YAMAHA

DX7

DIGITAL PROGRAMMABLE ALGORITHM SYNTHESIZER

Operating Manual

CONGRATULATIONS

Thank you for choosing the Yamaha DX7 Digital Programmable Algorithm Synthesizer. The DX7 employs unique and sophisticated FM digital tone generation technology combined with microcomputer control to permit creation of voices that are more "live" than voices available with any other system available.
We urge you to read this owner's manual thoroughly to ensure proper operation and maximum performance of the instrument.

FEATURES

- The DX7 has a 32-voice internal memory, while external cartridges can be plugged in to provide an extra 96 voices, making a total of 128 voices available to the performer for instant selection.
- Extensive microcomputer programming control makes it possible to edit existing voices to change their character, or produce entirely new voices. New voices can also be created "from scratch."
- Edited or new voices can be stored either in the instrument's internal memory, or in an optional external memory cartridge, so sounds you create can be saved for future use.

CONTENTS

PRECAUTIONS

LOCATION
Avoid placing your synthesizer in direct sunlight or close to a source of heat. It is also important to avoid locations in which the instrument is likely to be subjected to vibration, excessive dust, cold or moisture.

HANDLING
Avoid applying excessive force to the instruments's knobs and switches.

POWER CORD
Always grip the power plug directly when unplugging. Removing the power plug from the wall socket by pulling on the power cord can result in damage to or shorting of the power cord.
Be sure to unplug your synthesizer if you will not be using it for an extended period of time.

RELOCATION
When moving the synthesizer once it has been set up, be sure to disconnect all cords that connect to other equipment. This will help prevent accidental damage to or shorting of interconnection cables.

CONNECTION
Carefully follow the "CONNECTION" instructions given in this manual when setting up your synthesizer.
Connection errors can lead to serious damage to the instrument, amplifier, and speakers.

CLEANING
Do not use solvents such as benzine or thinner to clean your synthesizer as these may cause discoloration or staining of the instrument's exterior. Use a soft, dry cloth.

SAVE THIS MANUAL
After studying this manual thoroughly, it should be stored in a safe place for future reference.

LIGHTNING
In the event of an electrical storm, the instrument's power cord should be unplugged to eliminate the possibility of serious damage.

OTHER APPLIANCES
Use your synthesizer where its digital circuitry cannot be influenced by electromagnetic radiation from appliances such as televisions, radios, etc.

DX7 OUTLINE

As stated in the feature summary on page 1, the DX7 can be used to play pre-programmed voices, pre-programmed voices can be edited to alter their character, or completely new voices can be created from scratch. Newly created voices can be memorized for future use.
To accomplish all this, the DX7 has four main operating modes:

- **PLAY-MEMORY SELECT Mode**

This is the normal performance mode, and the mode in which pre-programmed voices can be selected.

- **FUNCTION Mode**

This mode permits setting parameters pertaining to the effect of the controllers (thumbwheel, foot controller, breath controller, key after touch) and is also used for loading and saving data.

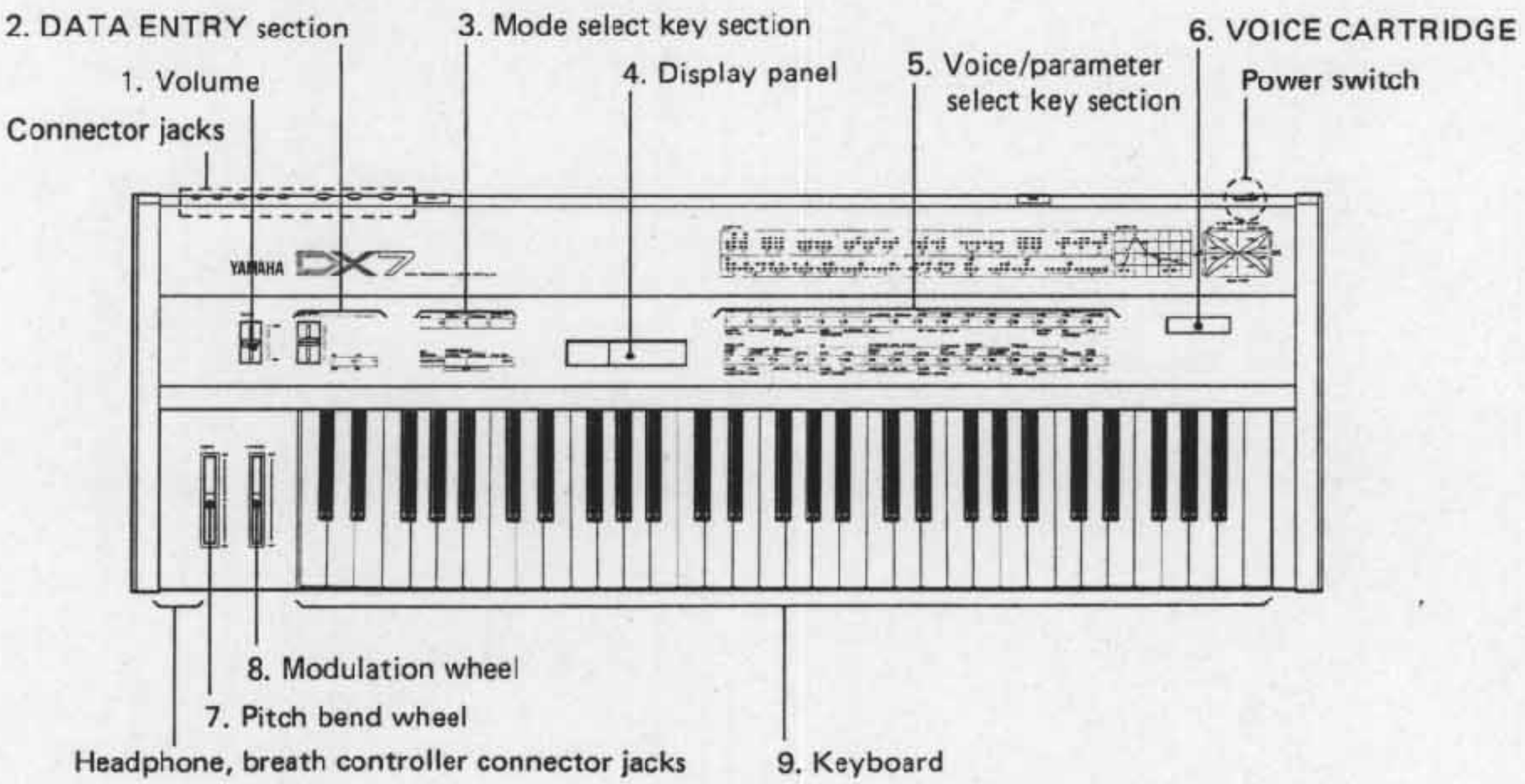
- **EDIT Mode**

This mode permits editing existing voice data to create new sounds as well as creation of entirely new voices.

- **STORE Mode**

Edited or newly created voices can be programmed into the memory in this mode.

All functions of the DX7 are performed in one of the above modes. Proper understanding of the functions of each mode is the key to successful operation of and performance with the DX7.

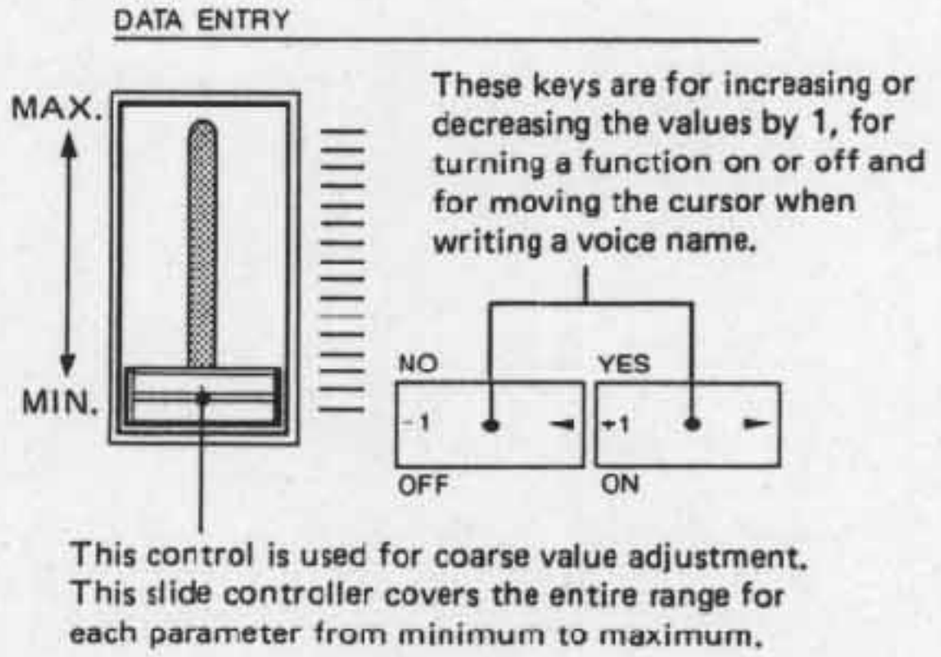


1 VOLUME

This controls the output level of the DX7 and at the same time controls the volume of the headphones.

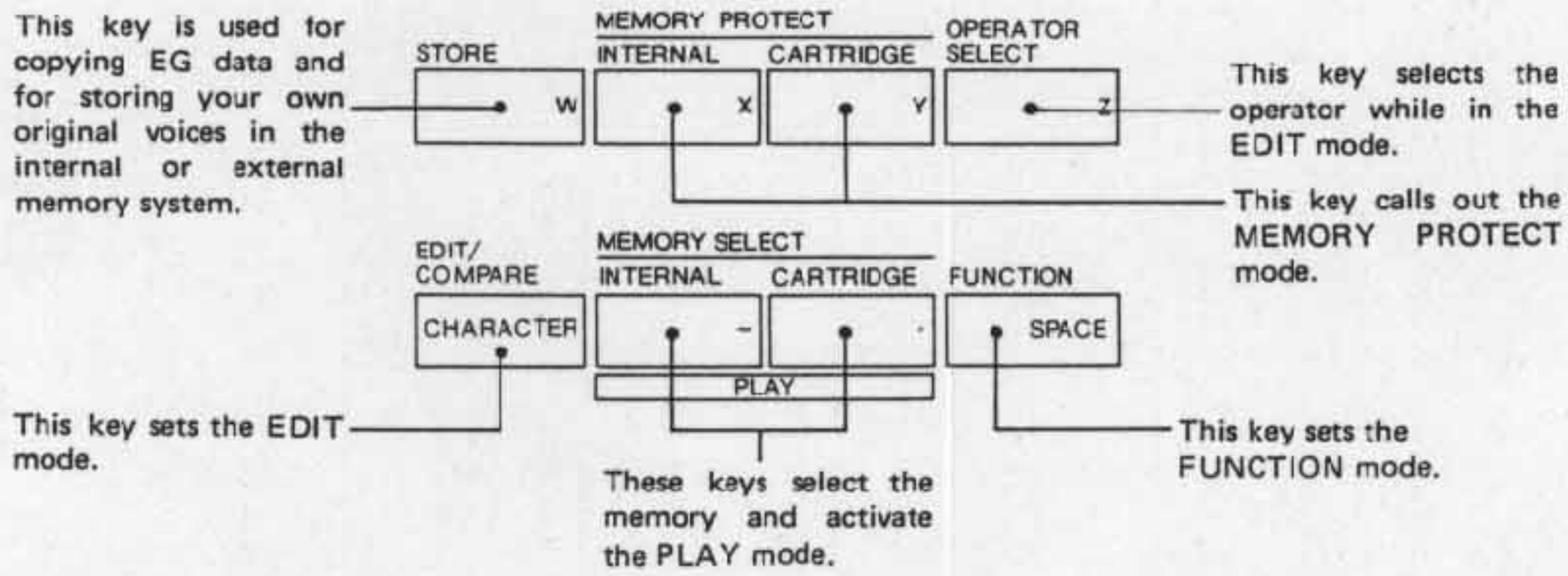
2 DATA ENTRY

This combination of keys and linear control is used to enter and modify data.



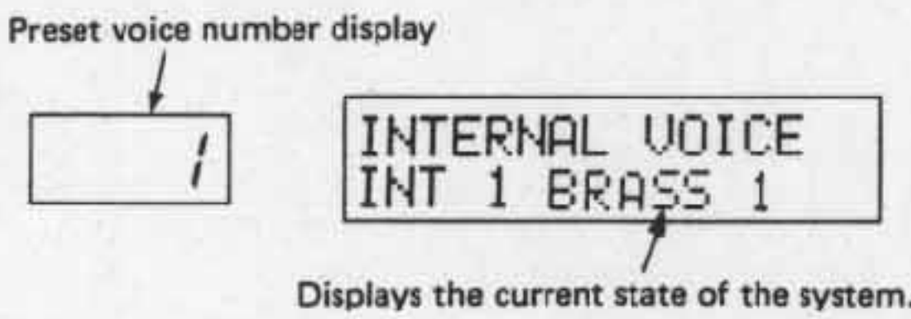
3 MODE SELECT KEY

Selects the operating mode, "operators" (these will be explained later) and memory protect functions.



4 DISPLAY PANEL

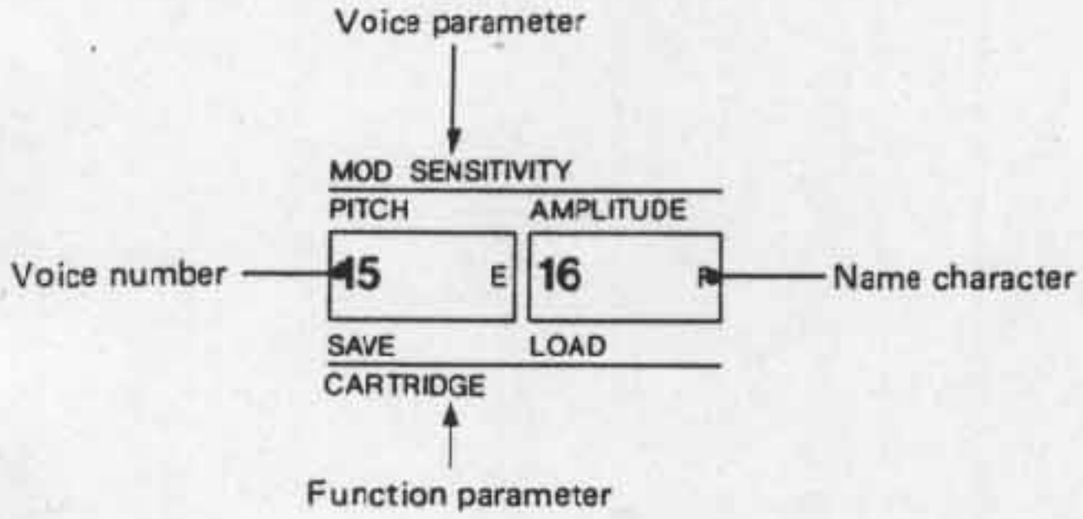
This Liquid Crystal Display panel displays the parameters in each mode and the name of the selected pre-programmed voice.



5 VOICE/PARAMETER SELECT KEY

These keys select either the voices in the instrument's internal memory or those in an external voice cartridge. The same keys are also used to select parameters in the FUNCTION or EDIT modes. One key can have a maximum of four different functions.

The function of these keys is determined by the MODE SELECT key.



6 VOICE CARTRIDGE

External voice cartridges can be plugged into the receptacle in the DX7 panel. The DX7 is supplied with two ROM (pre-programmed) voice cartridges, each containing 64 voices.

An optional RAM (user programmable) voice cartridge can contain 32 voices.

7 PITCH BEND WHEEL

The pitch bend range is set in the FUNCTION mode. The pitch bend wheel then permits upward and downward pitch bend throughout the set range.

8 MODULATION WHEEL

The modulation depth range is set in the function mode. The modulation wheel then permits variation of modulation depth throughout the set range.

9 KEYBOARD

The DX7 has a 61-key keyboard with 16-voice polyphonic capability (a monophonic mode is also selectable).

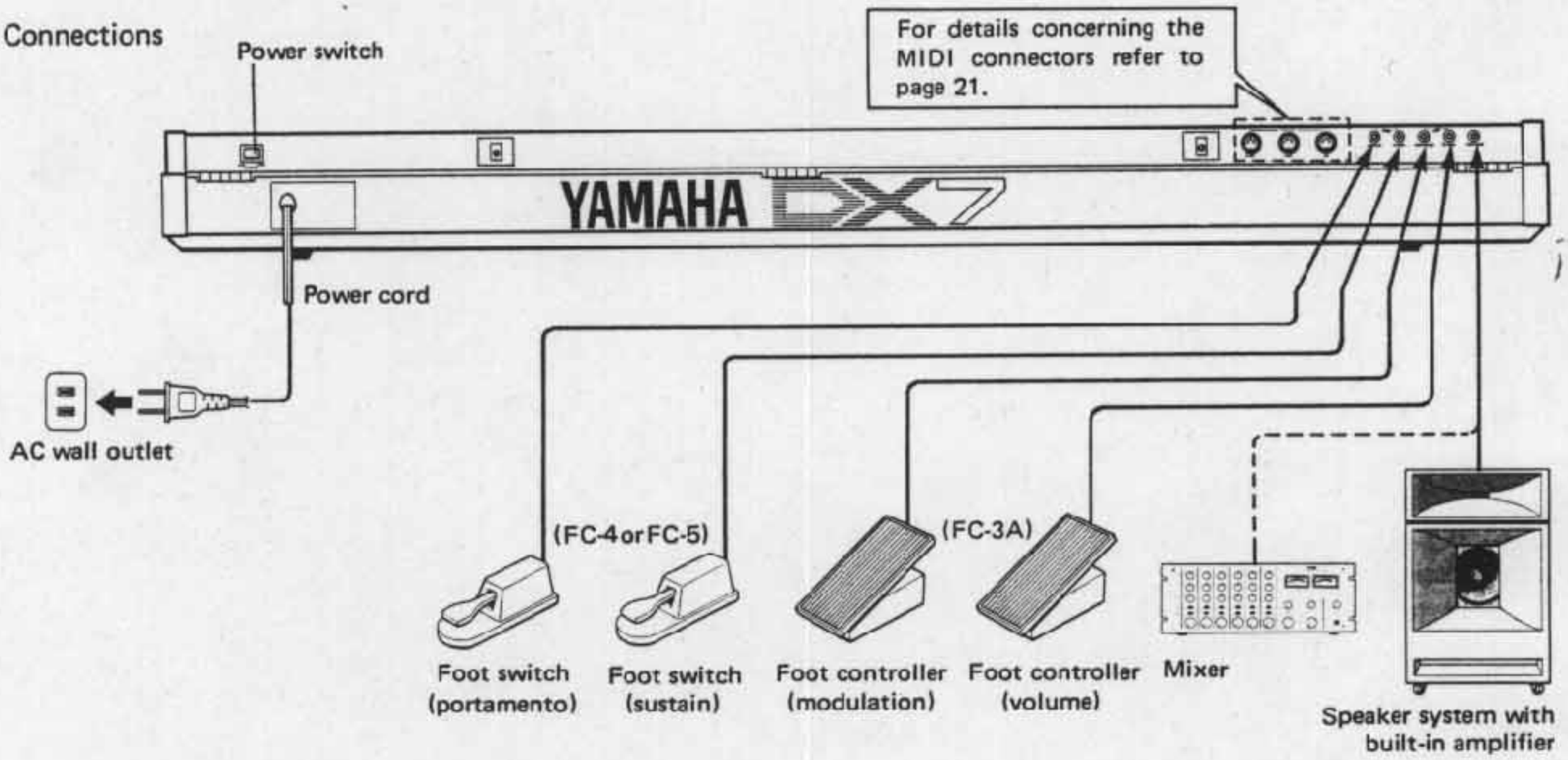
- Initial/After Touch response provided.

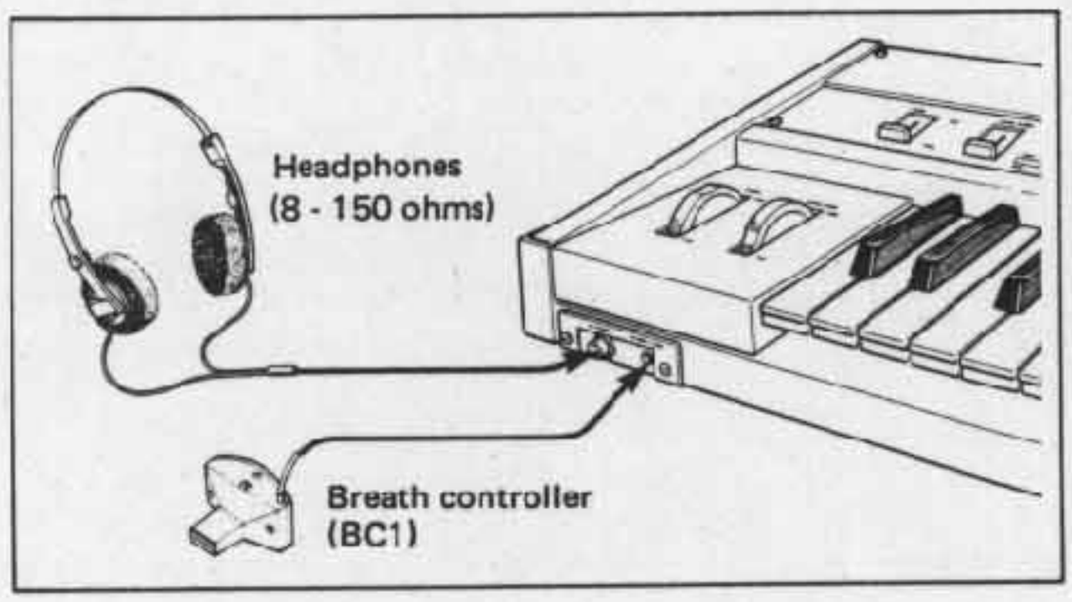
CONNECTIONS

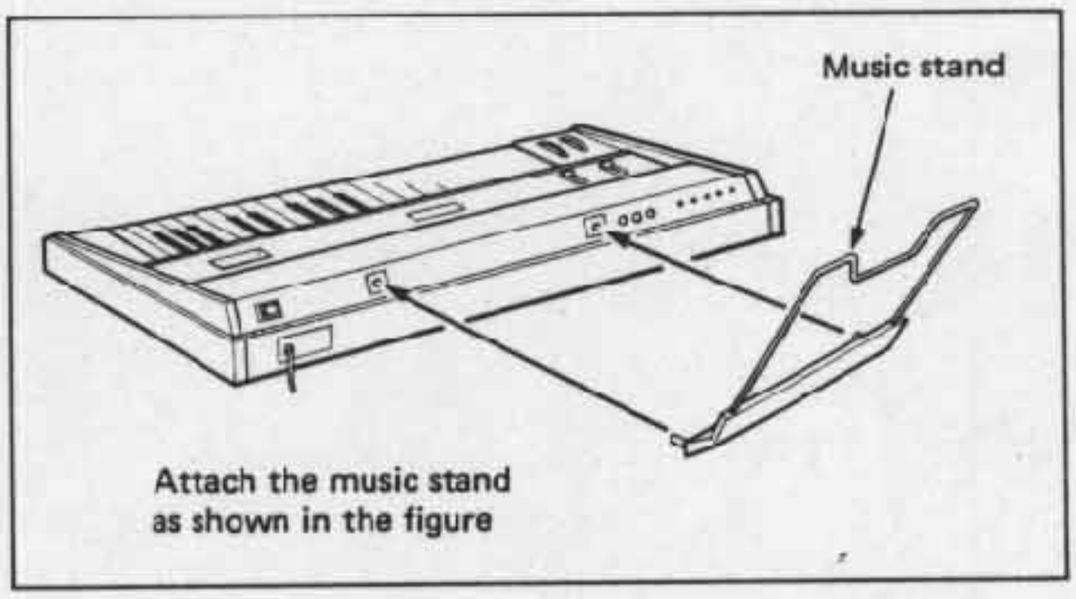
- **Setting Up and Applying Power**

The DX7 does not have an internal power amplifier, therefore either headphones or an external amplifier/speaker system are required. A high-quality keyboard amplifier system is recommended.
Hook up your DX7 as shown in the diagram below.

Connections

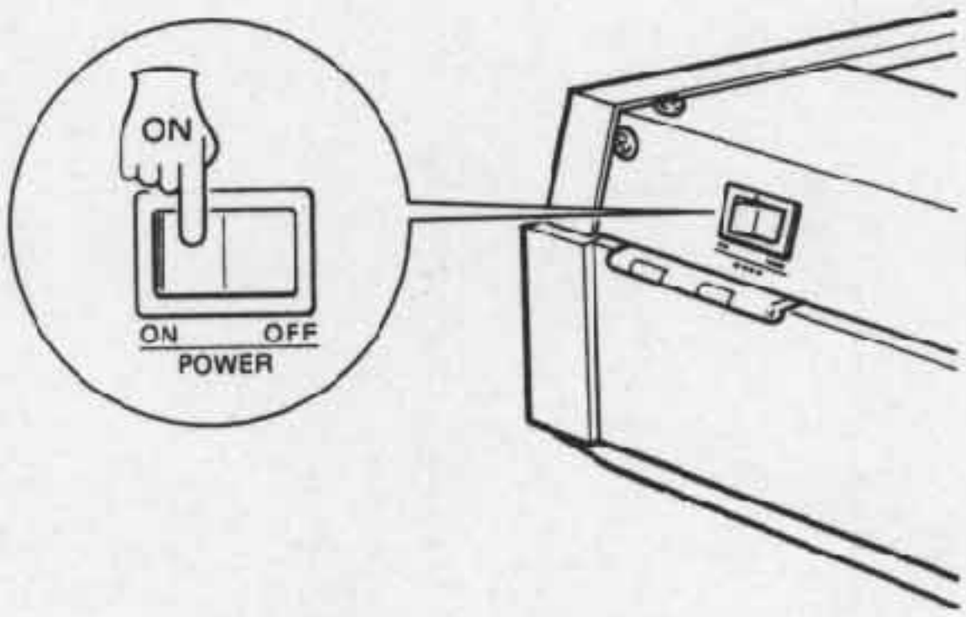






- **Turn POWER ON**

The DX7 power switch is located to the right of the rear panel (viewed from keyboard side). Turn the power switch ON only after all connections to other equipment (and to the AC supply) have been properly made. The display panel will appear as in the illustration below immediately after power is switched on.
After a few seconds, the same mode that was engaged before power was turned off is re-engaged. For example, if the PLAY mode was previously engaged, the PLAY mode will be re-engaged and the previously selected voice will be ready for performance. The same applies to the EDIT and FUNCTION modes.

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* YAMAHA DX7 *
* SYNTHESIZER *
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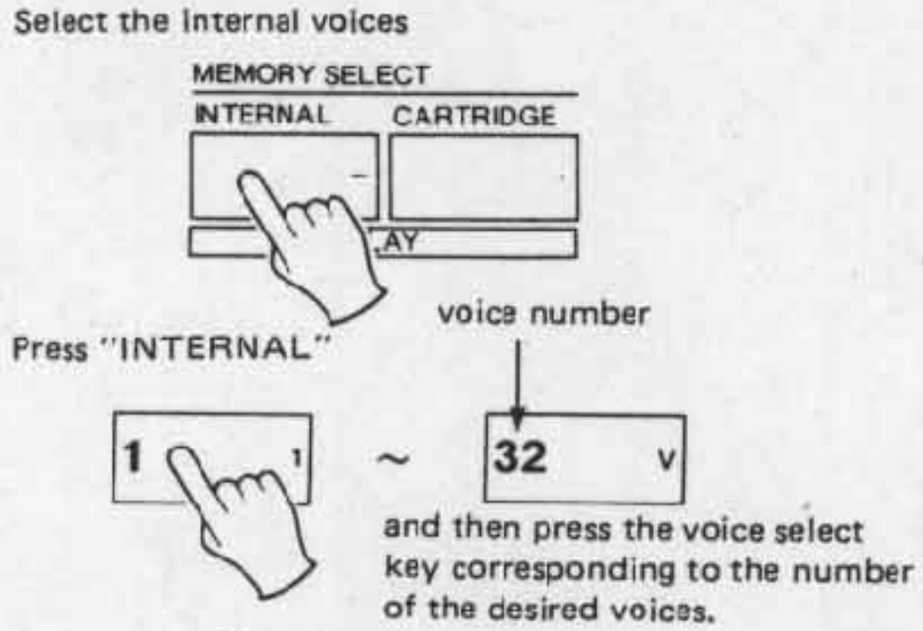
PLAY MODE

• Playing the Internal Voices

The DX7 has 32 internal voices, any one of which can be selected simply by pressing the [INTERNAL] key in the MEMORY SELECT group, and then by pressing the appropriate VOICE SELECT key.

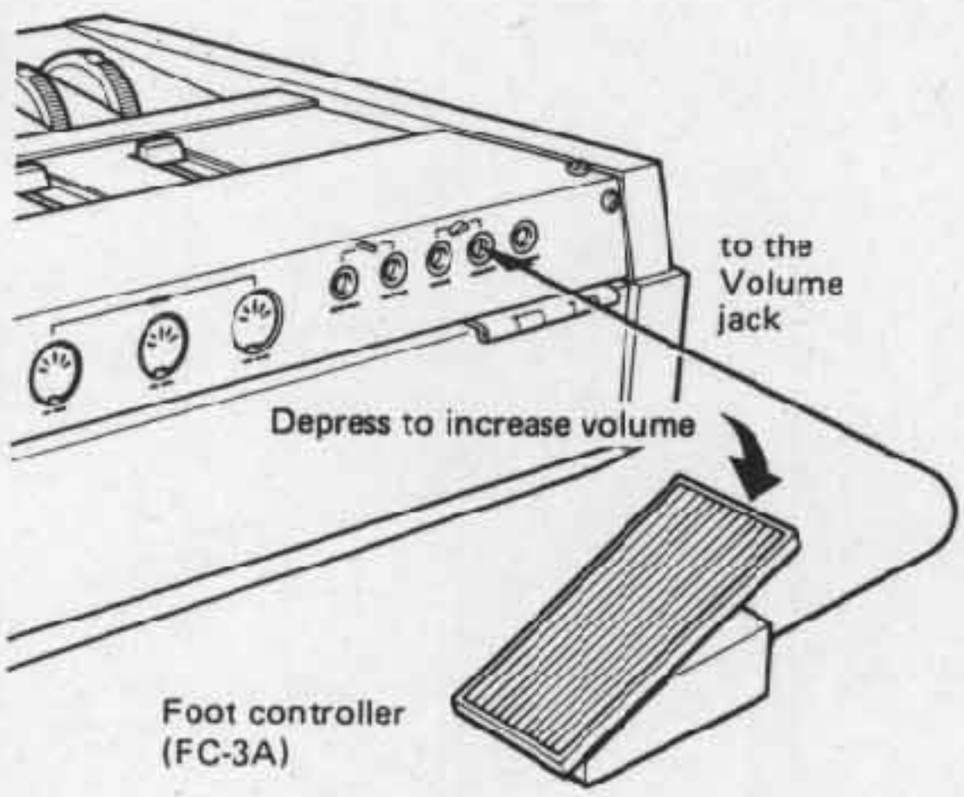
Each VOICE SELECT key has a large numeral that corresponds to the voice number at its left edge.



• Set the desired VOLUME level

With power to the DX7 and your amplifier system ON, gradually raise the volume control while playing a note on the keyboard until the desired volume level is reached. Set the volume control on your amplifier so the optimum volume is attained with the DX7 volume control set about "8".

Fine adjustment of volume while playing can be achieved using an optional FC-3A foot controller plugged into the VOLUME jack on the DX7 rear panel. Remember that the DX7 and amplifier volume controls should be set high enough that adequate volume control range is available using the foot controller.



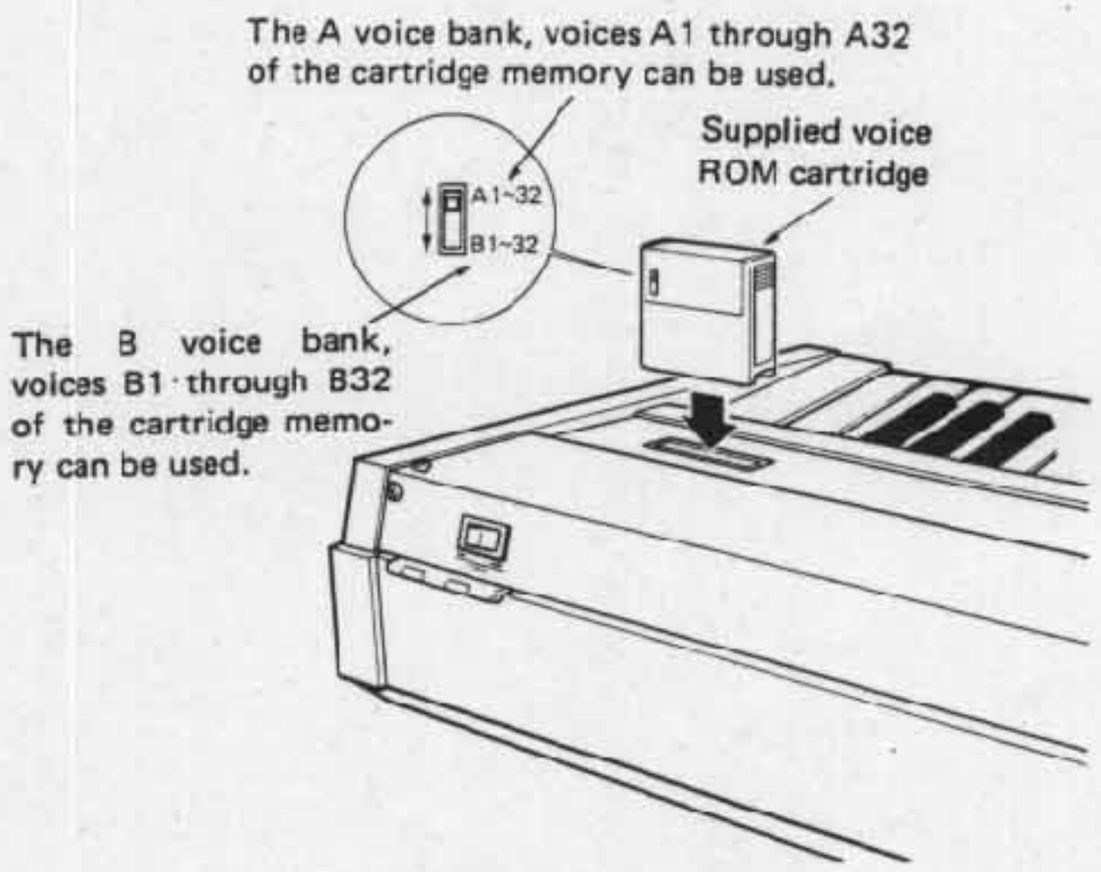
• Playing the Cartridge Voices

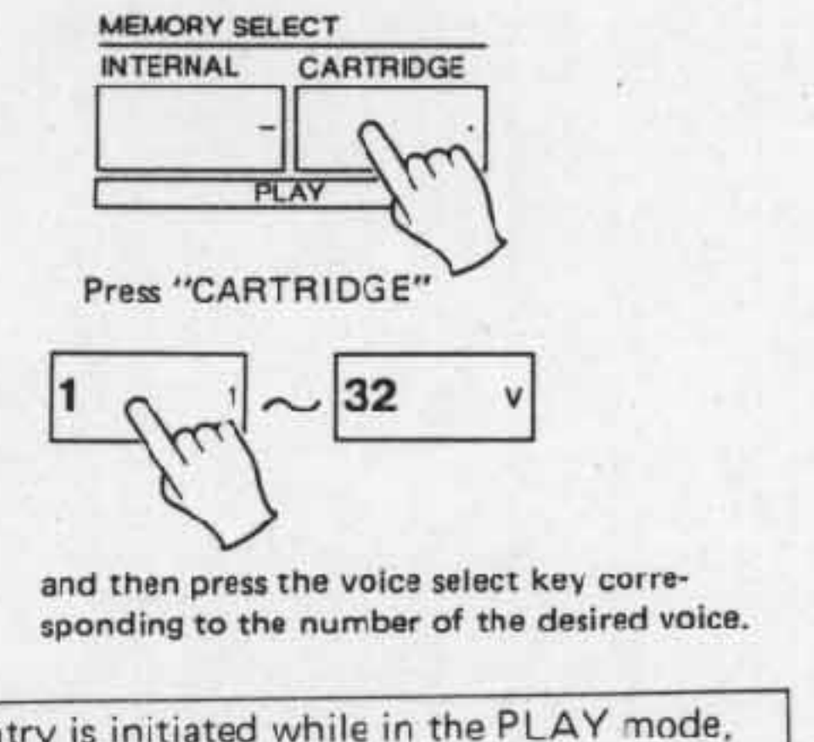
An extra 64 voices can be added to the available selection simply by plugging in one of the supplied external voice cartridges.

Insert a cartridge as shown in the figure.

Select the cartridge voices by first presseing the [CARTRIDGE] key in the MEMORY SELECT group, and then select the desired voice by pressing the appropriate VOICE SELECT key, just as in internal voice selection.

Selection of cartridge voice groups A1 – A32 and B1 – B32 is accomplished using the selector switch on the cartridge.





When data entry is initiated while in the PLAY mode, the parameter selected at the end of the FUNCTION mode can be controlled.

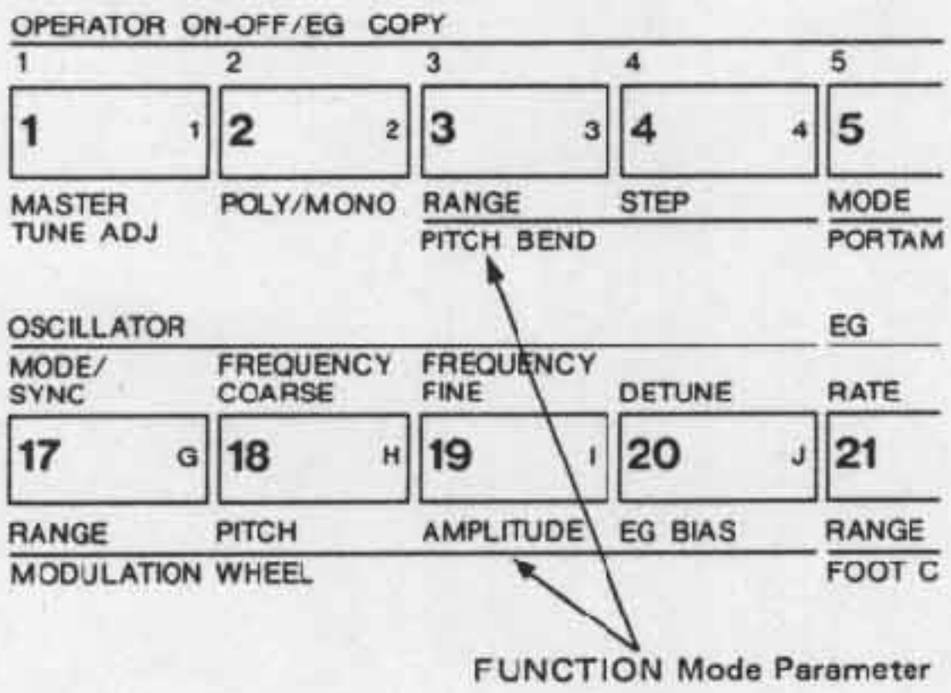
FUNCTION MODE

- **FUNCTION Mode . . . . Applying Effects**

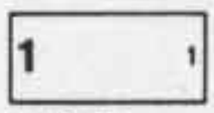
The FUNCTION mode permits tuning, pitch bend, modulation, and application of other effects while playing, as well as voice data load/save operations.

Press the [FUNCTION] key to enter the FUNCTION mode. Setting controller range parameters, etc., is carried out using the DATA ENTRY controls.

- **Function parameters are memorized and maintained even when power to the DX is cut off. Unlike voice data, however, function parameters cannot be saved in internal or external memory.**

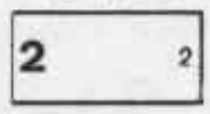


- **MASTER TUNE**



MASTER TUNE adjusts the overall tuning of the DX7 to match its pitch with other instruments. Pitch is variable over a 150 cent range. Press [MASTER TUNE] and then use the liner DATA ENTRY control for tuning.

- **POLY/MONO**



Determines whether the DX7 will function in the polyphonic or monophonic mode. Press the DATA ENTRY [−1] key for polyphonic operation, and the [+1] key for monophonic operation.

- **The range of the portamento effect is different in the polyphonic and monophonic modes. Refer to the PORTAMENTO section below.**

- **PITCH BEND**

Two keys are used to determine the effect of the PITCH BEND thumbwheel.

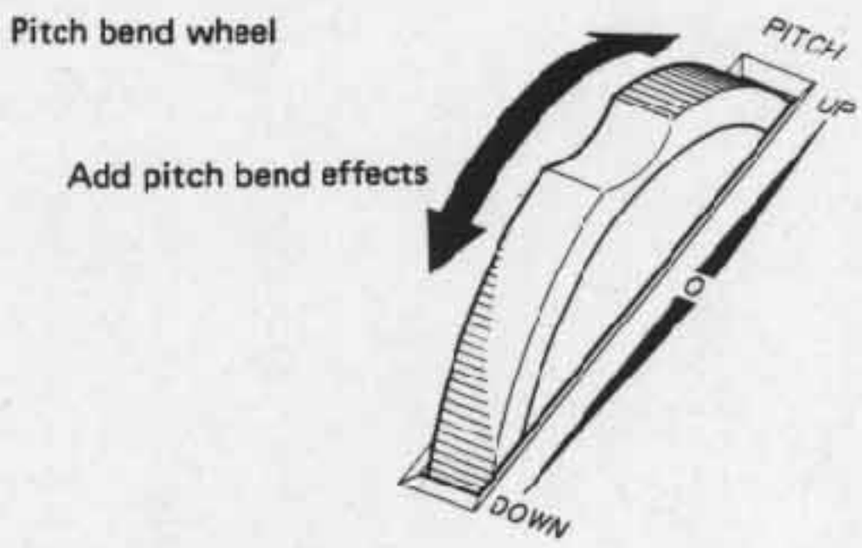
RANGE:

The range of pitch bend can be set from 0 to 12. 0 range is equivalent to no pitch bend. A setting of 12 permits pitch bend over a ±1200 cent (2 octave) range. If the range is set at 7, then pitch bend will be possible over a ±700 cent range (i.e. plus or minus one fifth).

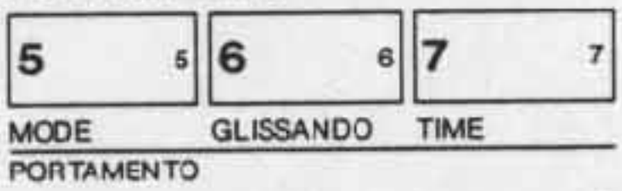
STEP:

The step parameter can be set from 0 to 12. A setting of 0 corresponds to 0-cent steps, and a setting of 12 corresponds to 1200-cent (1 octave) steps. If STEP is set to 0, then a perfectly smooth pitch bend will result. If STEP is set to 1, the pitch will bend in 100-cent (semitone) steps.

- **Pitch bend will not function if RANGE is set to 0.**



- **PORTAMENTO**



The portamento effect varies according to whether the DX7 is in the polyphonic or monophonic mode.

MONOPHONIC MODE:

In this mode press the DATA ENTRY [−1] key to activate "FINGERED PORTA." In this mode portamento is applied only to legato notes.

Press the DATA ENTRY [+1] key to activate "FULL TIME PORTA." In this mode portamento is always applied.

POLYPHONIC MODE:

Press the DATA ENTRY [−1] key to activate "SUS-KEY P RETAIN." In this mode the pitch of keys released while the sustain pedal is on or of notes that have a long sustain time does not change. However, portamento is effected between two subsequently pressed keys.

Press the DATA ENTRY [+1] key to activate "SUS-KEY P FOLLOW." In this mode the pitch of a key released while the sustain pedal is held slides (portamento) to a previously pressed key. There is no change with continuously pressed keys.

GLISSANDO:

The glissando function is turned either ON or OFF. When it is OFF a normal portamento effect is produced.

TIME:

Adjusts the speed of the portamento/glissando effect from 0 to 99. A 0 setting results in no effect, while a setting of 99 produces the longest (slowest) portamento or glissando.

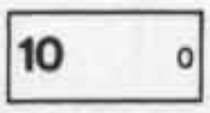
- The portamento/glissando effect can also be turned ON or OFF using an optional FC-4 or FC-5 foot pedal once the portamento/glissando function has been turned on using the front-panel controls.
  Pressing the foot pedal turns the effect ON. The effect is OFF when the foot pedal is released.

- An FC-4 or FC-5 foot pedal can also be connected for sustain pedal control. In the monophonic mode, a key pressed while another key is held will take priority, and the sustain effect will apply to the new key.
  Releasing the pedal turns the sustain effect OFF.

- **EDIT RECALL**

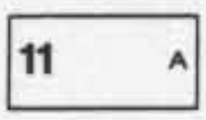
This function makes it possible to recall a voice that was previously being edited or created.
If, for example, the PLAY mode is accidentally or purposely entered while editing, the voice that was being edited can be recalled with this function
If the [EDIT RECALL] key is pressed, the display shows "EDIT RECALL?". Pressing the DATA ENTRY [YES] key then causes the "ARE YOU SURE?" display. Verify by pressing the [YES] key again, and the voice previously being edited will be restored.

- **VOICE INIT (Voice Initialize)**



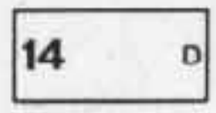
This function sets up the basic voice data for creating new voices. Press the [VOICE INIT] key and the display panel will read "VOICE INIT?" Press the [YES] key and the DX7 will respond with "ARE YOU SURE?" Verify by pressing the [YES] key second time. This sets up the basic voice data and activates the DX7 EDIT mode.

- **CARTRIDGE FORMATTING**



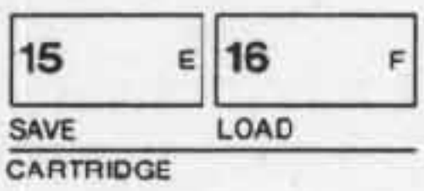
Since the format of a RAM cartridge used for other purposes such as DX1 performance memories, etc., will vary from that of a cartridge used for voice memory, make sure you observe the following procedure when storing or saving DX7 internal voices into such a cartridge.
Press "11" to select this function. The "CARTRIDGE FORM?" display will appear. Press [YES] and the instrument will respond with "ARE YOU SURE?". Press [YES] again and all 32 memorybank in the RAM cartridge are initialized to the basic voice data.

- **BATTERY CHECK**



A backup battery power supply is built into the DX7 so that voice data will be maintained even when power to the instrument is off. The state of the backup system can be checked by pressing the [BATTERY CHECK] key. The operational battery voltage range is from 2.2 volts to 3 volts. If the backup battery voltage drops below 2.2 volts, replacement of the backup system is necessary. The backup system consists of special batteries which can be replaced only by a Yamaha dealer. Contact your nearest Yamaha dealer when replacement becomes necessary.

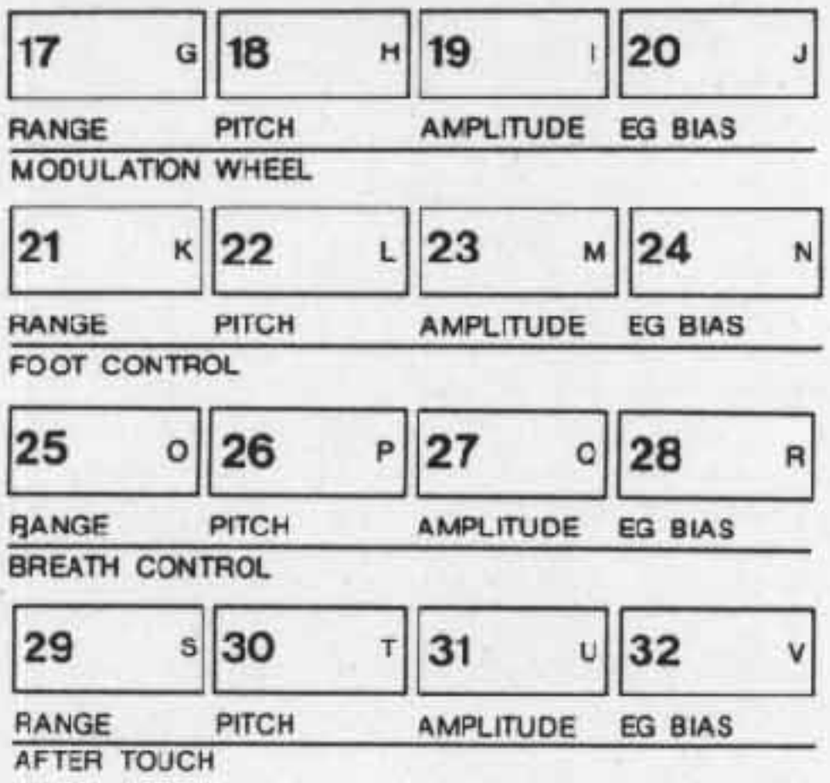
- **CARTRIDGE**



SAVE:
32 voices contained in the internal memory system can be saved on an external programmable memory cartridge.
LOAD:
32 of the voices contained in an external voice cartridge can be loaded into the internal memory at a time.

- Refer to the STORE/SAVE/LOAD section on page 19 for detailed instructions.

- **MODULATION WHEEL/FOOT CONTROLLER/ BREATH CONTROLLER/AFTER TOUCH**

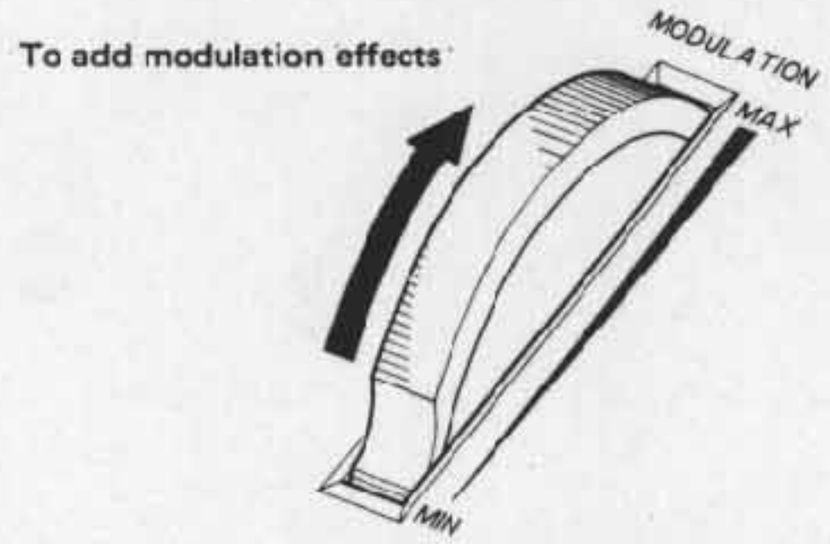


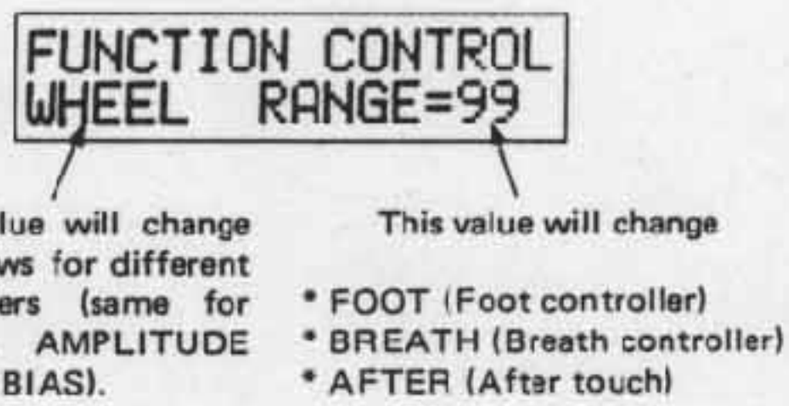
The modulation wheel, foot controller, breath controller or keyboard after touch can be used to control LFO modulation depth applied to pitch, amplitude or envelope producing controllable tremolo or vibrato effects while playing. Setting the RANGE, AMPLITUDE and ENVELOPE GENERATOR BIAS parameters for each controller is basically the same process, so we'll concentrate mainly on the MODULATION WHEEL.

1. MODULATION WHEEL

RANGE:

Range can be set from 0 to 99. No effect is produced with a 0 setting, and a setting of 99 produces maximum effect.





PITCH:

Determines whether LFO modulation is applied to pitch. Pitch is modulated if ON, and not modulated if OFF.

AMPLITUDE:

Determines whether LFO modulation is applied to amplitude. Amplitude is modulated if ON, and not modulated if OFF.

EG (ENVELOPE GENERATOR) BIAS:

When EG BIAS is ON, volume or brilliance (wow) variation effects can be added with the controllers by varying the level of each operator's envelope generator. MOD. SENSITIVITY (AMPLITUDE) is used to set the sensitivity (refer to page 14).

Applying EG BIAS to a modulator results in brilliance effects, while applied to a carrier it results in volume variation effects. In some cases, if the carrier sensitivity is maximum and the controller is set to its minimum, no sound will be produced.

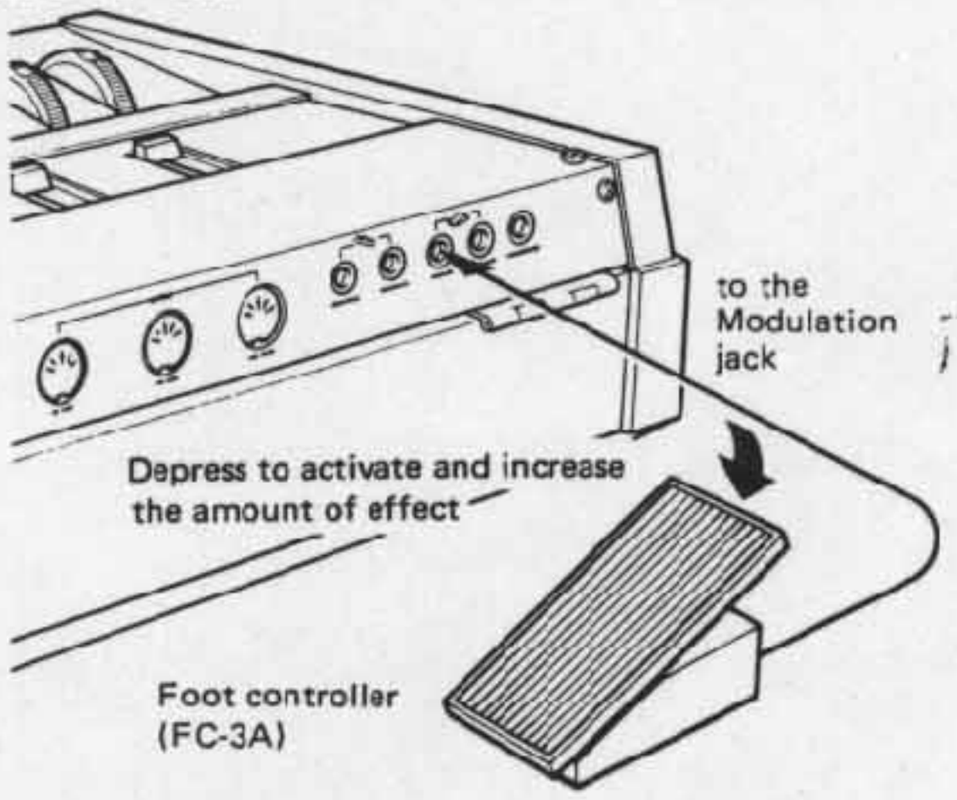
- **These parameters will have no effect if the PITCH MODULATION SENSITIVITY or the AMPLITUDE MODULATION SENSITIVITY of the voice used are zero.**

Refer to the MODULATION SENSITIVITY section on page 14 for details.

2. FOOT CONTROLLER

The LFO modulation effect programmed can be controlled using an optional FC-3A foot controller.

Maximum effect is produced by pressing the foot controller all the way down, while raising the controller fully eliminates the effect.

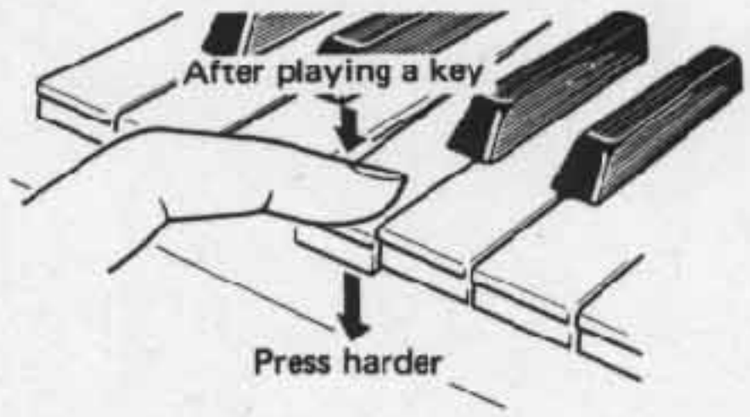


3. BREATH CONTROLLER

The LFO modulation effect programmed can be controlled using an optional BC1 breath controller. The effect is controlled by blowing into the BC1 mouthpiece. The effect will not be audible unless breath is applied to the controller.

4. AFTER TOUCH

This feature makes it possible to vary the degree of modulation by varying pressure on the keys. No effect is produced with normal key pressure, but the effect can be introduced by pressing harder on the key(s). The amount of pressure applied determines the depth of the effect.



FM TONE GENERATION

FM Tone Generation . . . . Understanding the Basics

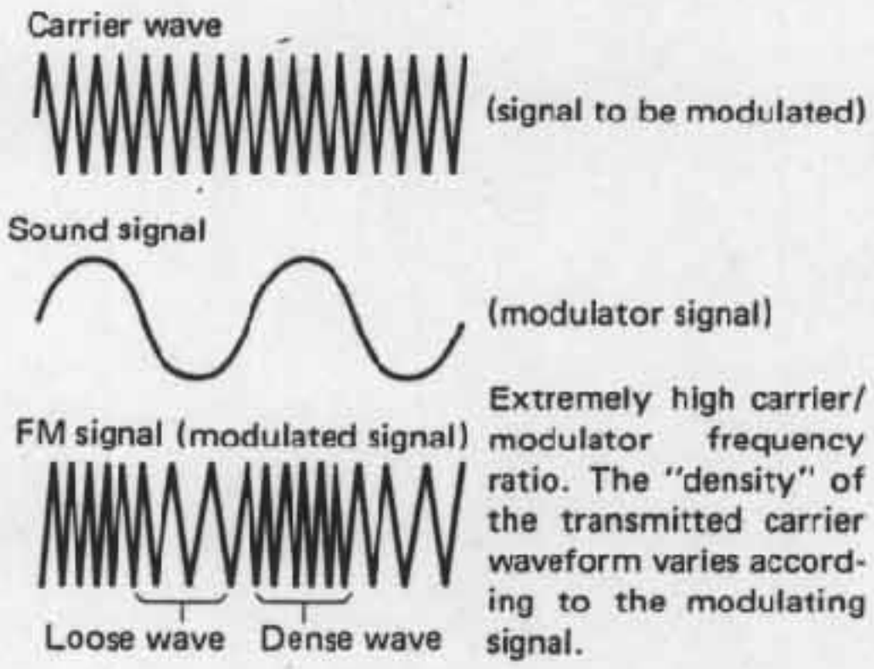
The DX7 is an entirely new type of synthesizer employing an entirely new FM digital tone generation system. This unique Yamaha system permits finer control over subtle musical nuances and vastly expanded voice creation potential compared to conventional synthesizers.

1. The Meaning of FM

FM stands for Frequency Modulation. FM radio broadcasts use the same principle. One signal—the modulator—modulates a second signal—the carrier.

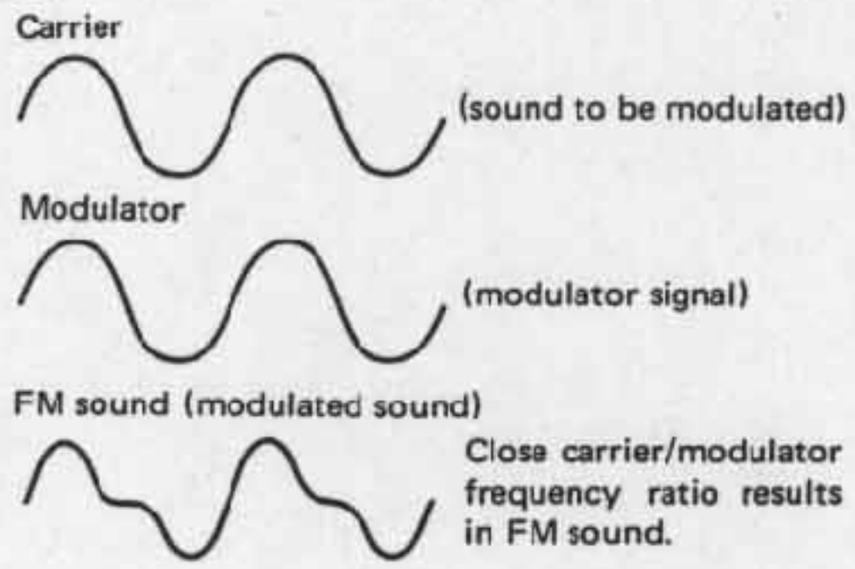
In FM radio the carrier is an extremely high "ratio" frequency and the modulator is the music signal to be broadcast. In effect, the carrier "carries" the modulator signal through the atmosphere to your receiving antenna.

FM broadcasting



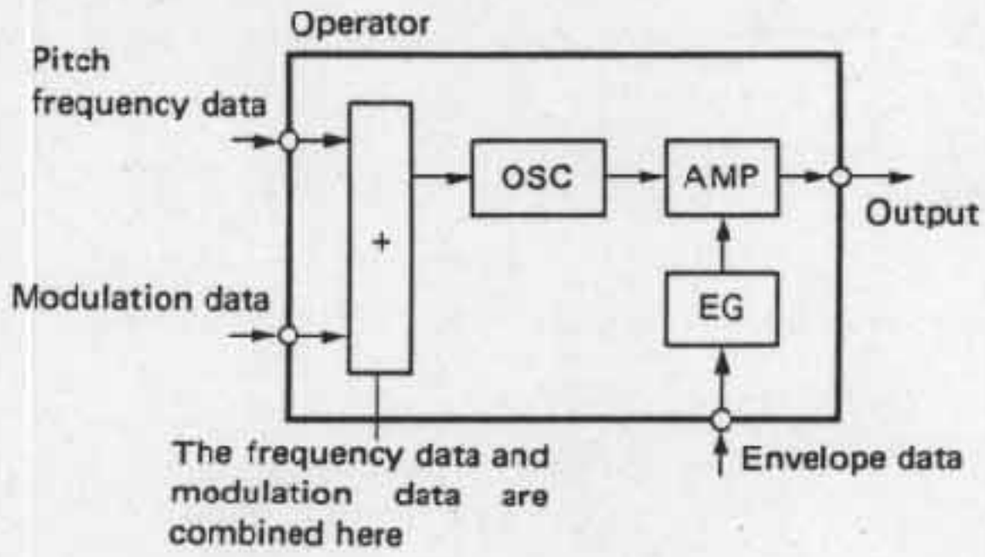
The FM tone generator system is similar in principle, but in this case both the carrier and modulator are audible signals, and their frequencies can be almost equal.

FM tone generation



2. FM Tone Generation In the DX7

In the DX7, the carrier signal determines the pitch of the note produced and modulator determines the shape of the waveform produced and therefore its timbre. This explanation may make it look like the carrier and modulator are two entirely separate things. In fact, they are one and the same. A special oscillator unit called an "operator" can be used as either a carrier or modulator in the DX7.



1) Pitch Frequency Data

Pitch frequency data from the DX7's microcomputer system determines the operator's oscillation frequency. When the operator is used as a carrier, this frequency is equivalent to the pitch of the note produced. When the operator is being used as a modulator, the ratio of its frequency to that of the carrier determines the timbre of the note produced.

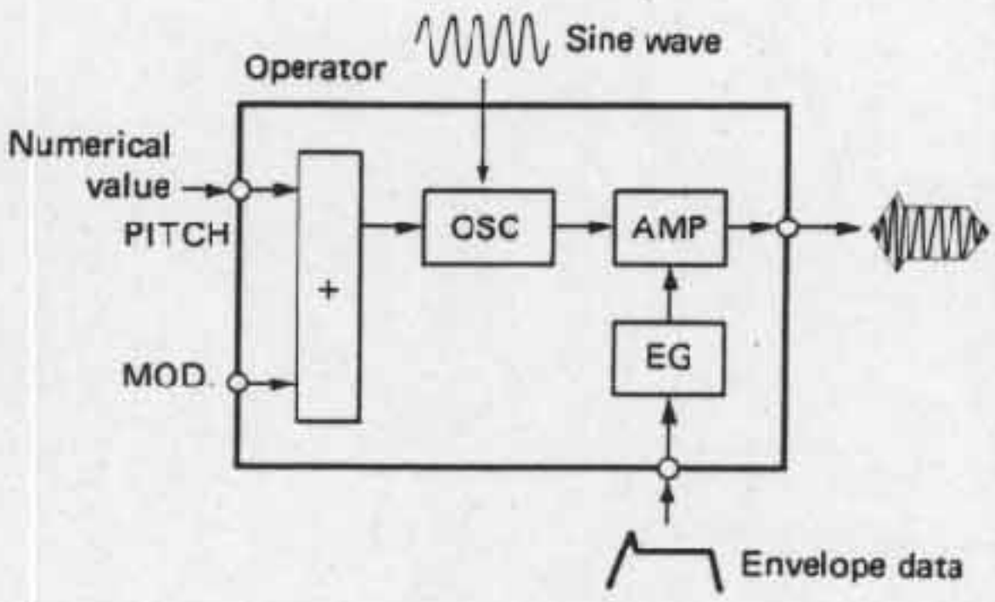
2) Modulation Data

This is the modulation data received from the previous operator's (modulator) output.

3) Envelope Data

When the operator is used as a carrier the envelope data determines the volume envelope of the note produced. When the operator is used as a modulator the envelope data determines the timbre envelope of the note produced.

For example, the pitch frequency data applied to an operator used as a carrier determines the frequency of the sine wave output from the operator. Inputting envelope data results in an output waveform similar to that shown in the figure.

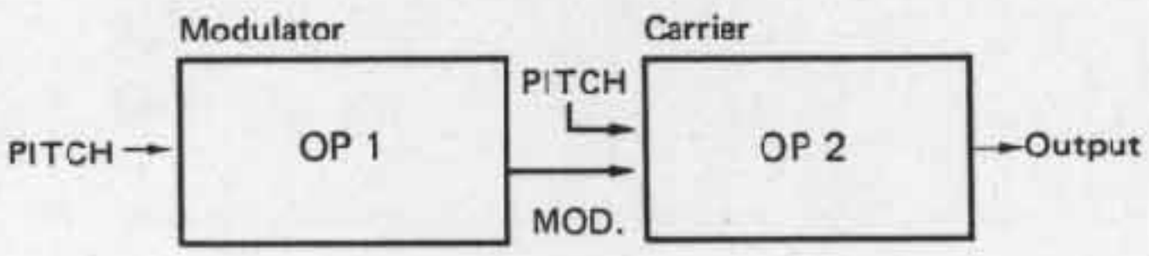


• Basic Operator Functions

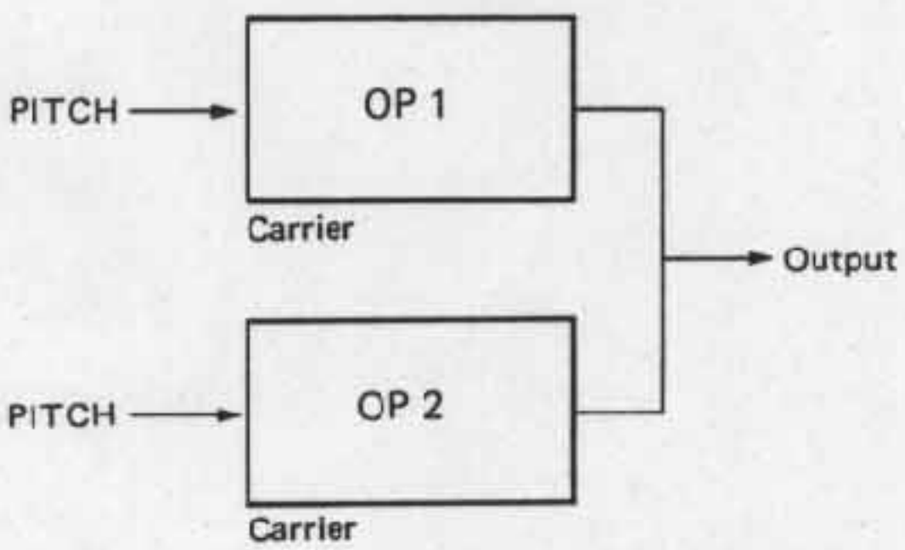
1) Relationship of Carrier to Modulator

An operator can be used as either a carrier or modulator. These two basic operator functions are the basis for the FM tone generation system. Two operators can be combined in two different ways.

1. Modulator and carrier combinations



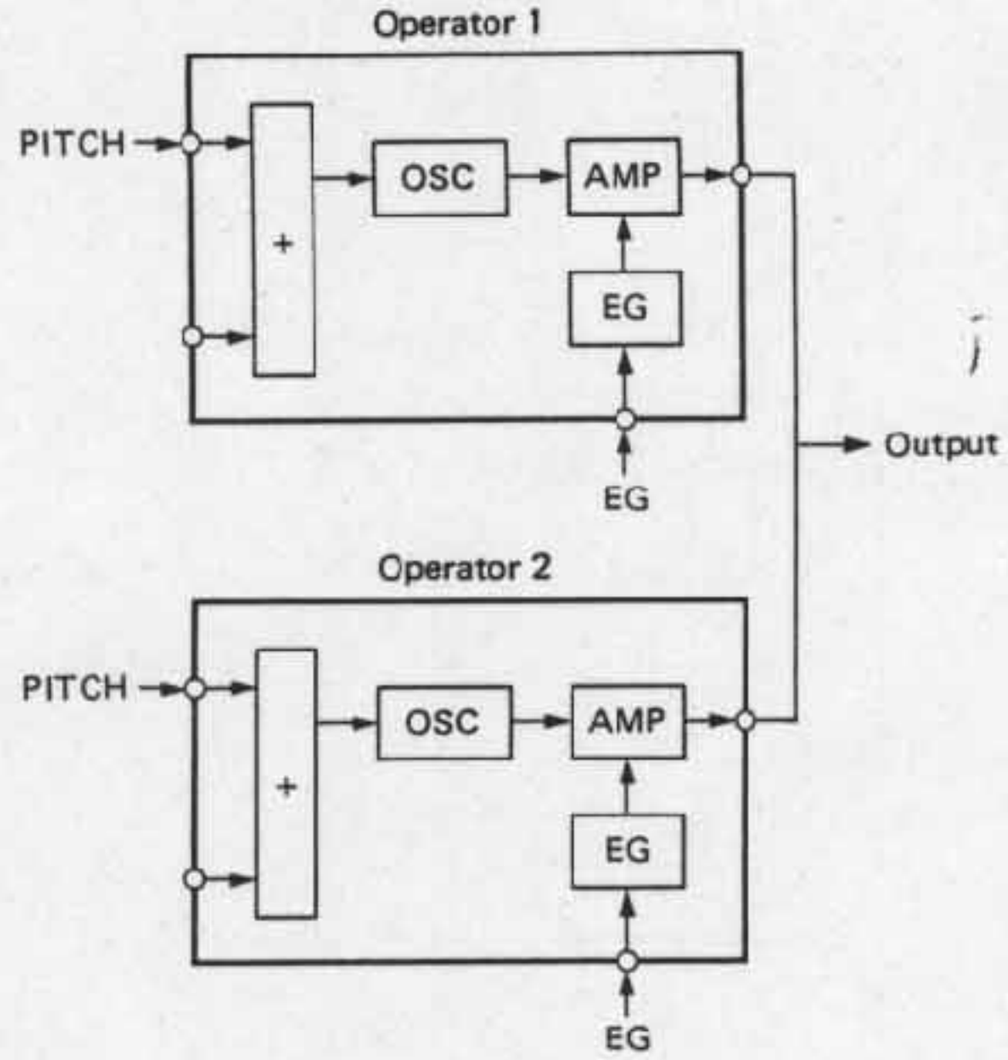
2. Carrier and carrier combinations



2) Carrier and Carrier

This configuration results in a pure sine wave output from both operators. The combination of these waveforms can sound much like a conventional organ.

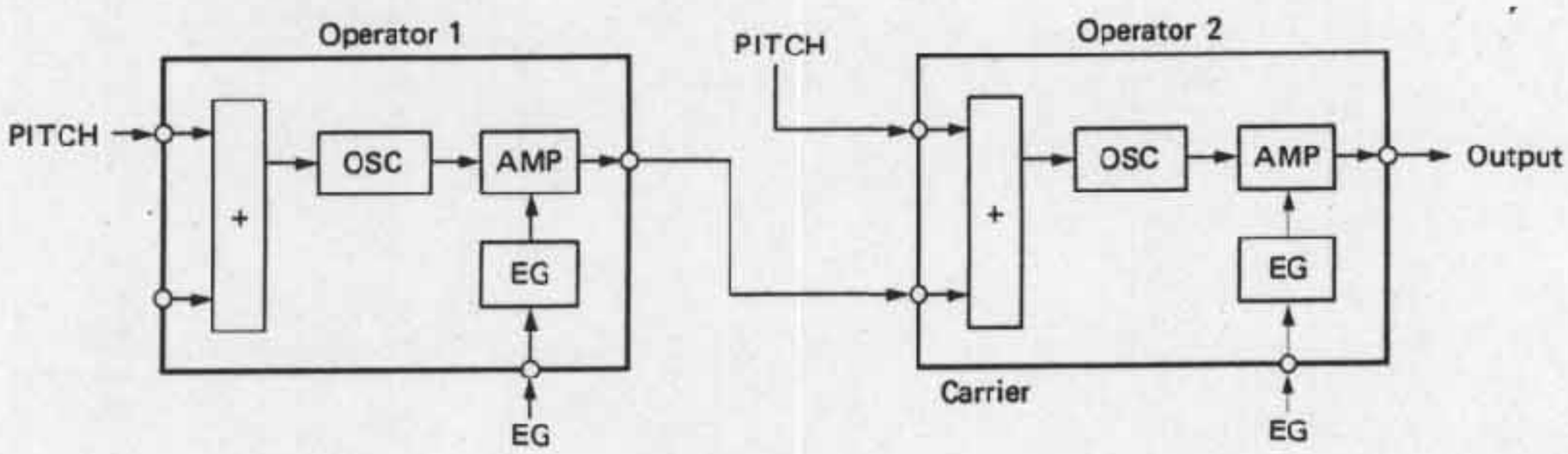
• Carrier and carrier combinations



3) Modulator and Carrier

In the modulator/carrier configuration using two operators, shown in the figure, the operator on the left is the modulator and the operator on the right is the carrier. In the FM system, the last operator in a chain of two or more operators is the carrier. By varying the ratio of the modulator and carrier frequencies, and by varying the envelope of the modulator, an extremely broad range of highly complex waveforms (complex harmonic structure) can be created.

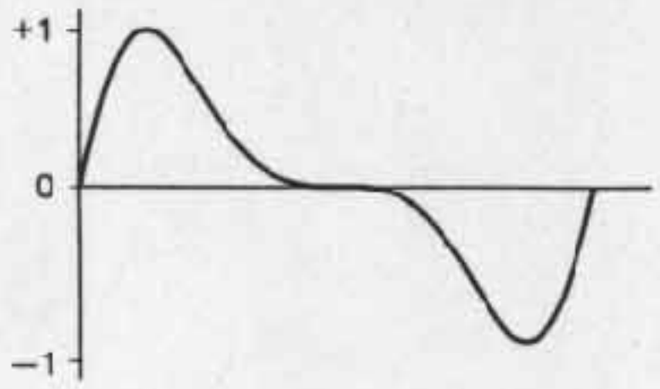
• Modulator and carrier combinations



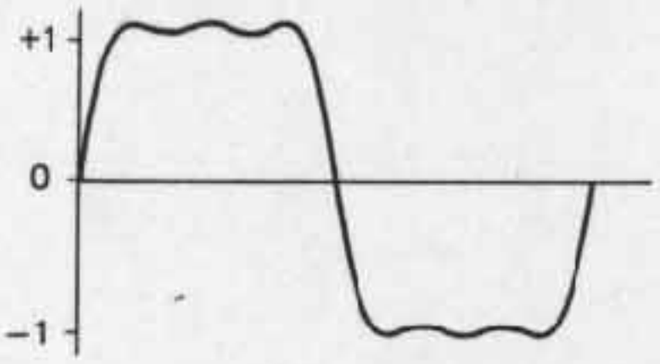
Examples of output waveforms

• Modulator and carrier combinations

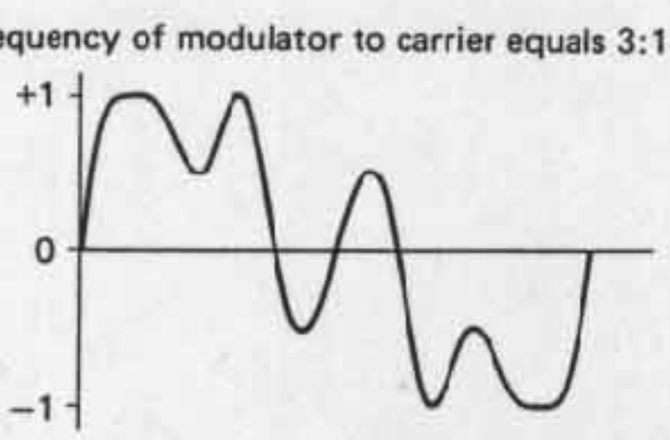
Frequency ratio of modulator to carrier equals 1:1



Frequency of modulator to carrier equals 2:1

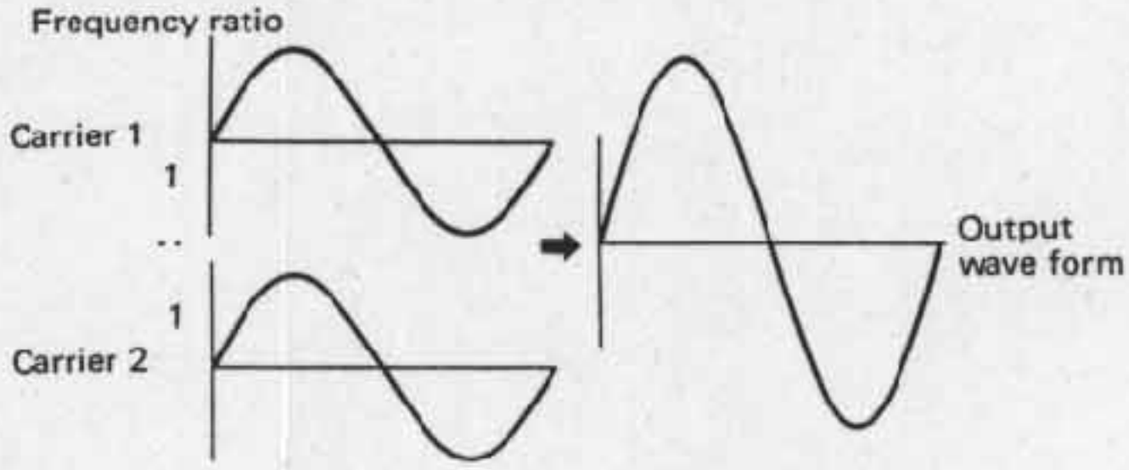


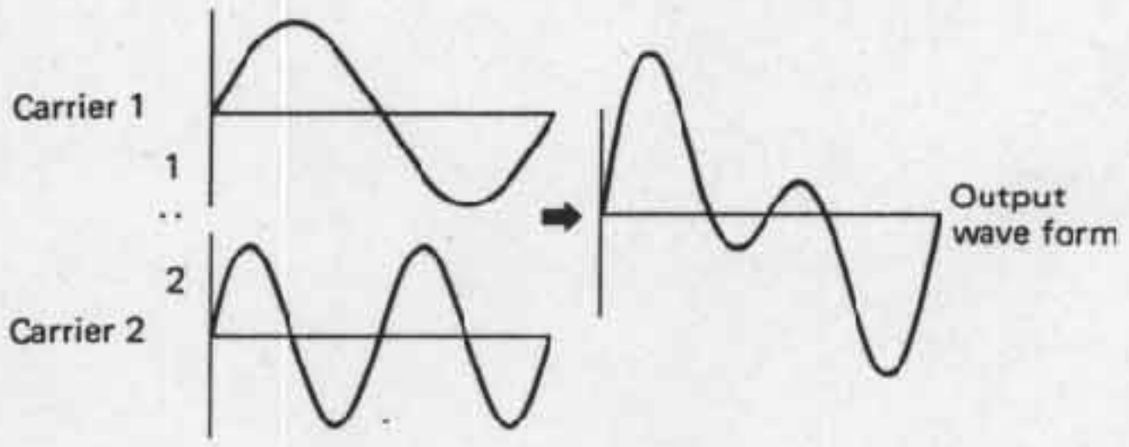
Frequency of modulator to carrier equals 3:1

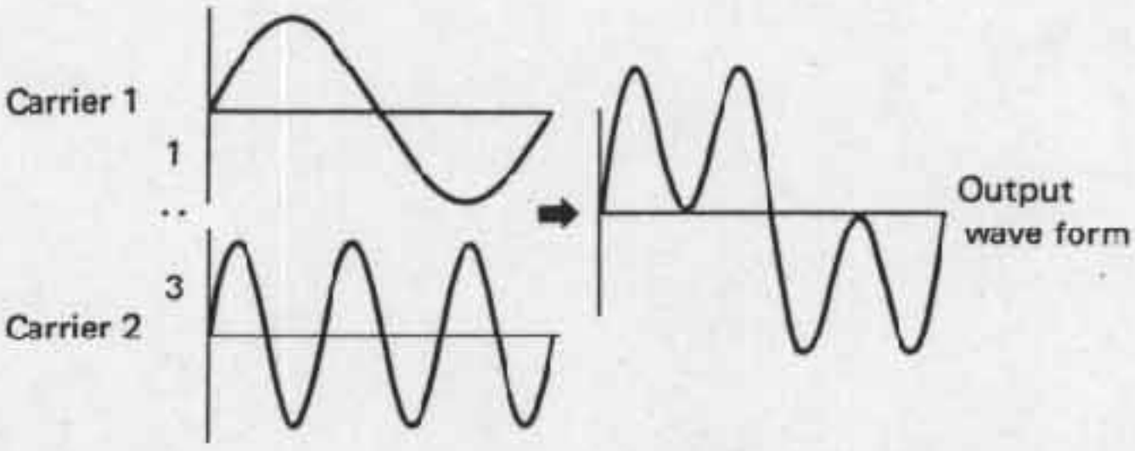


• Carrier and carrier combinations

Frequency ratio



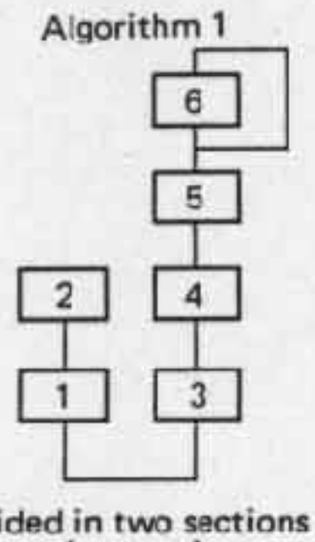


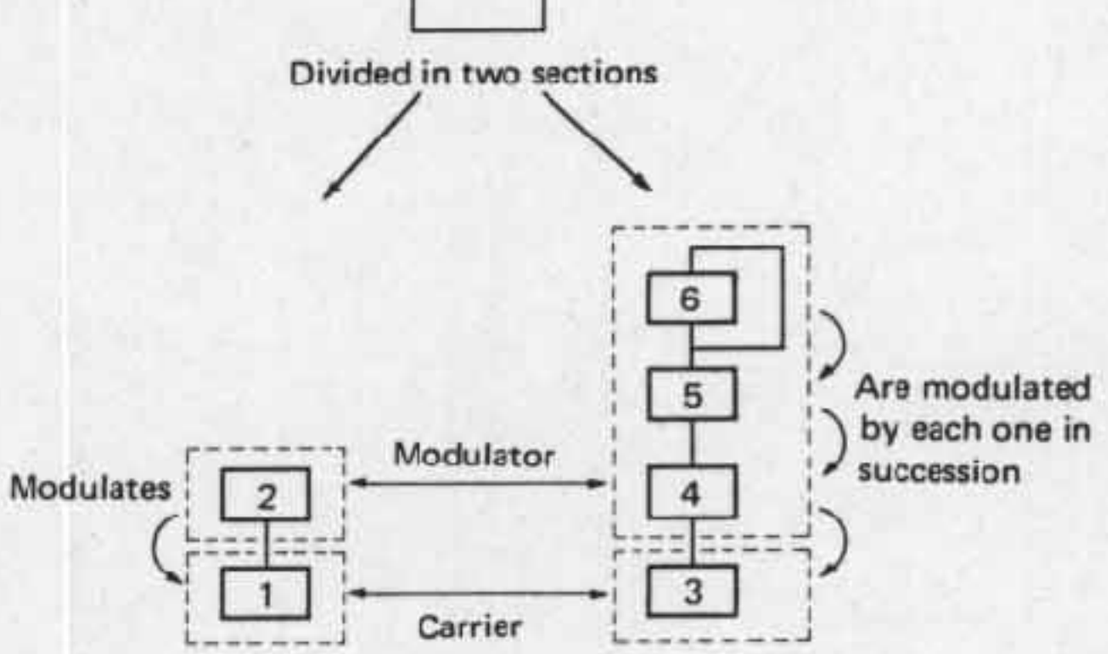


3. Algorithms . . . . Combining Several Operators

The DX7 has a total of six operators. The way in which these operators are combined is known as an "algorithm." The DX7 has 32 different pre-programmed algorithms. The 32 algorithms are displayed graphically along the top of the control panel above the selector keys. Taking algorithm number one as an example, the lowest two operators—1 and 3—are carriers. The four operators above the carriers will function as modulators. The output of operator 6 is fed back (feedback) to its input.

The above is a brief description of the internal workings of the FM tone generator system. By varying the pitch frequency, modulation and envelope data it is possible to edit pre-programmed voices or to create entirely new voices.

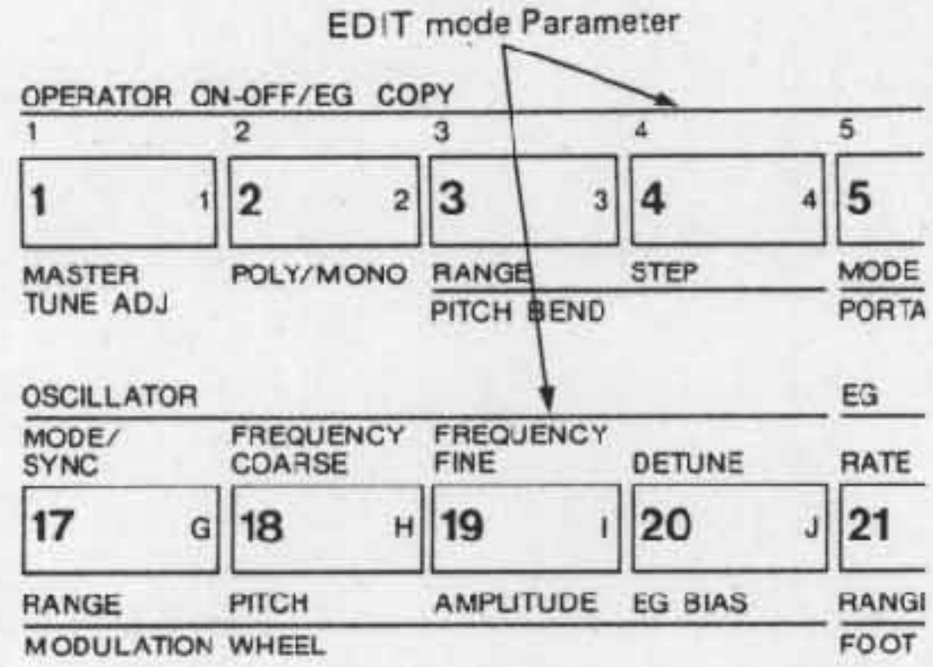




EDIT MODE

• EDIT MODE . . . . Creating Voices

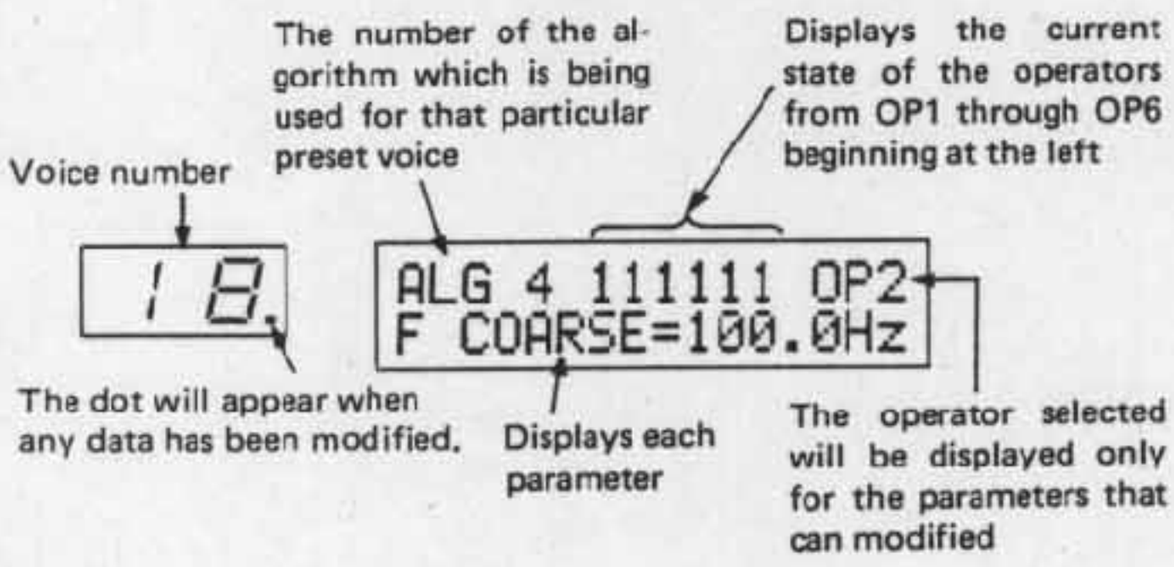
The EDIT mode can be used to edit pre-programmed voices or to create entirely new voices. Press the [EDIT/COMPARE] function key to enter the EDIT mode.



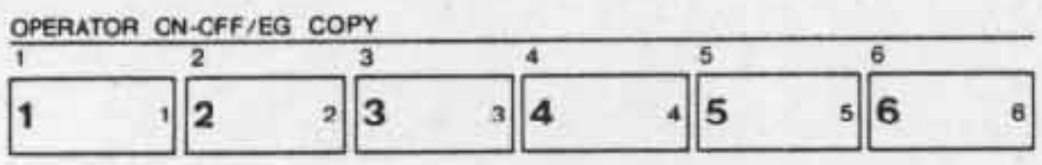
Setting and modifying parameters is carried out using the DATA ENTRY controls just as in the FUNCTION mode. A small dot will appear next to the voice number in the display if any data is modified. The original voice can be recalled at any time while editing by pressing the [EDIT/COMPARE] key again. The preset number will flash indicating that you are hearing the original voice. To continue editing press the [EDIT/COMPARE] button again.

Now for an explanation of the DX7's functions and operation.

• The indicators display for EDIT mode



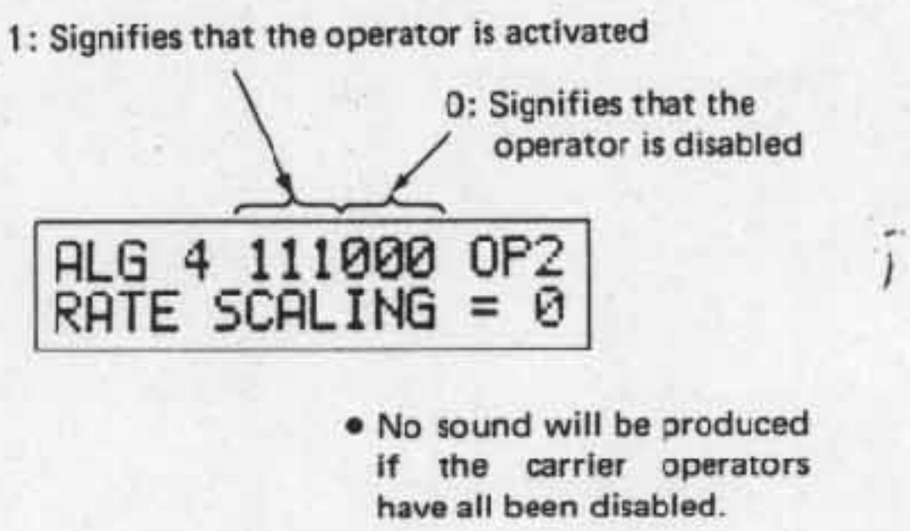
• OPERATOR ON-OFF/EG COPY



In the EDIT mode these keys permit turning any of the operators on or off, and copying the EG data of any operator to any other operator (EG COPY).

OPERATOR ON-OFF:

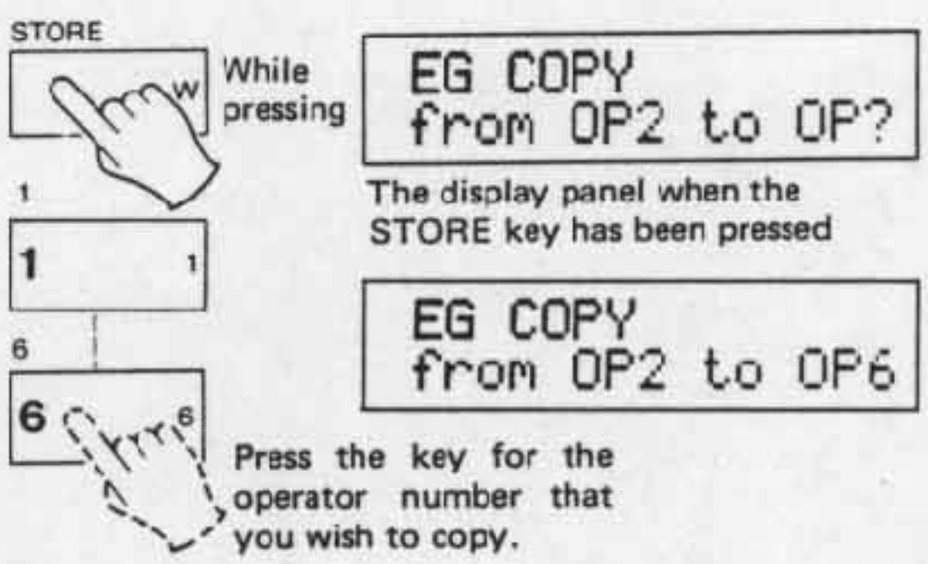
Pressing keys [1] through [6] will result in the corresponding operator being turned OFF, indicated by a "0" in the appropriate location on the display panel (the group of six 1's and/or 0's corresponds to operators 1 through 6). Press the key again to turn the operator back on-indicated by a "1" on the display.



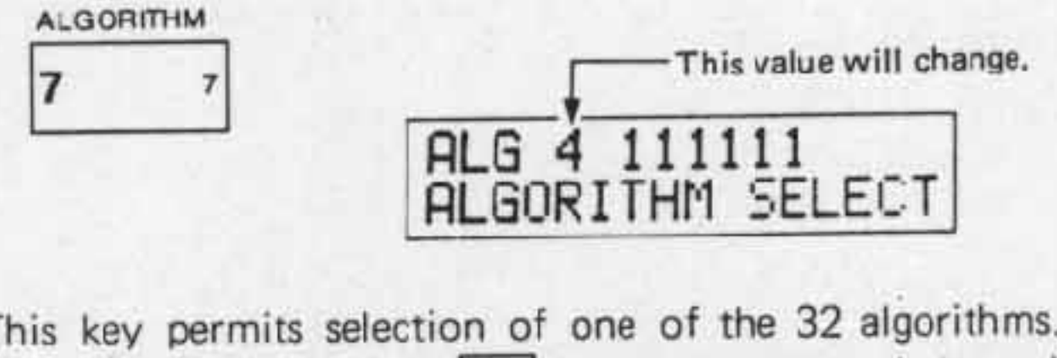
• No sound will be produced if the carrier operators have all been disabled.

EG COPY:

This function copys the EG data from one operator to another. While holding the selector [STORE] key, press the number of the operator from which you want to copy EG data.



• ALGORITHM



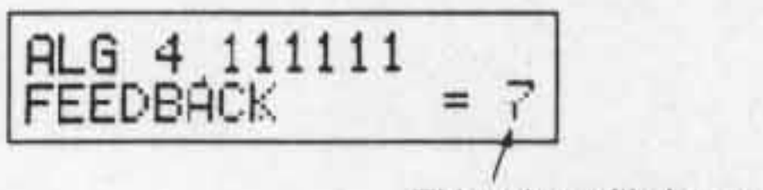
This key permits selection of one of the 32 algorithms. Press the DATA ENTRY [+1] key to increment (advance) the number of the selected algorithm, and the [−1] key to decrement the algorithm number. The slide control can be used for large variations.

- FEEDBACK

FEEDBACK

8	8

One operator in each of the 32 algorithms has its output fed back to its input. This is the feedback operator. The amount of feedback applied can be adjusted over a range of 0 to 7. By increasing the FEEDBACK level the harmonics are increased, resulting in the generation of noise-like sounds.



- LFO

LFO

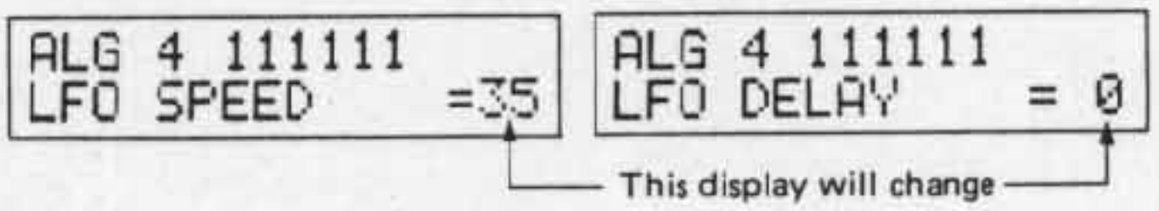
WAVE	SPEED	DELAY	PMD	AMD	SYNC
9 9	10 0	11 A	12 B	13 C	14 D

The Low Frequency Oscillator produces low-frequency sine, saw-tooth or square waves, or a SAMPLE/HOLD waveform. The LFO waveform can be used to apply vibrato, tremolo or " wow" effects to the voices. The amount of LFO modulation applied can be controlled using the modulation wheel, foot controller, breath controller or keyboard after touch once appropriate WAVE, SPEED, DELAY and KEY SYNC parameters are set.
(Refer to page 26)

WAVE:

This selects the waveform output by the LFO. Any of the six waveforms shown below can be selected.

TRIANGL : (Triangular wave)
SAW DWN : (Number 1 sawtooth waveform)
SAW UP : (Number 2 sawtooth waveform)
SQUARE : Square wave
SINE : Sine wave
S/HOLD : Sample and hold



SPEED:

The speed (frequency) of the LFO can be set from 0 to 99. 0 is the slowest LFO speed while 99 is the fastest.

DELAY:

This creates a delay between initial key closure and application of LFO modulation. A setting of 0 results in no delay—LFO modulation begins the instant a key is pressed—and a setting of 99 creates the longest delay.

PMD (Pitch Modulation Depth):

Varies, over a 0 to 99 range, the depth of LFO modulation applied to pitch. A 0 setting produces no pitch modulation, and a setting of 99 produces maximum modulation.

The PMD function is separate from the effect of the controllers, and can be used to apply vibrato effects that are entirely independent of the controller settings.

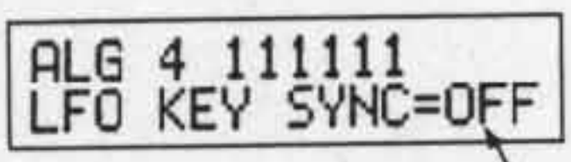
AMD (Amplitude Modulation Depth):

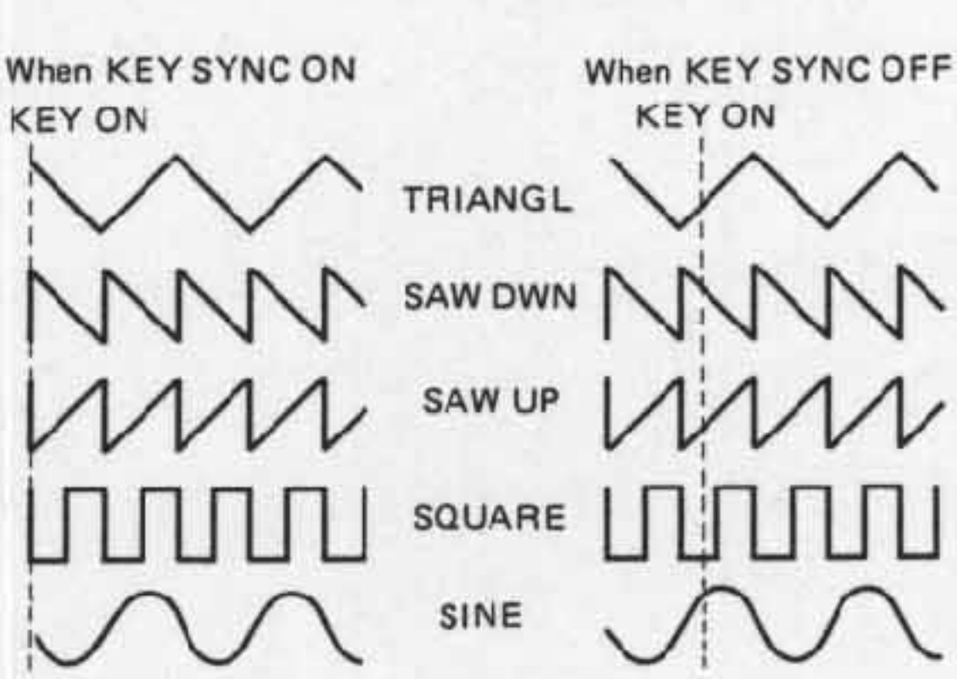
Varies, over a 0 to 99 range, the depth of LFO modulation applied to amplitude. A 0 setting produces no amplitude modulation, and a setting of 99 produces maximum modulation.

The AMD function is separate from the effect of the controllers, and can be used to apply tremolo effects that are entirely independent of the controller settings.

SYNC (Synchronize):

Pressing the SYNC key alternately turns the SYNC function ON and OFF. When SYNC is ON LFO modulation beings at the same point in the LFO waveform when a key is pressed. With SYNC OFF LFO modulation begins at a random point in the LFO waveform since the LFO is free running in this mode.





- MOD. SENSITIVITY (Modulation Sensitivity)

MOD SENSITIVITY

PITCH	AMPLITUDE
15 E	16 F

This adjusts the sensitivity (depth) of pitch and amplitude modulation. This parameter must be greater than 0 before any amplitude or pitch modulation can be applied.
Be sure to check this parameter before using the modulation wheel or other controllers.

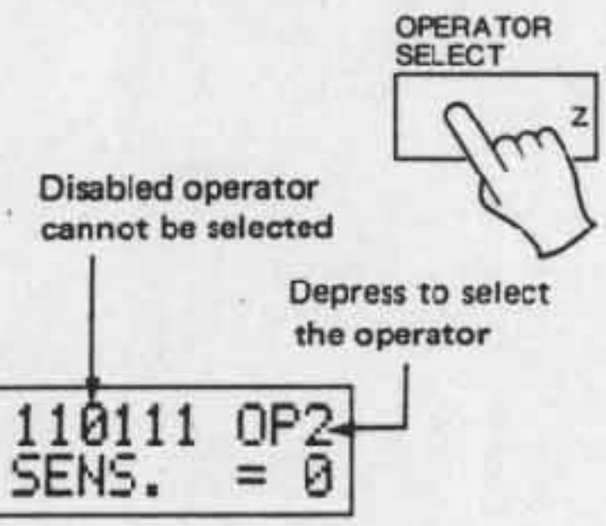
```
ALG 4 111111          ALG 4 111111 OP2
P MOD SENS.  = 1      A MOD SENS.  = 0
```

This display will change

PITCH:
Sensitivity to pitch modulation is variable from 0 to 7. This value sets the modulation sensitivity for all operators. Applying pitch modulation results in vibrato type effects.

AMPLITUDE:
Sensitivity to amplitude modulation is variable from 0 to 3. Amplitude modulation sensitivity is set independently for each operator. Applying amplitude modulation to a modulator creates "wow" effects, while applied to a carrier it results in tremolo effects.

Operators are selected using the OPERATOR SELECT key. Pressing the OPERATOR SELECT key successively selects the operators in order from 1 to 6. The number of the selected operator is displayed in the upper right hand corner of the display panel. Operators that are turned OFF will be "skipped" and the number of the next active operator will be displayed.



- OSCILLATOR

OSCILLATOR

MODE/ SYNC	FREQUENCY COARSE	FREQUENCY FINE	DETUNE
17 G	18 H	19 I	20 J

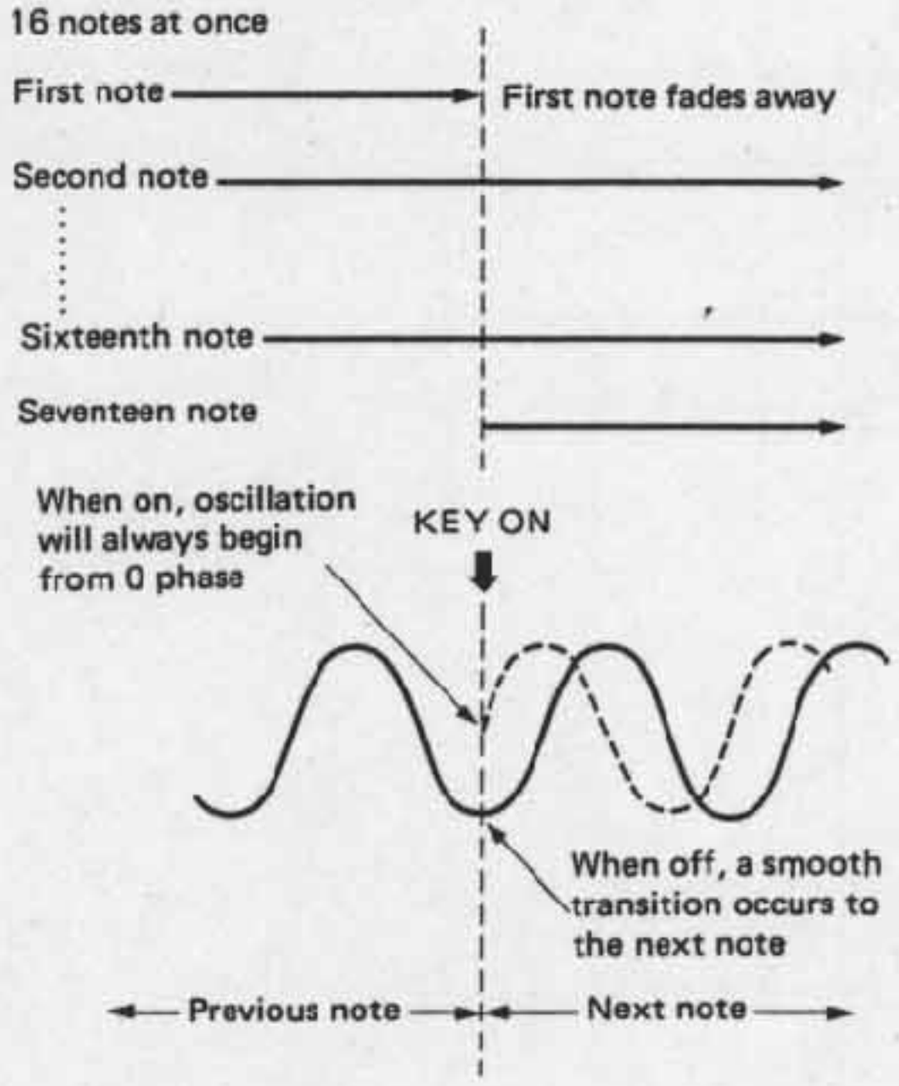
These keys set the pitch data for each operator.

```
ALG 4 111111 OP2      ALG 4 111111 OP2
FREQUENCY(RATIO)      FIXED FREQ.(Hz)
```

MODE/SYNC:
Pressing this key alternately switches to MODE and SYNC.

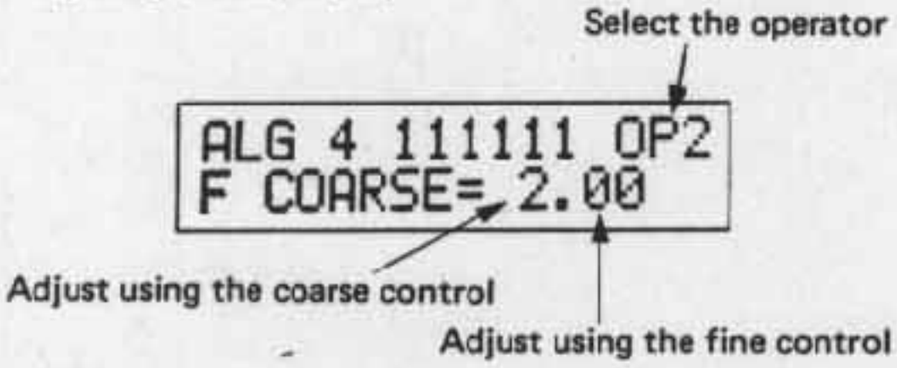
MODE:
Pressing the DATA ENTRY [−1] key sets the operators to the FREQUENCY (RATIO) mode, in which operator pitch is scaled to the keyboard as normal. Pressing the [+1] key sets the FIXED FREQ (HZ) mode in which a fixed frequency is produced no matter what key is pressed. The frequency is set using the [FREQUENCY COARSE] and [FREQUENCY FINE] functions in both modes.

SYNC (Synchronize):
When the SYNC function is ON, all oscillator begin operation from the same phase angle (0 degrees). With SYNC OFF the phase angle at which an operator begins oscillation is carried over smoothly from the preceding note. In the polyphonic mode, for example, maximum simultaneous output is 16 notes. If a 17th key is pressed the first note makes a smooth transition to the 17th note.

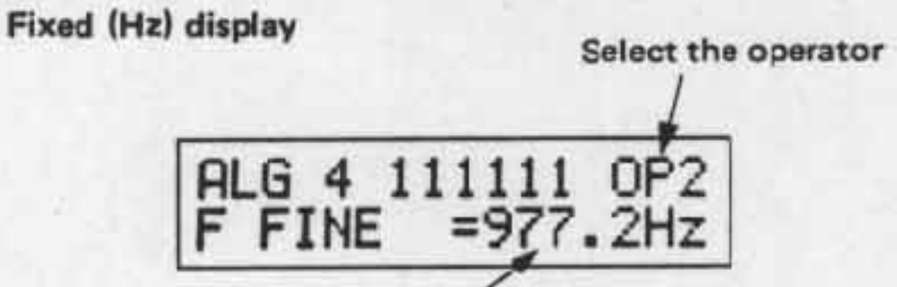


FREQUENCY COARSE/FREQUENCY FINE:
If MODE is set to FREQUENCY (RATIO) the operators are set to a standard frequency of 1.00 (8 feet) when the PITCH COARSE key is pressed. The frequency can then be varied from by one half (0.5 times) to 32 times. FINE adjustment is possible over a range of from 1 to 1.99 times. If the frequency is increased by 2 times, for example, the pitch will increase by one octave.
If MODE is set to FIXED FREQ (HZ), COARSE adjustment is possible in four steps—1, 10, 100 and 1000. FINE adjustment is possible from 1 to 9.772 times.

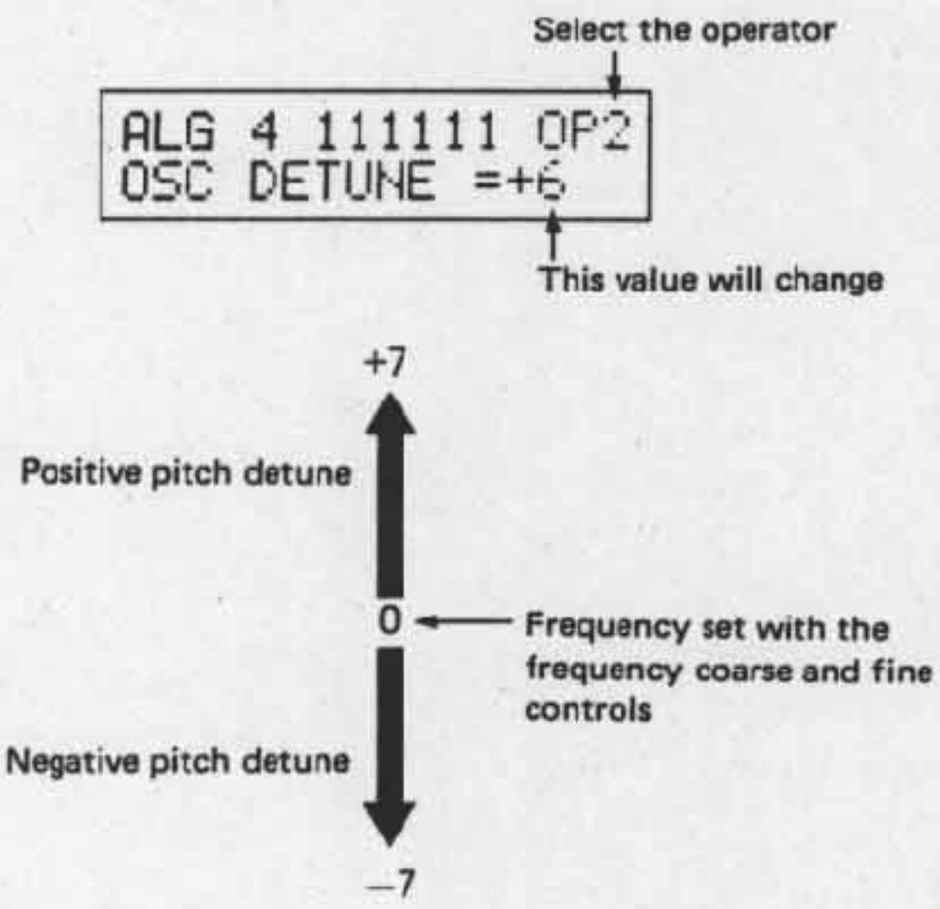
Frequency (ratio) display



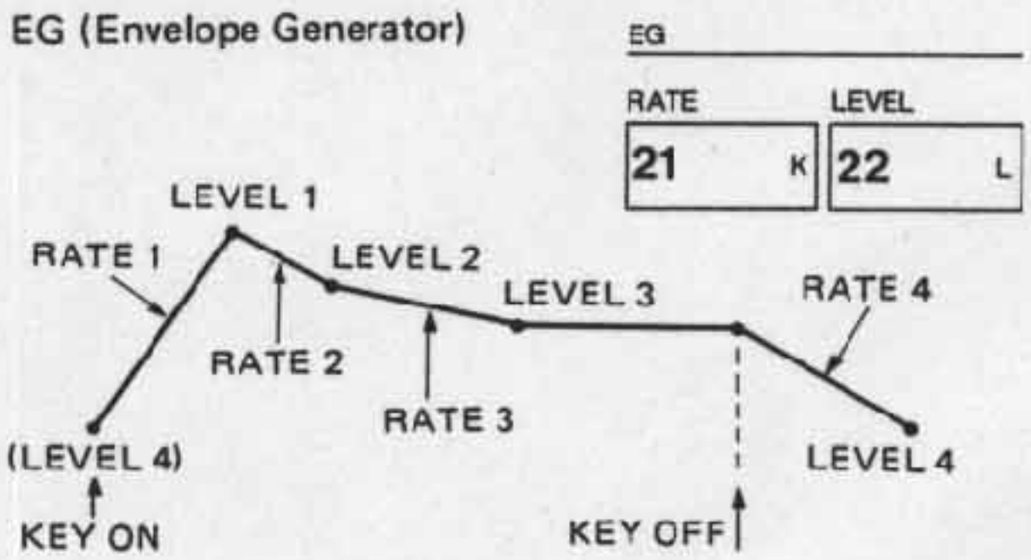
Fixed (Hz) display



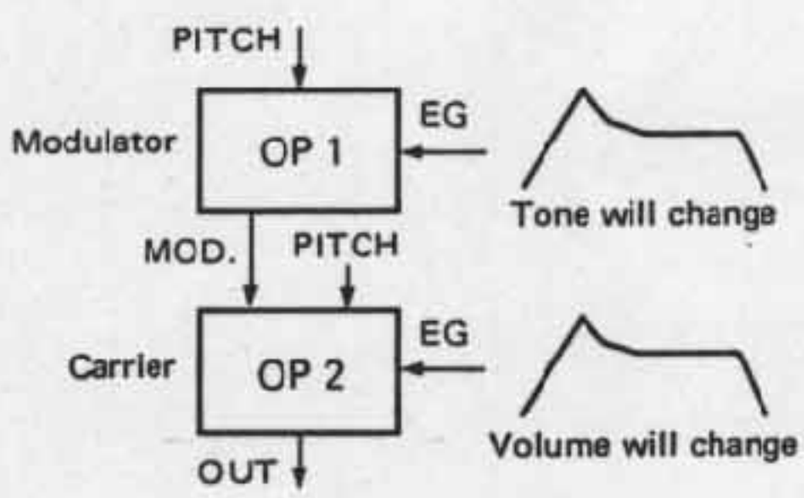
DETUNE:
The operator frequencies as determined by the FREQUENCY COARSE and FREQUENCY FINE controls can be detuned over a −7 to +7 range.

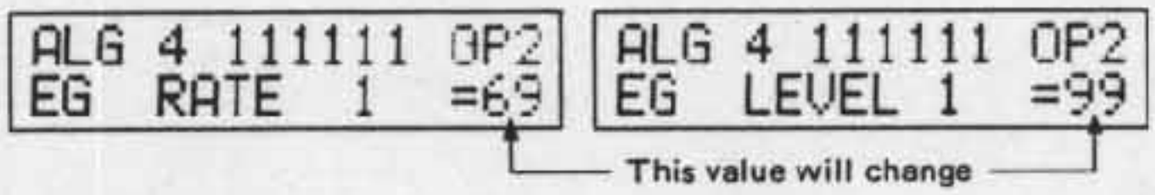


- **EG (Envelope Generator)**



The envelope generator determines how the amplitude (volume) or timbre (tone) of a note will vary over time. Envelope modulation of a modulator results in time-based timbre variations, while envelope modulation of a carrier produces amplitude variations.
The parameters which determine the "shape" of the envelope are RATE 1 through RATE 4 and LEVEL 1 through LEVEL 4. The RATE parameters determine how long it takes the envelope to reach one LEVEL from another. The envelope applied to each operator can be set individually, permitting an essentially infinite range of envelope combinations.





RATE:
Pressing the [RATE] key successively selects RATE parameters 1 through 4. Each RATE parameters can be set from 0 to 99. A 0 setting produces the longest (slowest) RATE, and a 99 setting produces the fastest RATE.
LEVEL:
Pressing the [LEVEL] key successively selects LEVEL parameters 1 through 4. Each LEVEL parameter can be set from 0 to 99. 0 is no output, while 99 is maximum level.

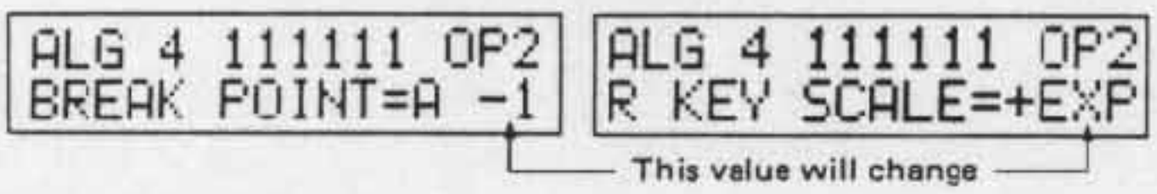
- Normally LEVEL 4 will be set at "0". In this case LEVEL 1 should be greater than "50" to ensure proper EG operation.

• KEYBOARD LEVEL SCALING

KEYBOARD LEVEL SCALING

BREAK POINT	CURVE	DEPTH
23 M	24 N	25 O

Permits raising or lowering the EG levels for keys to the left and right of any key specified as the "Break Point". This is basically a highly advanced version of the keyboard follower function found on some conventional synthesizers, permitting much finer scaling control.



BREAK POINT:

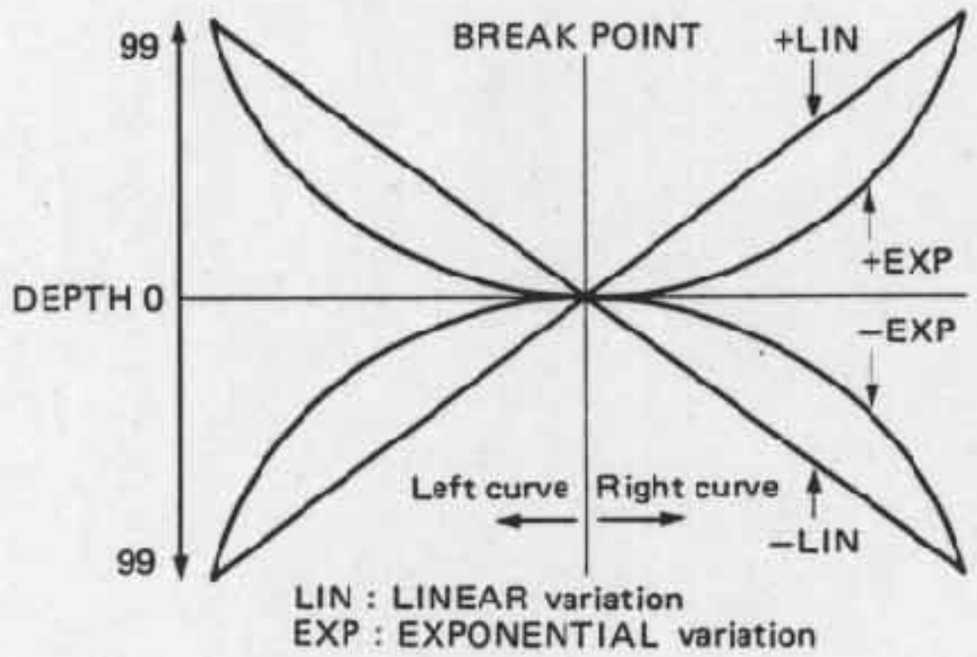
The [BREAK POINT] key—the reference key for the scaling function—can be specified anywhere between A-1 and C8.

CURVE:

Permits variation of the scaling curve to the left and right of the BREAK POINT key. Pressing the [CURVE] key alternates between R KEY SCALING and L KEY SCALING displays. Four different curves are available, as shown in the figure.

DEPTH:

Varies the depth of each curve over a 0 to 99 range. A 0 setting results in a flat (no variation) curve, and a 99 setting produces maximum scaling depth.



• KEYBOARD RATE SCALING

KEYBOARD RATE SCALING

26 P

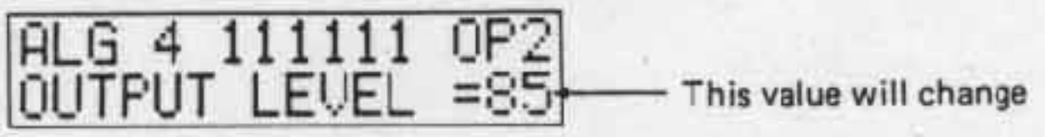
The EG for each operator can be set for a long bass decay and short treble decay—as in an acoustic piano. RATE can be set from 0 to 7.

• OPERATOR

OPERATOR

OUTPUT LEVEL	KEY VELOCITY SENSITIVITY
27 Q	28 R

Permits setting the output level and touch response effect of each operator.



OUTPUT LEVEL:

Controls overall EG level, like the EG DEPTH controls in conventional synthesizers. OUTPUT LEVEL can be set between 0 and 99.

For example, if a specific operator is found to be unnecessary once a voice has been created, its output level can be set to 0.

- **Since the OPERATOR ON-OFF function operates only in the EDIT mode and OPERATOR ON-OFF data is not stored in memory, the OUTPUT LEVEL of all unnecessary operators should be set to 0.**
  KEYBOARD LEVEL SCALING depth is also set to "0". Setting a large DEPTH value and either the +LIN or +EXP curve will result in output from the operator even if the operator's output level is set to "0".
  In order to maintain the same total output level regardless of which algorithm is selected, the OUTPUT LEVEL of each carrier operator is initially set to 1/2 or 1/6 depending on the configuration of the algorithm. For example, the OUTPUT LEVEL of operators 1 through 3 of algorithm 1 are set to 1/2, while operators 1 through 6 of algorithm 32 are set to 1/6.

KEY VELOCITY SENSITIVITY:

Permits adjustment of key touch response. That is, how the velocity with which the keys are played affects the sound. Since touch responce can be applied to carriers or modulators, variations in timbre as well as level can be produced. Sensitivity can be set from 0 to 7. No touch response will be produced with a 0 setting, while a setting of 7 produces maximum response.