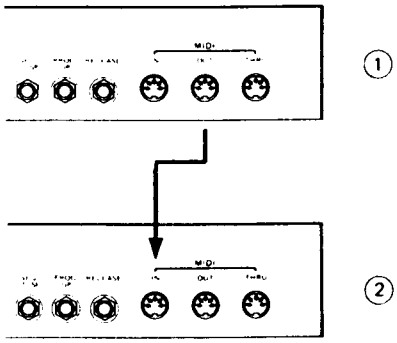
6.4 Linking to Sequencers and Other Equipment

The SX-240 MIDI conforms to international standards so sequencers and equipment made by other manufacturers may be connected in the same fashion as in Sections 6.2 and 6.3. Unless a feature has been implemented on both sides, however, the corresponding signals will be simply ignored.
In particular, only channel #1 is used. Each tone has been assigned a number – from "0" for A-1 to "47" for F-8.

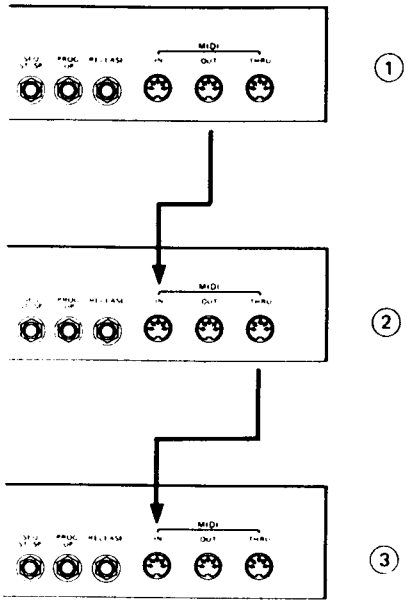
6.1



6.2



6.3



7. TAPE INTERFACE

By attaching a tape recorder or similar device, you can transfer the tone and sequence data stored in the SX-240's memory to tape and thereby build up your own virtually unlimited stock of sounds.

7.1 SAVE

"SAVE" is the word used to describe the process of transferring data from the SX-240 memory to cassette tape. The "SAVE" procedure automatically saves both sequencer data and tone memory data.

Procedure:

1. Connect your tape recorder to the jack labelled "TO TAPE".
2. Prepare your tape recorder for recording.
3. Press the TAPE ENABLE button. The LED in this button will light and so will all those in the BANK-TONE MEMORY area.
4. In response to the prompt "NAME ?" which appears in the IDENTIFIER section, enter a file name of your choice (up to 8 characters) using the keys on the keyboard.
5. If you wish to save all data, proceed to step 6. If you wish to save only selected banks, press the buttons corresponding to those banks of data which you DO NOT want to save, turning off their LEDs. (Only the data corresponding to those remaining lit will be saved.)
6. Start the tape recorder.
7. Press the SAVE button. Its LED will light and the IDENTIFIER display will change to "SAVE".
8. Wait. When the synthesizer has finished saving the data, it will deep and change the IDENTIFIER display to "STOP".
9. Rewind the tape and VERIFY the data using the procedure outlined in Section 7.3.

7.2 LOAD

"LOAD" is the word used to describe the process of transferring data from tape to the SX-240.

Procedure:

1. Connect your tape recorder to the jack labelled "FROM TAPE".
2. Prepare your tape recorder for playback.
3. Press the TAPE ENABLE button. The LED in this button will light and so will all those in the BANK-TONE MEMORY area.
4. In response to the prompt "NAME" ?" which appears in the IDENTIFIER section, enter the name of the file to be loaded – using the keys on the keyboard.

NOTE: If no name is entered, the synthesizer will load the first file on your tape.

5. If you wish to load all data, proceed to step 6. If you wish to load only selected banks, press the buttons corresponding to those banks of data which you DO NOT want to load, turning off their LEDs. (Only the data corresponding to those remaining lit will be loaded.)
6. Press one of the LOAD buttons – TONE LOAD or SEQ LOAD. Its LED will light and the IDENTIFIER display will change to "LOAD".
7. Start the tape recorder.
8. Wait. When the synthesizer has finished loading the data, the IDENTIFIER display will change to "STOP".
9. Stop the tape recorder. The synthesizer should beep once and change the IDENTIFIER display to "OK", signifying the end of loading.

NOTE: If the beeping is continuous and the IDENTIFIER display changes to "ERROR", something has gone wrong with the data transmission. Rewind the tape, adjust the tape recorder's output level, and try again.

7.3 VERIFY

"VERIFY" is the word used to describe the process of checking the data stored on the tape to that in the SX-240 memory.

Procedure:

1. Connect your tape recorder to the jack labelled "FROM TAPE".
2. Prepare your tape recorder for playback.
3. Press the TAPE ENABLE button. The LED in this button will light and so will all those in the BANK-TONE MEMORY area.
4. In response to the prompt "NAME ?" which appears in the IDENTIFIER section, enter the name of the file to be verified – using the keys on the keyboard.

NOTE: If no name is entered, the synthesizer will verify the first file on the tape.

5. Press the buttons corresponding to those sets of data which you DO NOT want to verify, turning off their LEDs. (Only the data coresponding to those remaining lit will be verified.)
6. Press the VERIFY button. Its LED will light and the IDENTIFIER display will change to "VERIFY".
7. Start the tape recorder.
8. Wait. When the synthesizer has finished verifying the data, the IDENTIFIER display will change to "STOP".
9. Stop the tape recorder. The synthesizer should beep once and change the IDENTIFIER display to "OK", signifying the end of verification.

NOTE: If the synthesizer detects a discrepancy between the memory contents and the tape contents, it will beep continuously and display the word "ERROR" in the IDENTIFIER section.

The SAVE, LOAD, and VERIFY operations each require on the order of one minute to complete. They may be interrupted at any time by pressing the TAPE ENABLE button.

SPECIFICATION

TYPE	8 VOICE PROGRAMMABLE POLYPHONIC SYNTHESIZER	
KEYBOARD		61 KEYS
	KEYBOARD ASSIGN	NORMAL SPLIT DUAL
	SPLIT ASSIGN	SPLIT 6-2 SPLIT 4-4 SPLIT 2-6
TONE GENERATOR	DCO 1	 PW/PWM
		SUB OSC
	DCO 2	( ) COARSE FINE
	BRASS	
	NOISE	
	RANGE	16' 8' 4'
	LFO	
	AUTO BEND	
	BENDER	
VCF	CUT OFF	
	RESONANCE	
	EG	MODULATION
	KCV	
	LFO	
	BENDER	
VCF-EG	ATTACK	
	DECAY	
	SUSTAIN	
	RELEASE	
VCA	EG	MODULATION
	LFO	
VCA-EG	ATTACK	
	DECAY	
	SUSTAIN	
	RELEASE	
HPF		
LFO	SPEED	
	DELAY	
	WAVE FORM	
		REVERSE
		LFO TRIGGER

EFFECT	PORTAMENTO	UPPER
	GL ISSANDO	
	SPEED	
	HOLD	
	OCT. UP	LOWER
	HOLD	
MEMORY	48 TONE MEMORIES	
	8 SEQ. MEMORIES	
	MEMORY WRITE	
	MEMORY EXCHANGE	
	MEMORY PROTECT	
SEQUENCER	BEAT	
	TEMPO	
	START/STOP	
	BREAK	
	REPEAT	
	OFFSET	
	LINK	
TAPE INTERFACE	TAPE ENABLE	
	SAVE	
	TONE LOAD	
	SEQ. LOAD	
	VERIFY	
CONTROLLER	MASTER VOLUME	
	LOWER VOLUME	
	TUNE	
	BENDER	
	LFO DISABLE/START	
	RELEASE	
	PROGRAM UP	
	SEQ. START/STOP	
	INCREMENT	
	FAST/VIEW	
	UPPER/LOWER SELECT	
IDENTIFIER	8 CHARACTER UPPER/LOWER	
REAR PANEL	MIDI	IN OUT THRU
	RELEASE	
	PROGRAM UP	
	CLOCK	IN OUT
	TAPE	FROM TO
	SIGNAL OUT	PHONES LEFT RIGHT LEVEL SELECT

VOLTAGE & FREQUENCY	JAPAN	USA, CAN	FRANCE	EUROPE	KU; AUS	KWAIT	FAR EAST etc.	
	100 V	117 V	220 V	220/240 V	240 V	110/240 V	110/220 V	50/60 Hz
POWER CONSUMPTION	38W							
DIMENSION & WEIGHT	886(W), 380(D), 130(H) mm 12.9 kg							

SOUND SAMPLE

NAME			MOVIN	SRTINGS	HISTRING	BOWCELLO	BRASS-1	T*BOLBY	CELESTE	DIGIBASS	DOGHOUSE	MUSHROOM	MEATY	PICKBASS
TONE MEMORY														
TONE GENERATOR	DCO 1	◿	•	•	•		•	•	•		•	•	•	•
		⊓				•			•					•
		⊓̃	•	•	•			•		•	•	•	•	
		PW/PWM	82	99	99	86		99	62	33	74	73	79	98
		SUBOSC						•	•	•				
	DCO 2	(⊓)	•							•	•	•	•	•
		COARSE							48–					24–
		FINE	3+		3+		3+	3+		5+	5+	5+	5+	
	RANGE	16'	•			•	•			•	•	•	•	•
		8'		•				•						
		4'			•				•					
		LFO				2	6							
		AUTO BEND				3				48	28			
		BENDER	30			29	30				30	30	30	
		BRASS	•		•		•	•	•	•	•	•	•	•
		NOISE												
VCF		CUT OFF	35	60	64	46	4	93	16	5	3	4	4	22
		RESONANCE			7			7				14		
	MOD	KCV	20	25	35	26	34	35	62	30	20	37	37	40
		LFO	81							10		99	50	
		BENDER	37	12	12	12		12		55	21	55		81
		EG	39			27	99		38	73	30	99	83	99
VCF-EG		ATTACK				14	7					91		
		DECAY				24	30		52	60	61		31	24
		SUSTAIN	31			15	78		42	7	12	95	50	
		RELEASE	59				38		91	60	60	60	50	50
VCA	MOD	LFO							44					
		EG	35	40	35	75	45	12	40	30	60	40	60	65
VCA-EG		ATTACK		64	64	45	3	40					3	3
		DECAY	80						67	80	83			61
		SUSTAIN	60	99	99	99	99	99		58	62	99	99	
		RELEASE	40	53	53	30	35	53	68	45	45	45	58	34
LFO TRIGGER														
HPF														
ENSEMBLE				•	•			•						
LFO		SPEED	38	70	70	88	87	70		57	57	24	33	
		DELAY				57				13	13	82		
	WAVE FORM	⊓												
		◿												
		⌒	•	•	•	•	•	•	•	•	•	•	•	
		REVERSE												
		DISABLE					•							
KYBD ASSIGN		POLY 8	•	•	•		•						•	•
		POLY 4				•			•	•		•		
		MONO						•			•			
CHORD MEMORY						•		•	•	•	•	•		
UPPER		PORTAENTO										•		
		GLISSANDO												
		SPEED										80		
		HOLD												
		OCT UP												
LOWER		HOLD												

* This data is not the data stored on the cassette tape.

SOUND SAMPLE

NAME			CLAVINET	WAH-CLAV	ELCPIANO	FLUTE	VIBES	VIBE-PT2	PIANO 1	PIANO 2	STEELDRM	LEADMONO	AUTOBEND	LEADLINE
TONE MEMORY														
TONE GENERATOR	DCO 1	/\				•				•		•	•	
		⊓	•	•	•		•		•	•	•			•
		⊓ꜜ										•	•	
		PW/PWM	98	98	97				77	77	63	65	40	40
		SUBOSC								•		•		
	DCO 2	(⊓)			•		•	•				•	•	
		COARSE					38+	35+			36+	48+		
		FINE			2+	1−	3+		2+	2+		1+	4+	4+
	RANGE	16'	•	•			•					•	•	•
		8'			•	•			•	•	•			
		4'						•				12		14
		LFO	2	2									22	
		AUTO BEND										29	30	30
		BENDER	29	29		30								
		BRASS			•	•			•	•	•	•		•
		NOISE										20		
VCF		CUT OFF	24	24	8			26			7	29	45	12
		RESONANCE												
	MOD	KCV	18	18	3	54	25	21	16	6	34	32	42	42
		LFO												
		BENDER												
		EG	81	79	71	55	58	62	71	58	60		86	73
VCF-EG		ATTACK				17								
		DECAY	60	46	90	30	60	45	90	90	57		34	
		SUSTAIN	10	38	25	55	45	1	25	25	27		13	65
		RELEASE	56	29	99	43	83	70	99	99	65		37	37
VCA	MOD	LFO	20	20	44	49	42				20			
		EG	60	99	90	99	60	11	70	70	70	18	30	18
VCA-EG		ATTACK			1	52			1	1				
		DECAY	75	75	59			55	82	82	75			
		SUSTAIN			45	99	99					99	99	99
		RELEASE	20	20	26	33	68	86	49	49	65	67		
LFO TRIGGER											•			
HPF													32	32
ENSEMBLE														
LFO		SPEED		53	88	87	80	17			99	91	72	91
		DELAY	57	57		53	25	25				15	25	
	WAVE FORM	⊓	•								•			
		/\		•	•	•	•	•				•	•	•
		REVERSE												
		DISABLE									•	•		•
KYBD ASSIGN		POLY 8	•	•	•	•	•	•	•		•		•	
		POLY 4								•				
		MONO										•		•
CHORD MEMORY										•		•		•
UPPER		PORTAENTO										30		
		GLISSANDO												
		SPEED												
		HOLD												
		OCT UP												
LOWER		HOLD												

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