MSX

# YAMAHA

## YRM-506

## FB-01 VOICING PROGRAM
OWNER'S MANUAL

## PROGRAMME DE REGISTRATION DU FB-01
MANUEL D'UTILISATION

## FB-01 VOICING PROGRAM
BEDIENUNGSANLEITUNG

NIPPON GAKKI CO., LTD.
PRINTED IN JAPAN

# INTRODUCTION

Congratulations on your purchase of the Yamaha FB-01 Voicing Program. In order to appreciate the full performance of this program, please read this Owner's Manual carefully and completely. Keep it in a safe place for future reference.

## *Features*

The Yamaha FB-01 Voicing Program (YRM-506) is a ROM cartridge which is used with the Yamaha FB-01 FM Sound Generator to create voices. This allows a wide variety of original voices to be created by the FM sound generation system, in addition to the 240 voices already contained in the FB-01. Furthermore, it also simplifies the process of Configuration creation. Here is a list of this program's main features.

- This ROM cartridge program allows the user to alter the voices contained in the FB-01 FM Sound Generator unit, as well as create new voices from scratch.
- The data can be displayed on the screen as they are entered from the Music Computer (or MSX computer equipped with an FM Synthesizer unit) keyboard. Sound can also be output for checking the voice data as it is edited or created.
- Newly created voice data can be saved on cassette tape or Data Memory Cartridges (UDC-01) and later utilized with the FM Music Macro and/or FM Music Composer II program cartridges (sold separately).
- The voice data and the table of voices can both be printed out using an optional printer.
- Newly created voicing data can be saved onto a floppy disk (with SFG-05 Synthesizer unit only).
- Playback using MIDI keyboard instead of the special music keyboard becomes possible (with SFG-05 Synthesizer unit only).

## *How to use this manual*

We suggest that you read this manual while actually using the FB-01 Voicing Program. This way, anything you read can immediately be put into practice, so that you become familiar with the various operations.

★ If you already own the FM Voicing Program II, you will only need pages 6, 7 and 72.

# CONTENTS

# CHAPTER I
# SETTING UP YOUR SYSTEM

# SYSTEM COMPONENTS

Here is a list of the components that you need to enjoy the full potential of the FB-01 Voicing Program.

| | |
|---|---|
| • **Yamaha Music Computer or MSX computer + FM Sound Synthesizer unit** | The main unit of the system. The Music Computer is to be equipped with a Yamaha Sound Synthesizer Unit (SFG-01 or SFG-05). |
| • **Color monitor or color TV** | Necessary for visual control of the parameters. Consult Owner's Manual for connection with the Music Computer. |
| • **FB-01 FM Tone Generator** | The unit you want to modify the voices and Configurations on. |
| • **Yamaha Music keyboard (YK-01 or YK-10/20)** | Used to playback and to compare voices. |
| • **MIDI keyboard plus 3～4 MIDI cables** | With SFG-05 only. Can be used instead of the Yamaha Music Keyboard. |
| • **Cassette recorder** | For storing the data. |
| • **Yamaha Data Memory Cartridge (UDC-01) plus Single Cartridge Adaptor (CA-01)** | For easy storing of the data. Adaptor is unnecessary if your computer is equipped with two cartridge slots. |
| • **Floppy disk drive** | With SFG-05 only. (Consult Owner's Manual for connection.) |
| • **Yamaha Thermal Printer (PN-101) or EPSON printer** | To print out almost all the screen pages as well as the Voice and Configuration data and the table of voices. |
| • **Stereo amplifier/speaker system or keyboard amplifier** | To fully enjoy the high quality FM Sound. |

# SYSTEM CONNECTIONS

***Caution: Before connecting the system, be sure that the power to all components is turned OFF.***

(1) Please refer to the Owner's Manual supplied with your Music Computer for connecting **video display**, **printer** and **cassette recorder**.

(2) Connect the **Data Memory Cartridge (UDC-01)** or the **floppy disk drive set**.

★ Music Computer: You need a **Single Cartridge Adaptor** (CA-01). First assemble the adaptor with the cartridge or disk drive connector, then insert the assembly into the computer's rear slot see p. 5.

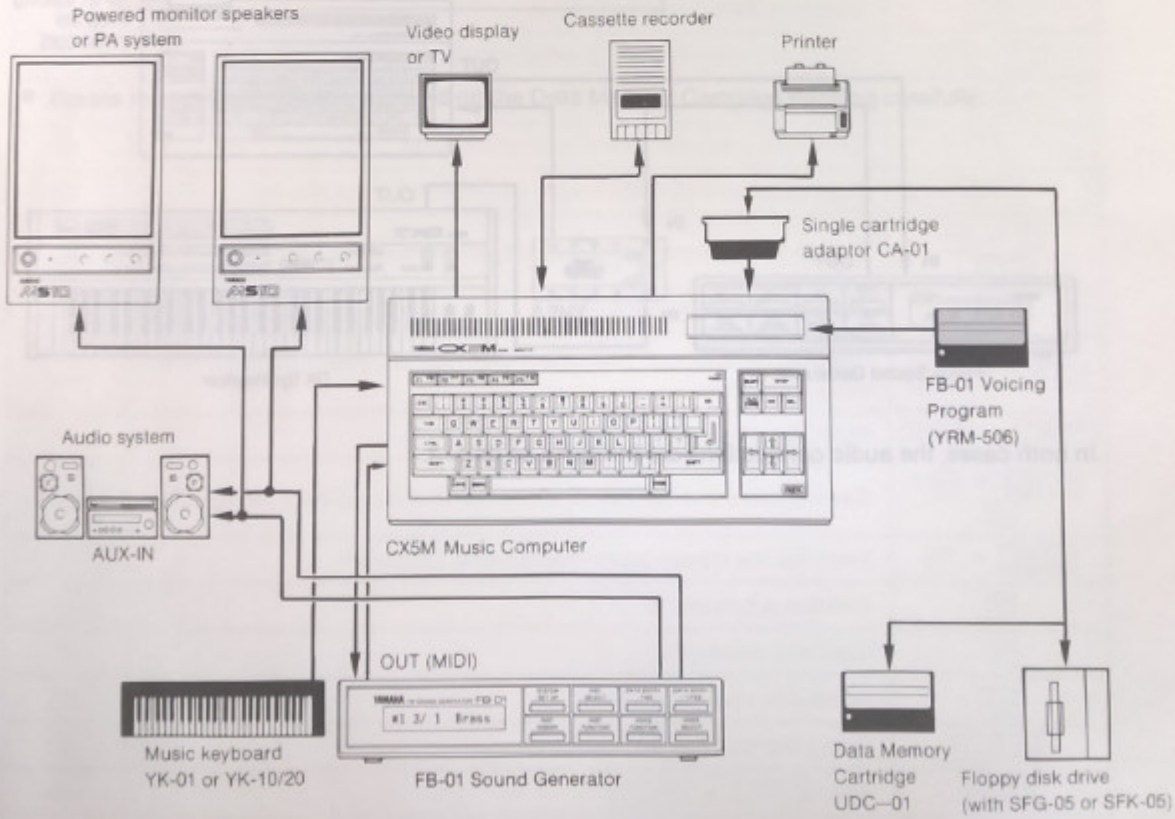
(3) Insert the **Music Keyboard** cable connector into the MUSIC KEYBOARD 20-pin jack at the left side of the computer.

(4) If you intend to use MIDI a keyboard, the connection is slightly different. Please refer to page 4.

(5) Connect the audio Output (L/R) of the FB-01 to the AUX-IN jacks of your sound system (stereo system) or to the input of your powered speaker or PA system.

(6) Connect the MIDI-cables according to which system configuration you choose (Fig. 1～3).

*Fig. 1 System configuration (using a YK Keyboard)*



If you prefer to use your MIDI-compatible keyboard instead of a YK, connect the former according to the figures. You need a YME-8 MIDI Expander to connect a DX synthesizer.

*Fig. 2 Connecting your System (using a KX88/76)*

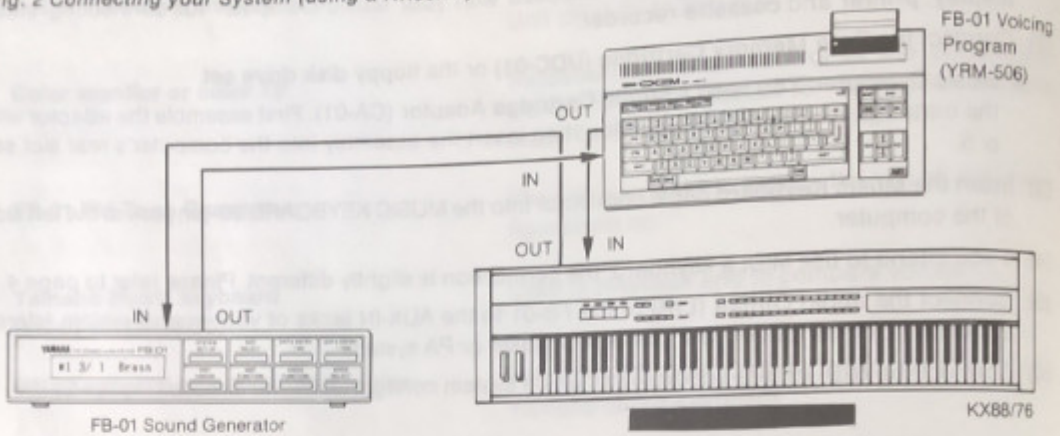
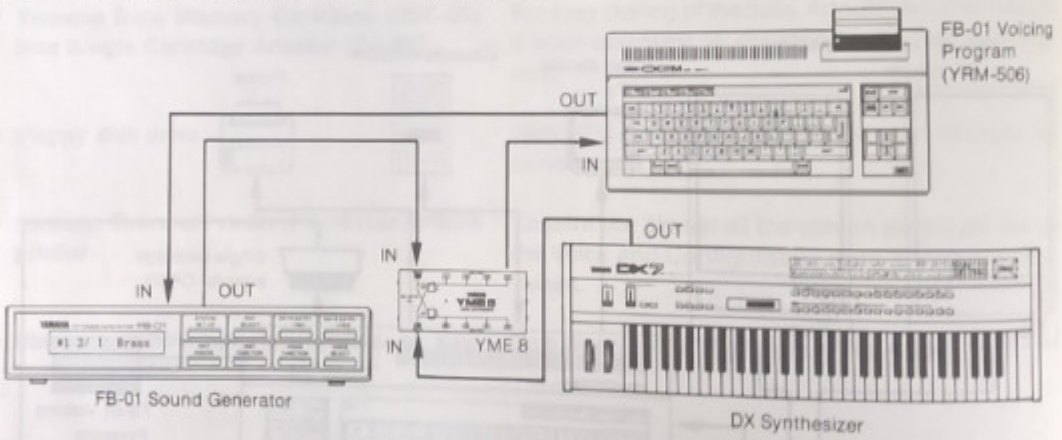



*Fig. 3 Connecting your System (using a DX synthesizer)*

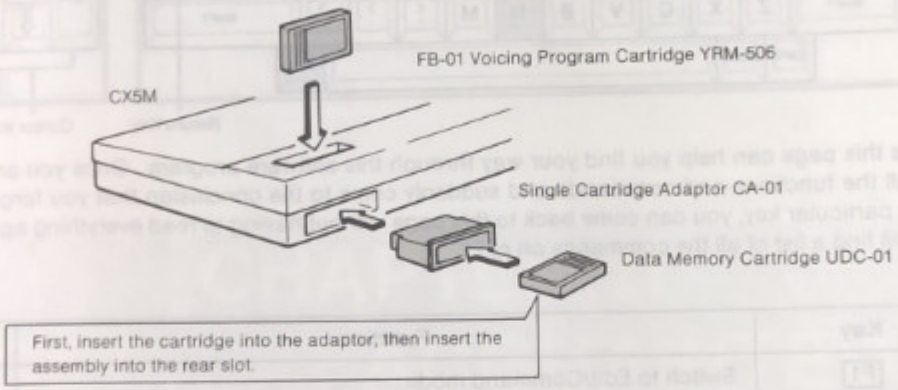



In both cases, the audio connections are the same as on p. 3.

# PRECAUTIONS REGARDING THE USE OF CARTRIDGES

- **Always** turn the power to the computer. OFF before inserting or removing a cartridge; removing or inserting a cartridge when the power is ON can easily cause trouble.
- **Always** return the cartridges to their protective package after use and reinstall the rear slot cover when a cartridge is removed from the rear slot as dust on the connection pins can produce erratic operation.

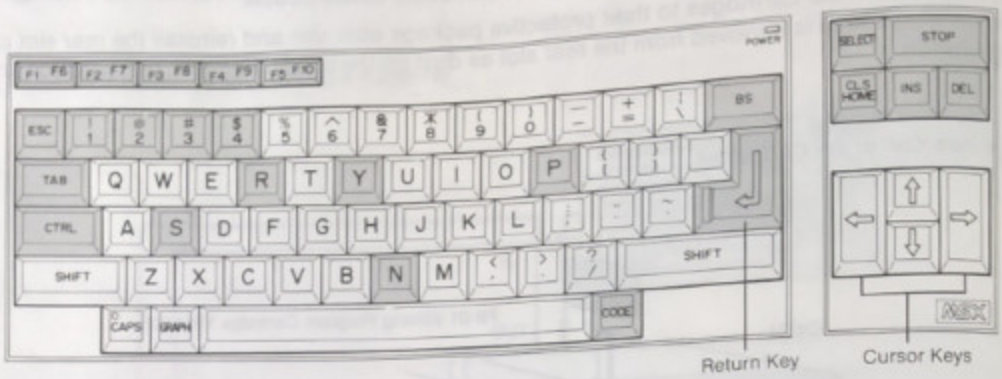
*Fig. 4 Insertion of the Cartridges*




- Prease read the information supplied on the Data Memory Cartridge packing carefully.

# A FIRST LOOK AT THE RELEVANT KEYS

*Fig. 5 The Computer Keyboard*




Maybe this page can help you find your way through this software program. Once you are familiar with all the functions and commands and suddenly come to the conclusion that you forgot how to use a particular key, you can come back to this page without having to read everything again. You will find a list of all the commands on p. 71.

| Key | Function | Page |
|---|---|---|
| [F1] | Switch to Edit/Command mode. | 13 |
| [F2] / [F3] | Check the velocity setting without an appropriate keyboard. | 27 |
| [F4] | Set the compare function. | 33 |
| [F5] | Display of a key list (Edit/Command mode). | 14 |
| [ESC] | Stop a Command. Return from the Transfer block/file list. | 12 |
| [1] ~ [4] [CTRL] | Switch the operator corresponding to the number ON/OFF. | 22 |
| [TAB] | Operator/instrument copy. | 27, 41 |
| [CTRL] + [TAB] | Restore the operator/instrument that has just been changed by a copy operation. | 27 |
| [CTRL] + [STOP] | Stop the printer operation. | 19 |
| [CTRL] + [S] / [R] | Save/Restore the Configuration/voice that is currently being edited. | 35, 36 |
| [CTRL] + [P] | Print out the screen page that is being displayed. | 19 |
| [Y] | Confirm a command. | 27 |
| [N] | Cancel a command. | 27 |
| [BS] | Erase one character to the left. | 21 |
| [SELECT] | Select the split point. | 34 |
| [STOP] | See "[CTRL] + [STOP]". | — |
| [RETURN] | Enter a command. Move to the Main Display. | 11 |

| Key | Function | Page |
|---|---|---|
| HOME / DEL | Decrease/Increase parameter value. Restore original name. | 20, 32 |
| INS + HOME / DEL | Decrease/Increase a parameter value in steps of 10. Select the lowest/highest value. | 20 |
| Cursor Keys | Move the cursor. Select another voice or Configuration. | 20 |
| CODE | Select the print mode. | 19 |

# CHAPTER II
# GETTING ACQUAINTED WITH THE FB-01 VOICING PROGRAM

# CHAPTER II
# GETTING ACQUAINTED WITH THE FB-01 VOICING PROGRAM

# INITIAL DISPLAY

## *Starting the Program*

(1) Make sure that all the equipment is properly connected. Switch on the FB-01.

(2) With the power to the computer OFF, insert the FB-01 Voicing Program cartridge into the upper cartridge slot of your computer.

(3) If you are using a floppy disk drive, turn ON the power to the drive unit.

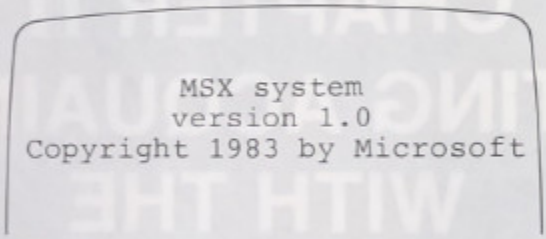
(4) Turn ON the power to the computer.

(5) The program will start automatically. An opening display will appear for a few seconds, then the program will switch to the display shown in Fig. 6.

★ If the program does not run, turn OFF the power to the computer and make sure that the FB-01 Voicing Program cartridge is properly inserted.

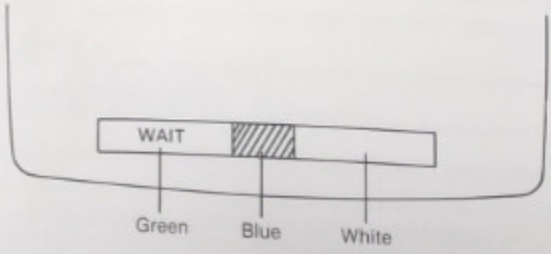
★ Always turn the power to the computer OFF before inserting or removing a cartridge; removing or inserting a cartridge when the power is ON can easily cause trouble.

*Fig. 6 BASIC Initial Display*




The data transfer from the FB-01 to the computer's memory takes some time. This is why the program will ask you to wait. As soon as the white rectangle has turned to blue, the program starts.

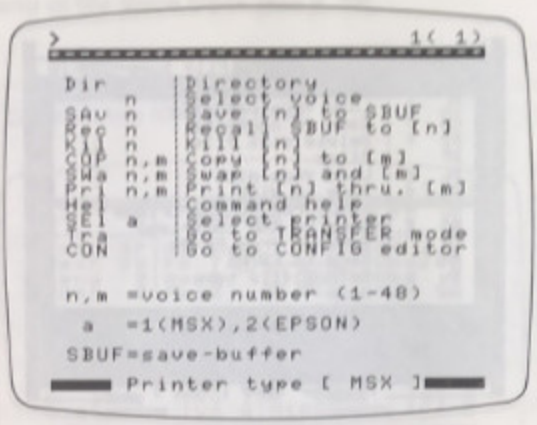
*Fig. 7 Lower Portion of the Initial Display*




NOTE: Be sure to properly connect the FB-01's MIDI cables, because otherwise, the program will begin with initialized voices.

- **The Voice Block**
  The first display of your program is this:

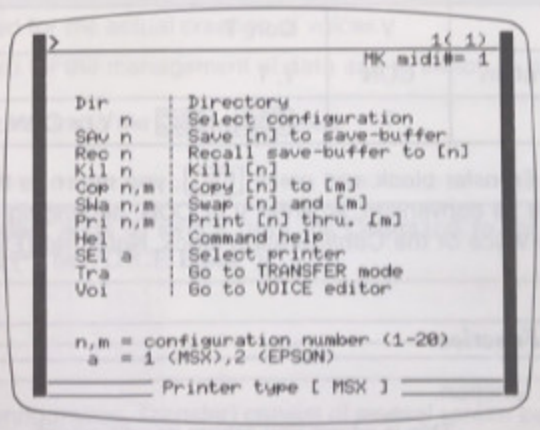
*Fig. 8 Initial Display of the FB-01 Voicing Program*




This screen page is called the Command Menu, because it provides you with a list of commands that you may use inside this block. This block is called the Voice Block. The division into blocks implies that there are also other blocks. Let us have a look at their Command Menus too.

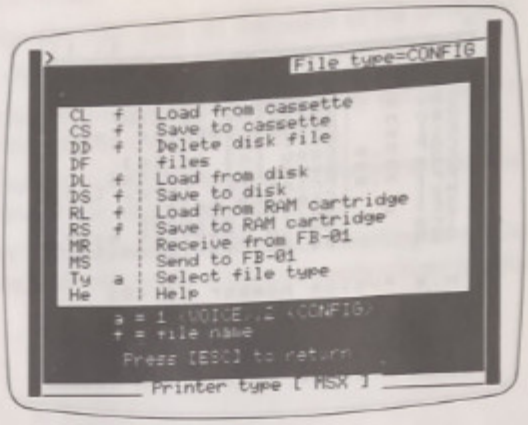
- **The Configuration Block**
  Type **CON**. These letters appear on the upper portion of the screen, just above the Keyboard Line (see p. 13). This part is called the Command Area, and every time the cursor is located here, you are in the Command Mode.
  Press RETURN (↵). This means that your command (**CON**) is entered and will be executed.

*Fig. 9 Command Menu of the Configuration Block*



- **The Transfer Block**
  The Transfer Block is the third and last block. Type **T** and press [RETURN].

*Fig. 10 Command Menu of the Transfer Block*




## *Switching from one Block to another*

Let us go back to the Command Menu of the Voice Block. Press [ESC]. As you will notice, you do not need to press [RETURN], which means that [ESC] is not a command.
The next thing you will see is that the display is not the one we wanted, but rather the Command menu of the Configuration block. Type V and press [RETURN] (from now on, we will call this "enter V". "enter V" means "type V and press [RETURN]"). Now we are back in the Voice block.

Table 1 The Blocks and their Commands

| Block | Command | Switching to the other blocks |
|---|---|---|
| Voice | V | Con; T |
| Configuration | CON | V; T |
| Transfer | T | [ESC]; [ESC] + V or CON |

Whenever you are in the Transfer block and press [ESC], you return to the block where you came from. This may not always be convenient, so enter V or **CON**, depending on where you want to go, i.e. to switch to either the Voice or the Configuration block. Note that [ESC] is the only way to exit the Transfer block.

## *The Blocks and their Function*

Every block has a specific function.

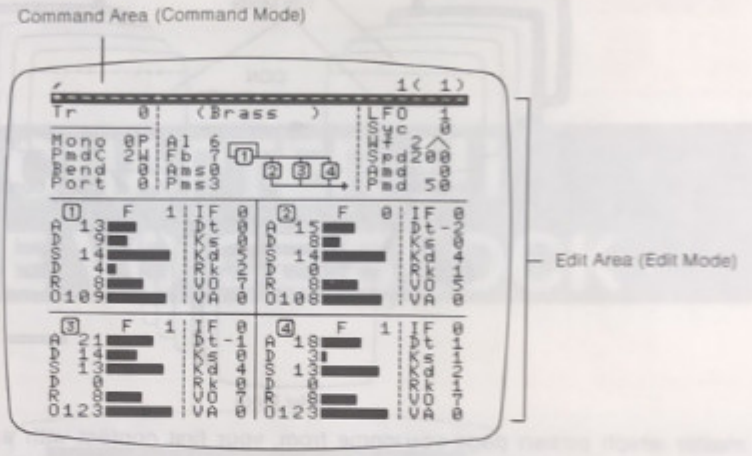
- The VOICE Block: This is where you create or edit voices.
- The CONFIGURATION Block: To set the performance data.
- The TRANSFER Block: Used for saving/loading all your data.

These blocks will be covered in chapters III, IV, and V respectively.

## *Command Mode vs. Edit Mode*

All the entries we have used so far have to be typed in the upper part of the screen, i.e. next to the arrow (in the upper left corner of the display). When the cursor is located here, you are in the Command mode.
Return to the Command Menu of the Voice block (see p. 12).
Next, press [RETURN].

*Fig. 11 Main Display*




You are still in the Voice block. This screen page is called the Main Display because this is where you will do the bulk of your work (see chapter III).
To change the parameters you have to move the cursor to the voice parameters but this is impossible in the Command mode. Press [F1]. The cursor is now on the value of Al (of "algorithm"), which means that you can change its number. You are also able to change (or edit) all the other parameters. In other words: this is the Edit mode.

- EDIT mode: Used for the actual creation of voices.
- COMMAND mode: Used for the management of data and to switch to other blocks or displays.

★ Press [F1] once again to return to the Command mode.

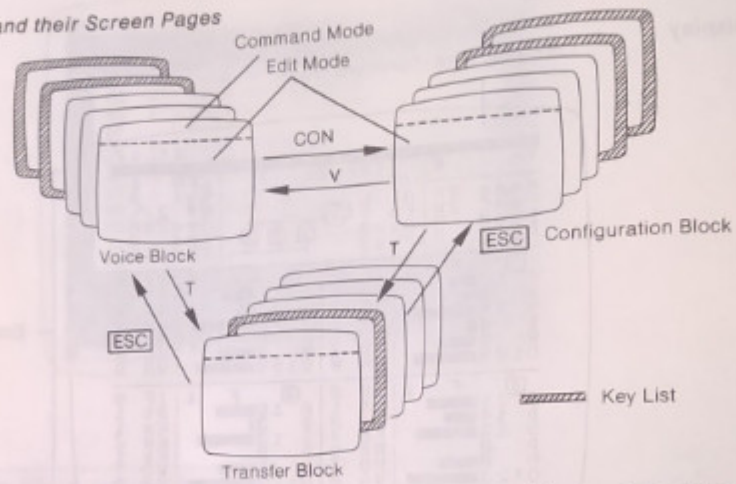
NOTE: There are also other ways to switch from the Command to the Edit mode. They will be covered in Chapter III ("The VOICE Block").

## *The Screen Pages*

The three blocks (Voice, Configuration, Transfer) consist of several screen pages. These screen pages include a Directory (one for the voices and one for the configurations). The Main display is another screen page of the Voice block.

The Voice and the Configuration modes both consist of five screen pages, two of which are Key lists (memory aids). Both blocks feature one Key list for the Command mode and one for the Edit mode (see below).
The Tranfer block has also five screen pages (two of which cannot be selected see p. 17, "Dir").
All these screen pages will be explained in the chapters relating to the blocks.

*Fig. 12 The Blocks and their Screen Pages*

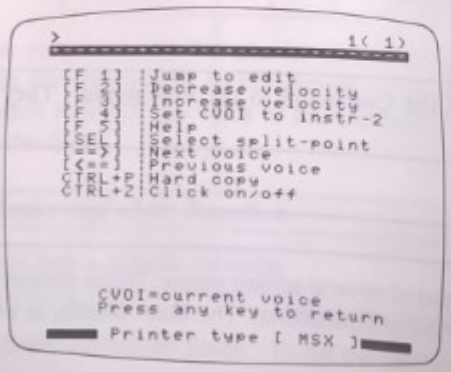


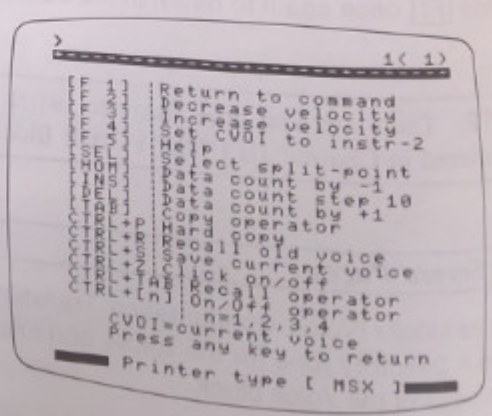

No matter which screen page you come from, your first contact with another block is always its Command menu. So before being able to select the desired display, you first have to call its block (see p. 11) and make your choice from its Command menu.

## *The Key Lists*

Whenever you do not remember which key you are to press to carry out a particular operation, press F5. Depending on the mode you are in (Command or Edit), you will be provided with an Edit or a Command Key list. Return to the Voice block and press F5.

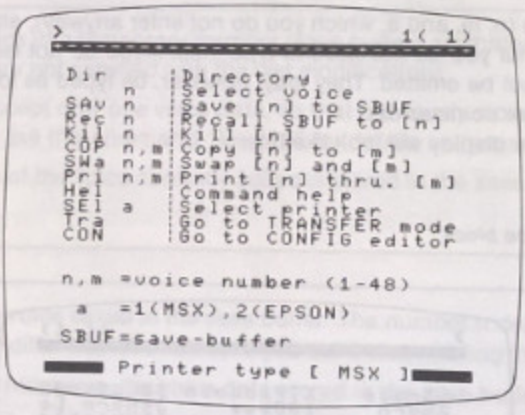
*Fig. 13 Command and Edit Key List (Voice Block)*




Press any key to return to the previous screen page.
As the Transfer block only works in the Command mode, it features only one Key list.
Why don't you have a look at the Key list(s) of the Configuration and Tranfer blocks?

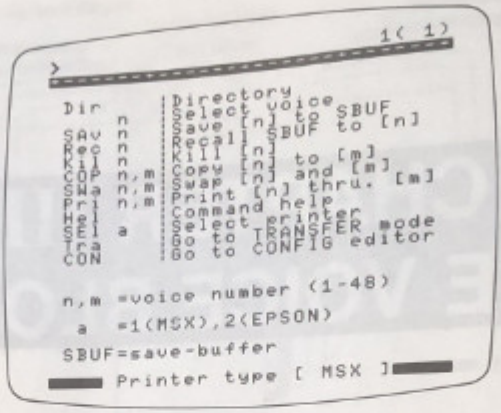
# CHAPTER III
# THE VOICE BLOCK



## Upper and Lower Case Letters

Call the Voice block.

*Fig. 14 Command Menu of the Voice Block*




Except for the parameters (n, m, and a, which you do not enter anyway), all the lower case letters are redundant. This means that you do not need to type them if you do not feel like doing so. Capitals, on the other hand, may not be omitted. They may, however, be typed as lower case letters (this also holds for the one-character commands).
Enter **d** (Directory) and the display will look like this:

*Fig. 15 Directory of the Voice block*


Let us go back to the Command menu. Enter **h** (Help). Now enter **di**. The Directory appears once again. Return to the Command menu (enter h). Now enter **CO** (Copy or Configuration). The computer will tell you that this is a **Bad command**, so enter either **COP** or **CON**. Both commands are accepted.

## *Dir (Directory)*

The first thing one will usually do after switching on one's system is to check whether the voices have been loaded from the store device. The easiest (and fastest) way to do this is to look at the Directory. So enter **d** (or Dir). If the Directory reads "initial" for all 48 voices, there are no data in the computer's memory.

★ The Transfer block also provides two Directories (see p. 46). However, copy and swap operations have to be carried out in the Voice and Configuration blocks.
Furthermore, the Transfer Directories only apply for data you loaded yourself (as the first data are loaded automatically as soon as you switch your computer ON).

## *n (SELECT n)*

This command switches to the Main display (see p. 18), but you are still in the Command mode. The voice parameters corresponding to the number that you entered as a command are now displayed on the screen. If the number **n** is not in the range 1 ~ 48, the message **Bad argument** appears.

★ When you are in Command mode, pressing the [←] or [→] cursor keys produces a similar effect but the number of the voice corresponds to the number of the voice last displayed, decremented ([←]) or incremented ([→]) by one.

## *SAv n (SAVE n)*

This is used to store a voice in a temporary memory (save buffer), so that you may further modify the voice and recall it if you are not satisfied with the last modifications.

★ The save buffer can accept only one voice data, so that previously stored data will be replaced by the new one when you use this command. See p. 35 for details on memory organization.

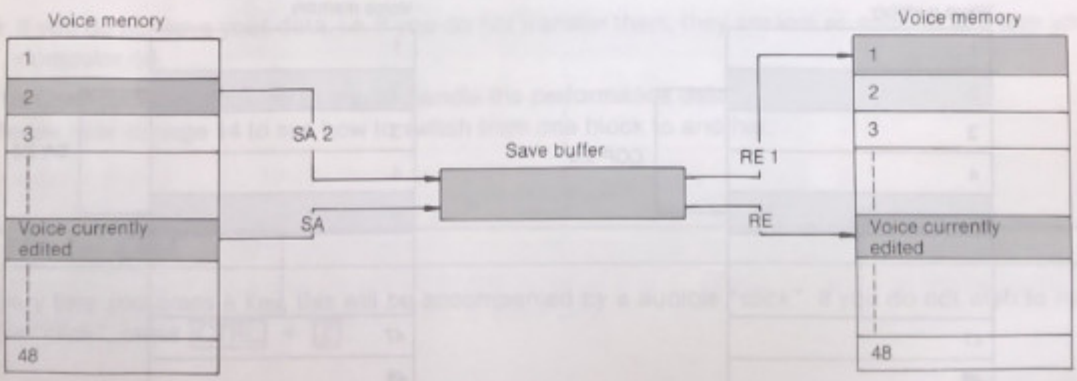
★ If **n** is omitted, the data of the voice currently edited is stored in the save buffer.

## *Re n (RECALL n)*

This command recalls the voice saved in the save buffer. The number **n** designates the destination in the voice memory and may differ from the number **n** you used when storing the voice data to be recalled.

★ If you omit to input the number **n**, the voice data stored in the save buffer replaces the data of the voice currently edited.

*Fig. 16 SAve and Restore commands*

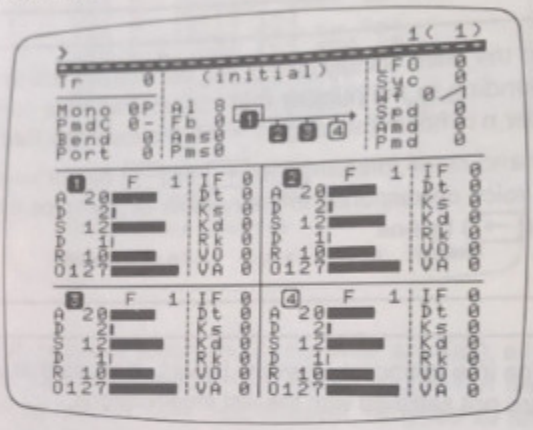


## Kil n (KILL n)

This command is used to INITIALIZE a voice in order to create a new voice from scratch.

- ★ You must specify n with this command.
- ★ The voice data is stored in the save buffer in the state it was before the use of this command. This means the original state can be restored after accidental deletion.
- ★ Do not use this command when you want to modify a voice because it serves for the creation of a new voice from scratch only.

*Fig. 17 Initialization of the voice data*



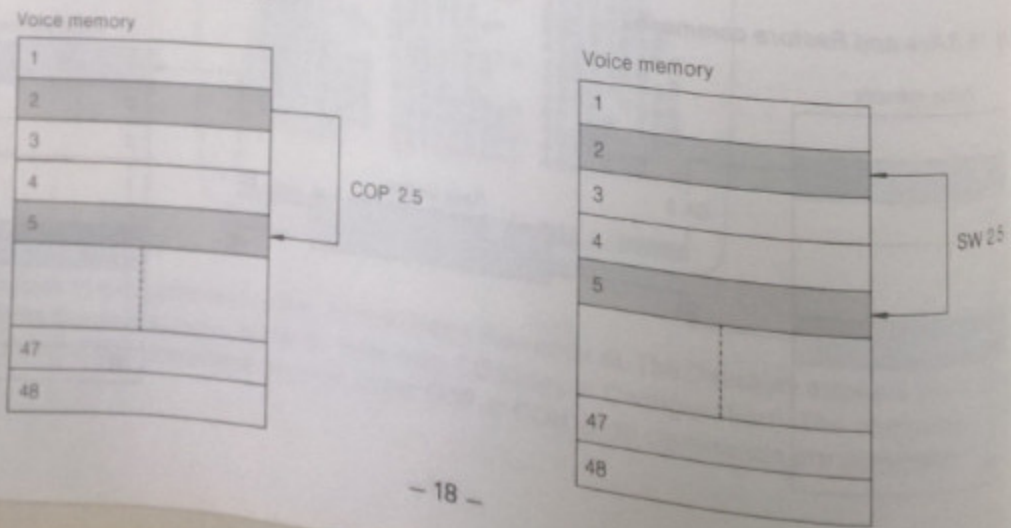

## COP n, m (COPY n to m)

This command copies the voice data specified by n to the location of the voice data specified by m. Parameters are indispensable.

## SWa n, m (SWAP n and m)

This command swaps voice data between the memory locations specified by n and m. Parameters are required.

*Fig. 18 COPy and SWap commands*



### *Pri n, m (PRINT n through m)*

Enables you to print out the voice data from number n through number m. If you only wish to print out the data of one voice, type in its number twice. Do not forget to specify the parameters.

★ If you hold down [CTRL] and then press [P] (from now on, we will call this "press [CTRL] + [P]"), you can print out any page. This is also the easiest way to make a hard copy of the parameters of one single voice.

★ Use the [CODE] key to select the print mode.

| Default setting | [CODE] key pressed once |
|---|---|
| Normal | Light |

★ Press [CTRL] + [STOP] to interrupt the printing process.

### *Hel (Help: Command Menu)*

This is the command one has to enter to return to the Command menu of a block. As a matter of fact, h is as useful a command to remember as the [F5] key (see p. 14), because it always takes you back to the Directory.

### *SEl a (Select Printer)*

Selects the printer type. Enter one of the two values:

| Value | Printer type |
|---|---|
| 1 | MSX |
| 2 | EPSON |

### *Tra and CON (Transfer and Configuration Blocks)*

Two commands you are already familiar with. The former (T) calls the Transfer block where the data are saved onto or loaded from other units, including the FB-01 itself.

★ If you do not save your data, i.e. if you do not transfer them, they are lost as soon as you turn your computer off.

The Configuration block helps you to handle the performance data.
Please refer to page 14 to see how to switch from one block to another.

### *The Key Click*

Every time you press a key, this will be accompanied by a audible "click". If you do not wish to hear this "click", press [CTRL] + [Z].

# EDIT MODE

The main feature of the FB-01 Voicing Program is its edit mode, which is used to create sounds and to combine them. The various functions of this mode are explained below.

## *Switching to the Edit Mode*

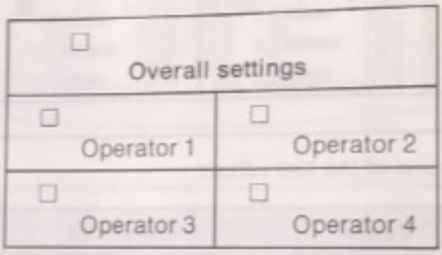
The FB-01 Voicing Program automatically enters the Command mode when the power is turned on. Let's assume you are going to edit the Brass voice, located in voice memory number one. While the computer is still in the Command mode, type in 1 and press the [RETURN] key. The voice data of Brass will be displayed, but the cursor still remains in the Command mode. To enter Edit mode, press [F1].

★ If you press [F1] when the system is in the Command mode, the main display will always re-appear with the data of the voice curently being edited. The cursor is located on the algorithm setting area.

★ Pressing the [←] or [→] cursor keys when the system is in Command mode switches to the main display without exiting the Command mode. The voice number of the data is increased ([→]) or decreased ([←]) by one.

The display of the voice data is divided into five blocks. The lower four blocks correspond to the four operators and display the data (parameters) for setting each operator.

*Fig. 19 Edit Area Blocks*




NOTE: See the APPENDIX for an "Introduction to the FM Sound Synthesis"

## *Editing*

(1) Use the cursor keys to move the cursor to the parameter you want to edit.

(2) Use the [HOME], [INS] and [DEL] key to alter the value.

| Key | Change |
|---|---|
| [HOME] | −1 |
| [DEL] | +1 |
| [INS] + [HOME] | −10 (or minimum value) |
| [INS] + [DEL] | +10 (or maximum value) |

You may also alter a parameter by positioning the cursor over it, and then typing in a new value. In this case, the new value is entered after you press [RETURN] or as soon as you move the cursor to another area.

★ To change the voice name, move the cursor to the name and type a new one. The [BS] key erases one character to the left; the space bar creates a blank space. Pressing the [RETURN] key moves the cursor back to the beginning of the name.

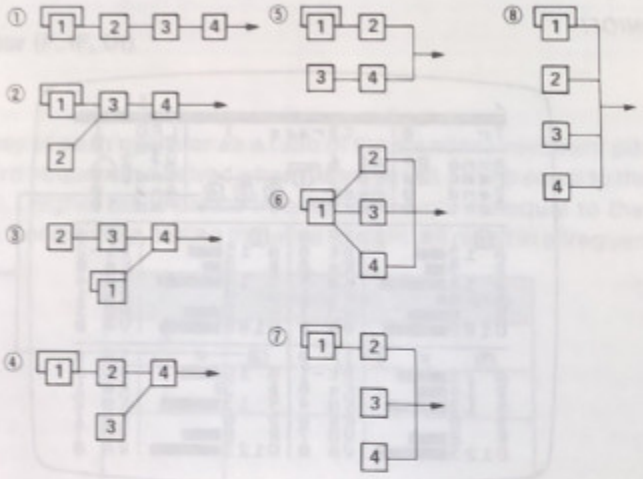
## *Parameters*

NOTE: The FB-01 Voicing Program provides a Compare function. Please refer to page 33.

**Algorithms (Al)**

This selects the algorithm from the eight algorithm patterns available. Select the number of the desired algorithm after moving the cursor to the Al position. Selecting another algorithm can cause a significant change in the voice. The various algorithm patterns have the configurations shown in the following diagram. An operator functions as a modulator when its output goes to another operator, and as a carrier when its signals are output directly. A general rule of algorithms is that the fewer carriers there are (thus the more modulators), the more complex the voice will become, and the easier it will be to create noise components (broad band frequency spectra).

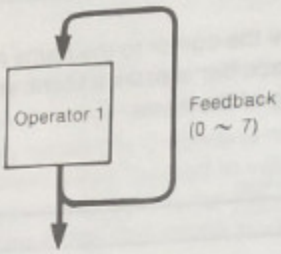
*Fig. 20 Algorithm Patterns of the FB-01 Sound Generator*




**Feedback (Fb)**

Operator 1 has a feedback feature which allows that operator to modulate itself. The high-frequency components will increase and the voice will change considerably as the amount of feedback increases. The amount of feedback can be set within the range of 0 to 7. Check the effect of the feedback by using algorithm 8 and turning operators 2, 3, and 4 OFF.

*Fig. 21 Feedback*

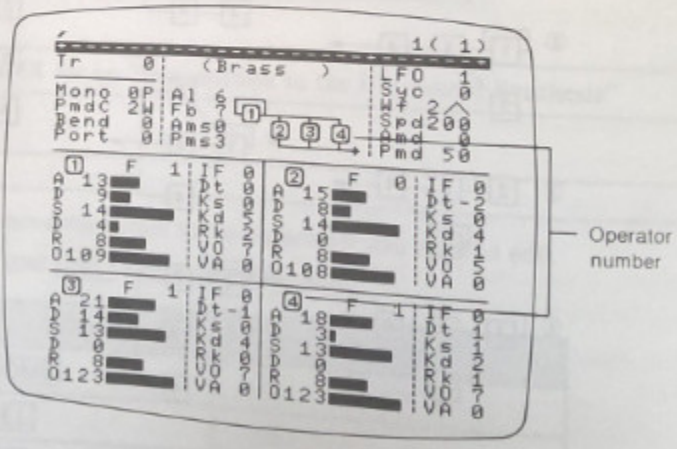



**Operator ON/OFF**

Each of the four operators can be switched ON/OFF during the process of editing so you can quickly hear the effect of cutting the output of an operator. Switching is done by pressing the number key corresponding to the desired operator (1 ~ 4) while holding down the CTRL key. For example, operator one can be turned OFF by pressing the 1 key while the CTRL key is held down. When the 1 key is pressed, the color of its indicators will be reversed both in the algorithm pattern and in the heading of its data block, and the operator function will be suspended. The operator can be turned back ON by pressing the 1 and CTRL keys again in the prescribed manner.

★ An operator can also be turned OFF by positioning the cursor over its number in the operator block and then pressing HOME. Pressing DEL will turn it ON. You may also move the cursor over the operator number and type in a different number to turn it OFF or the correct number to turn it ON. Such a change is actually entered after you press the RETURN key or move the cursor away from the operator number.

*Fig. 22 Operators ON/OFF*




★ An operator is functioning when the background color of its indicator is yellow; it is not functioning when the background is inverted and becomes black.

NOTE: Sound does not pass through an operator that is OFF. Therefore, if you turn OFF a carrier you will not hear the modulators connected to the carrier. Similarly, if you turn OFF a modulator that feeds into a carrier, any modulator feeding that modulator will have no effect.

Let's analyze the voice data for Brass by using this operator ON/OFF feature. The algorithm pattern is 6 which means that operators two to four are carriers, while operator one is the modulator. Turn OFF operator one and play a few notes. You are listening to the carriers two to four. The pure sound that you hear is the sound of an unmodulated sine wave. Turn ON operator one and listen to how the sound changes as soon as you turn each operator on.

**Output level of operator (O)**

- O (Output level)

This sets the output level of the operators. With the FM Sound Generation system, the volume and the timbre will change according to the output level of the operators.

The setting range is 0 (minimum) to 127 (maximum). Try changing the output level of Brass with operators two and three OFF. First change the output level of operator four (default setting is 127). This will change the volume because operator four is the carrier. Next, change the output level of operator one (default is 112).

Operator one is a modulator, thus its output level affects the degree of modulation. As the level is raised, the amount of modulation will increase and the sound will become more brilliant because the number of the harmonics increases. Increasing the output level of the modulator still further will cause the sound to become noise. Lowering the output level of the modulator will cause the sound to become purer as the degree of modulation decreases. There will be no frequency modulation (if operator 1 is OFF), and the voice output will become a sine wave when the modulator output level drops to 0.

**Frequency of operator (F, IF, Dt)**

- F (Frequency)

This sets the frequency of each operator as a ratio of the standard keyboard pitch. The setting range is 0 to 15. The keyboard frequency is halved when the value is 0. One is equal to the keyboard frequency (based on eight feet). Higher ratios create frequencies which are equal to the keyboard frequency multiplied by the ratio. For example, setting the value to eight will result in a frequency eight times higher.

| F | Pressed key pitch ratio |
|---|---|
| 0 | 0.5 |
| 1 | 1 |
| . | . |
| . | . |
| . | . |
| 15 | 15 |

- **IF (Inharmonic Frequency)**

This also sets the frequency of the operators but in terms of non-integer multiples or odd-numbered harmonics of the reference frequency. The setting range is 0 to 3 and the set frequency is determined as follows:

| Set value | Frequency ratio |
|---|---|
| 0 | 1 times the set ratio (1 x F) |
| 1 | 1.41 times the set ratio (1.41 x F) |
| 2 | 1.57 times the set ratio (1.57 x F) |
| 3 | 1.73 times the set ratio (1.73 x F) |

Thus, for example, if F = 2 and IF = 3, the frequency will be 2 x 1.73 or 3.46 times the keyboard pitch. Generally, IF will be set to 0 for most voices; high IF values are useful for creating unusual timbres.

*Table 2 Frequency Ratio determined by F and IF Settings*

| IF \ F | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.50 | 1.00 | 2.00 | 3.00 | 4.00 | 5.00 | 6.00 | 7.00 | 8.00 | 9.00 | 10.00 | 11.00 | 12.00 | 13.00 | 14.00 | 15.00 |
| 1 | 0.71 | 1.41 | 2.82 | 4.33 | 5.64 | 7.05 | 8.46 | 9.87 | 11.28 | 12.69 | 14.10 | 15.51 | 16.92 | 18.33 | 19.74 | 21.15 |
| 2 | 0.79 | 1.57 | 3.14 | 4.71 | 6.28 | 7.85 | 9.42 | 10.99 | 12.56 | 14.13 | 15.70 | 17.27 | 18.84 | 20.41 | 21.98 | 23.55 |
| 3 | 0.87 | 1.73 | 3.46 | 5.19 | 6.92 | 8.56 | 10.38 | 12.11 | 13.84 | 15.57 | 17.30 | 19.03 | 20.76 | 22.49 | 24.22 | 25.95 |

Turn ON operators one and four only for Brass and listen to the changes in sound as the frequency ratio changes. The pitch will increase as the frequency of the modulator (operator one) increases resulting in a more brilliant sound.

- **Dt (Detune)**

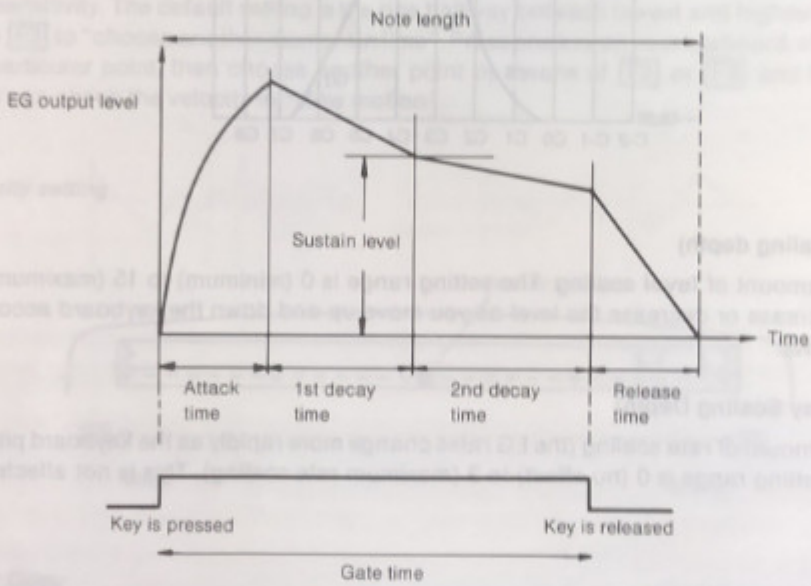
This feature allows the sound to be modified by slightly shifting the pitch of the operators. The setting range of the operators is −3 to 3 (0 is the normal setting). A sound effect similar to a phaser can sometimes be created by slightly shifting the pitches of the carrier and modulator. "Honky-tonk" piano is also aided by pitch detuning. Shifting the pitch of the carriers of algorithm patterns which have more than one carrier, such as algorithms 5 to 8, will allow the creation of a chorus-like effect.

**Envelope generator (A, D, S, D, R)**

The envelope of each operator is set in the order A, D, S, D, R. The setting range of these components are as follows:

| Screen display | Function | Setting range |
|---|---|---|
| A | ATTACK RATE | 0 ~ 31 |
| D | 1st-DECAY RATE | 0 ~ 31 |
| S | SUSTAIN LEVEL | 0 ~ 15 |
| D | 2nd-DECAY RATE | 0 ~ 31 |
| R | RELEASE RATE | 0 ~ 15 |

*Fig. 23 The parameters controlled by envelope generator*




RATE is the rate at which change occurs. Changes become more significant as the set value is increased. An exception is that there will be no change if the RATE of the ATTACK, 1st DECAY, or 2nd DECAY is set at 0. For example, if A is set to 0, the EG output level will not rise for ATTACK (there will be no operator output). If the second D is 0, the output level will not fall for the second DECAY so the level will remain at the sustain level until the key is released.

Try various envelope combinations with only operator four ON. Alter values after moving the cursor to the A, D, S, D, and R of operator four.

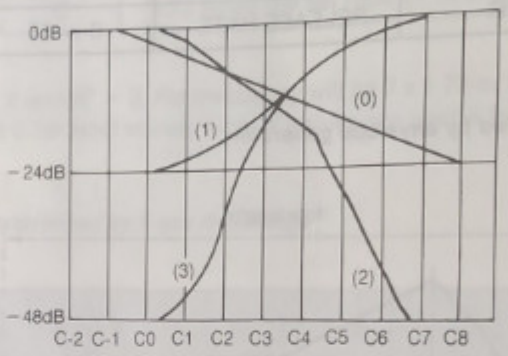
**Key scaling (Ks, Kd, Rk)**

This feature changes the EG response in relation to the pitch.

- Ks (Key Scaling select)

Choose Ks = 0 ~ 3 as the level scaling curve (scaling in relation to EG output level). Depending on the setting you choose, the notes will sound differently. That way you can either cut off high frequencies of the highest notes or add treble to the lowest notes.

*Fig. 24 Key Scaling Select*



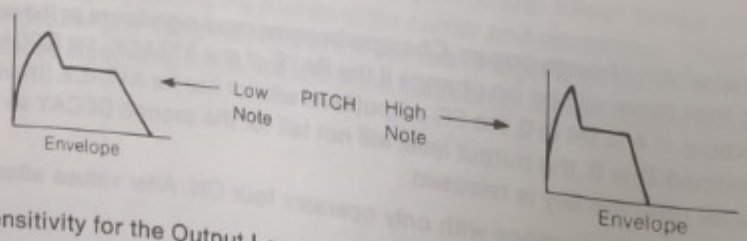

- Kd (Key Scaling depth)

This sets the amount of level scaling. The setting range is 0 (minimum) to 15 (maximum). The level scaling will increase or decrease the level as you move up and down the keyboard according to the curve set with Ks.

- Rk (Rate Key Scaling Depth)

This sets the amount of rate scaling (the EG rates change more rapidly as the keyboard pitch becomes higher). The setting range is 0 (no effect) to 3 (maximum rate scaling). This is not affected by the Ks setting.

*Fig. 25 Rate Key Scaling Depth*




- VO (Velocity Sensitivity for the Output Level)

"Velocity Sensitivity" means that it matters a great deal how hard (and therefore how fast) you hit a key because the sound (and the volume) of a note will differ. Some synthesizer keyboards are capable of producing this effect and are thus comparable to a piano keyboard. The FB-01 accepts velocity data (sent from an appropriate keyboard), but does not always act according to these bits because

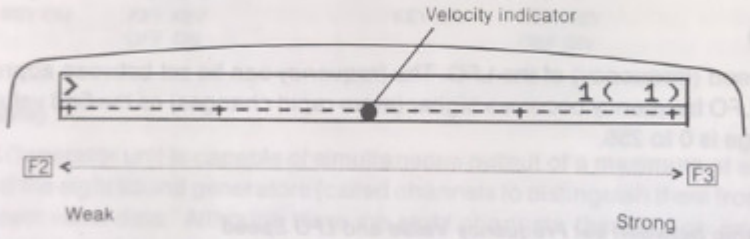
one can also set the sensitivity, i.e. the extent to which velocity bits will be taken into account. A setting of 0 ignores the velocity bits, whereas a setting of 7 produces a maximum response.
You can set the sensitivity for all four operators, which means that the effect of added harmonics (modulators) and increased volume (carriers) will be quite similar to the one produced on a piano keyboard, and hence more realistic.

- **VA (Velocity Sensitivity for the Attack Rate)**

This sets the degree to which the velocity data affect the attack rate of the envelope generator. The setting range is 0 to 3 (maximum sensitivity). An increase in sensitivity means that the attack will slow down when keys are struck lightly, and speed up when keys are struck strongly.

★ Checking Velocity Settings without a Touch Sensitive Keyboard
If you use a YK keyboard that does not generate any velocity data, you can still check the effect while programming a new sound. That way, you know how your sound is going to react when triggered by a velocity sensitive keyboard.
This is where the keyboard line of the Voice block comes in. You will have noticed that there are two dots on this line (Command menu, Directory, and Main Display). The yellow dot refers to the velocity sensitivity. The default setting is the one halfway between lowest and highest velocity. Press [F2] and [F3] to "choose another moment in time". Press one key on your keyboard, check the sound at that particular point, then choose another point by means of [F2] or [F3] and try again. This way, you can check the velocity in "slow motion".

*Fig. 26 Velocity setting*




- **Operator Copy**

This is one of the hidden functions of the YRM-506. Move the cursor to the operator block you want to copy and press the [TAB] key. The Command area will read **COPY n to m** (n representing the operator to copy and m the operator you want to change), thus requesting you to specify the second number. You do not need to press the [RETURN] key. The operator to be copied will also appear on a red background in its block. Press [ESC] to stop this function (before you specify a number!)

★ You can also recall the previous operator setting. Press [CTRL] + [TAB] and the Command area will read **Restore Op n?**. This is where you hit either the [Y] (Yes) or the [RETURN] key. Pressing the [N] (NO) or the [ESC] key cancels the restore operation.

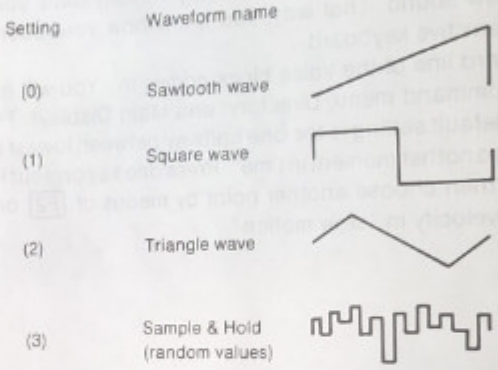
## *LFO (LFO, Syc, Wf, Spd, Amd, Pmd, Ams, Pms)*

The LFO (Low-Frequency Oscillator) generates very low frequency signals which are used to modu
the voice. It allows the creation of vibrato and tremolo effects by changing the pitch and amplitud
of the voice. The LFO section has several related parameters that all affect the voice.

- **Wf (Waveform)**

This selects the waveform of the LFO. The changes in pitch and/or amplitude (volume) will follow th
selected waveform. The setting range is 0 to 3:

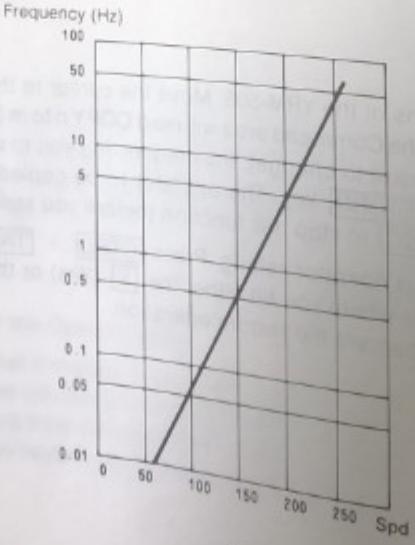
*Fig. 27 Wave Form Shapes*




- **Spd (Speed)**

This sets the speed (frequency) of the LFO. The frequency can be set between approximately 0.00
and 53Hz. The LFO frequency becomes higher (more rapid changes) as the Spd value becomes larg
The setting range is 0 to 255.

*Fig. 28 Relationship between set Frequency Value and LFO Speed*



- **Amd (Amplitude Modulation Depth)**

This is a scaling factor which determines how much the LFO will affect volume (output level of the carrier). The setting range is 0 to 127. The depth increases (more volume change) as the **Amd** value becomes larger.

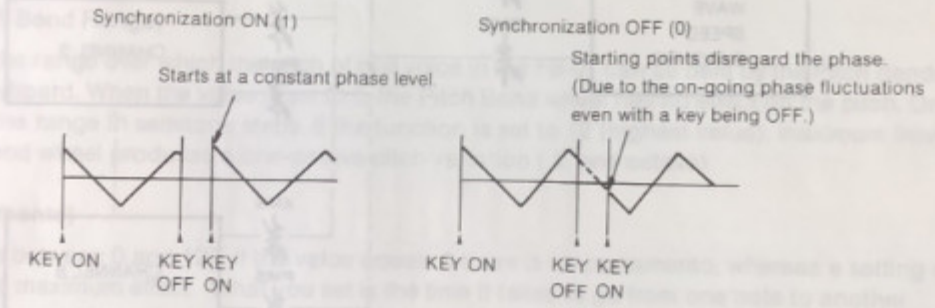
- **Pmd (Pitch Modulation Depth)**

This is a scaling factor which determines how much the LFO will affect the pitch of all operators. The setting range is 0 to 127. The depth (amount of pitch change) increases as the value becomes larger.

- **Syc (Sync)**

This sets whether or not the LFO is synchronized to the playing of a note. Pressing [DEL] activates synchronization, pressing [HOME] releases it. The Synchronization ON mode (**1**) means that the waveform of the LFO will re-start each time the key is played whereas a **0** setting may catch the LFO in the middle of a waveform. This is shown in the following diagram:

*Fig. 29 Starting Point of the LFO*




- **LFO (LFO Enable)**

The FB-01 Sound Generator unit is capable of simultaneous output of a maximum of eight voices. This means that each of the eight sound generators (called channels to distinguish them from the operators) may contain different voice data. Although there are eight channels, there is only one LFO in the FM Sound Synthesizer Unit, and it can have only one voice-controlled setting at a time.

This may create difficulties at times, such as when you want to use the simultaneous output of "strings" which require the LFO, and percussion which does not use the LFO. (see p. 40)

Use the **LFO** Enable feature, which is usually set to **1** (ON). Setting it to **0** (OFF) will result in no LFO data. This means that there will be neither amplitude not pitch modulation.

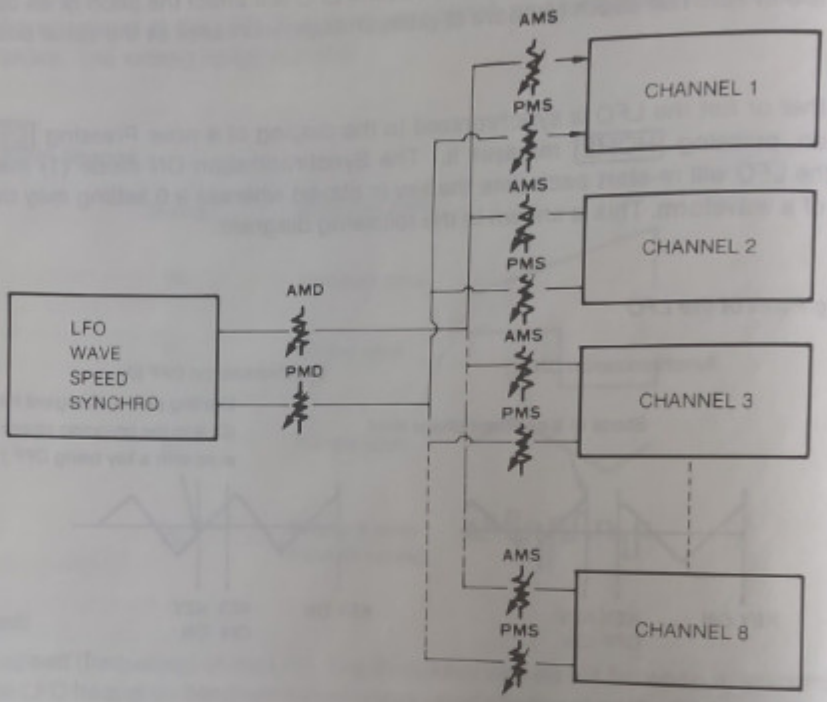
- **Ams (Amplitude Modulation Sensitivity)**

While the **Amd** setting determines how much LFO signal can be applied to the voice, it does not directly affect the voice. Amd signal must go through a "gate" known as **Ams**. The sensitivity of the voice to amplitude modulation can thus be altered for proper response when a number of voices are simultaneously output. **Ams** scales the voice's LFO sensitivity to change the voice output level or volume. The setting range is 0 (no amplitude modulation) to 3 (maximum amplitude modulation).

- **Pms (Pitch Modulation Sensitivity)**

Once again, this is a "gate" or scaling factor, but it controls how much the set **Pmd** will affect the voice's pitch. The setting range is 0 (no pitch modulation) to 7 (maximum pitch modulation).

*Fig. 30 Block diagram showing the relationship between Amd, Pmd, and Ams, Pms, for each channel*




There will be no LFO effect in relation to pitch when either **Pmd** or **Pms** is 0. Similarly, there will be no LFO effect in relation to volume when either **Amd** or **Ams** is 0.

## *Additional Parameters*

- **Tr (Transpose)**

This allows transposing in half steps. The setting range is −128 to 127 (change this value by 12 to transpose one octave). If the transposed pitch of the note played exceeds the range of the sound generator, the FM Sound Synthesizer will raise or lower the actual pitch in one octave units as required. The transpose feature is very useful when you are using the keyboard for comparison. You may adjust the overall pitch of instrument-1 so that exactly the same pitches are available on instrument-1 and instrument-2.

• Mono

This function selects either the POLY or the MONO note output. Use the [HOME] or the [DEL] key to select either mode.

| Mode | Display |
|---|---|
| Poly | 0P |
| Mono | 1M |

Note that the portamento setting varies according to the note output mode (see below).

★ Poly mode: Every time you press a key, the EG will function. If you exceed the number of eight keys, the added notes will sound, but the first will be deleted, thus ensuring that there are only 8 Note on messages.

★ Mono mode: Legato notes trigger no new EG operation, i.e. they possess no distinctive features as for the EG goes. Last note priority (if you try to play a chord, only the lowest note will sound).

• Bend (Pitch Bend Range)

Is used to set the range over which the pitch of one voice in the FB-01 can be bent by the Pitch Bender of the MIDI-keyboard. When the value is set to 0, the Pitch Bend wheel has no effect on the pitch. One can increase the range in semitone steps. If the function is set to 12 (highest value), maximum travel of the Pitch Bend wheel produces a one-octave pitch variation (± one octave).

• Port (Portamento)

Selects a value between 0 and 127. If the value equals 0 there is no portamento, whereas a setting of 127 produces a maximum effect. What you set is the time it takes to go from one note to another.

★ Poly Mode: Constant portamento, regardless of your performance.

★ Mono Mode: "Fingered portamento". There will only be portamento if you play legato. If you release one key before pressing another one, there will be no portamento.

• PmdC (Pitch Modulation Depth via a Controller)

You can also generate a vibrato-like effect via a MIDI-controller. Actually, you may choose among four different kinds of controllers that trigger this effect:

| Controller | Display |
|---|---|
| None | 1– |
| After touch | 2T |
| Modulation wheel | 3W |
| Breath Controller | 4B |
| Foot controller | 5F |

The depth of this effect can be controlled in real time using the selected controller on the synthesizer or MIDI-device. Don't forget that instruments of a given Configuration, whose PmdC is set to respond to the same controller, will all react whenever you use that particular controller.

## *Voice Name*

As soon as you are satisfied with your voice, you will have to name it. Move the cursor to the bracket and type the name. Some keys may produce strange characters. Please select other characters.

★ Pressing either [DEL] or [HOME] (BEFORE returning to the Command mode, see p. 35, "Buffers and Memories") will restore the original name.

# KEYBOARD SPLIT FEATURE

The music keyboard can be split into two sections at any point: one section for editing and the other for comparison. The section of the keyboard designated for editing can be played to allow you to hear the effect of modified voice data as it is entered for the purpose of checking. The voice sounded by the comparison section of the keyboard will remain unchanged until you reset that section. This allows sound creation to be carried out in the edit mode while comparing the previous voice on the comparison section to the new voice on the editing section.

NOTE: The Split Feature works on both the YK and MIDI keyboard.

## *Keyboard for Editing*

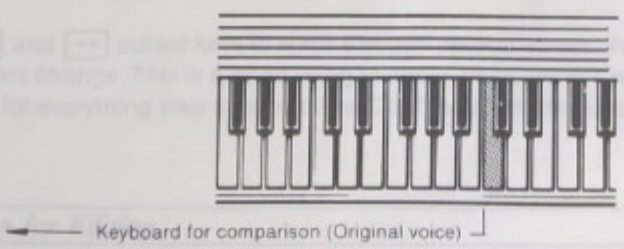
The section of the keyboard above the split point is designated for editing; it can output a maximum of seven voices simultaneously. The voice data specified when the edit mode is first selected is the voice which is automatically set for this portion of the keyboard.

*Fig. 31 Keyboard for Editing*


## *Keyboard for Comparison*

The section below the keyboard split point is a monophonic keyboard to be used for comparison purposes. The current voice data is set for this keyboard by pressing the F4 key in the edit mode.

*Fig. 32 Keyboard for Comparison*



## *Setting the Keyboard Split Point*

The keyboard split point is automatically set as the lowest key on the keyboard when the program is started. In other words, the keyboard for editing uses all the keys on the keyboard. To change the split point, first press the [SELECT] key. The color of the (●) indicator on the keyboard line (directly below the Command area) will change from green to red. Next, press the key on the keyboard corresponding to the desired split point. The red (●) indicator will return to its original green color and move to the selected position. The green mark indicates the current position of the keyboard split point.

*Fig. 33 Keyboard Split Indicator*

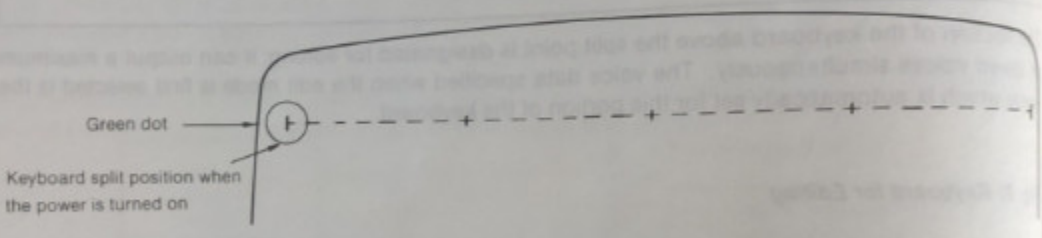
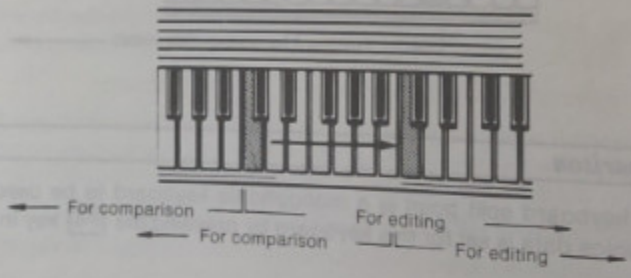



*Fig. 34 Example of Change of the Keyboard Split Point*



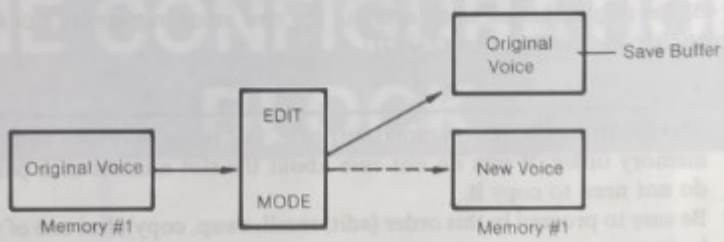
# BUFFERS AND MEMORIES

If you own a Yamaha DX Synthesizer, you should read this section very thoroughly. The memories of the computer do not function the same way as the ones on your synthesizer.

★ The Edit/Compare function is different. You can immediately compare the voice that is being edited with the source voice. (see "Keyboard Split Functions")

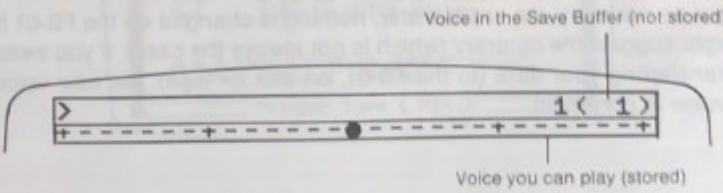
★ The buffer system, too, differs from the one applying to your DX. Here it is the source voice that is loaded into the Save buffer, while the new voice is stored in the slot of the voice it is derived from. You can do this yourself by either pressing [CTRL] + [S] or by entering a save command (see p. 17).
However, as soon as you return from the Command mode to the Edit mode, your new creation (whether perfect or not) occupies the memory slot of the original voice.

*Fig. 35 Memory Organization*




This means that if you load another voice into the Save buffer, you lose a voice you may not want to loose. (On the DX, however, the source voice is not replaced by the edited one unless you store the letter.) SO BE CAREFUL.

*Fig. 36 Buffer Voice and New Creation*




Use the [←] and [→] cursor keys to scroll through several voices. You will notice that only the stored voice numbers change. This is a good thing to know, because this way, you see which Voice (or Configuration, for everything also applies to the Configuration mode) is in the Save Buffer.

## *Suggestion for Editing*

Keep slot 48 free for voice ping-ponging and use it as follows.

- **Choose the voice you want to work on.**

Switch to the Edit mode and change the voice to meet your requirements.

When you have finished, you had better go to the Directory (D, remember?) because that way, y
have visual control over the saving operation.

- **Recall the Original Voice**

We shall send the original voice to #48. So enter **re 48**, meaning "recall voice number 1 (the origi
voice) and send it to memory slot #48." (It goes without saying, that it does not necessarily hav
be #48.)

NOTE: There is another Recall command which you can use while you are editing. This comman
is accessed via [CTRL] + [R] and restores the original voice. Hence, this is the fastest way t
reset the edited voice and to start again without affecting the original voice.

- **Swap the Voices**

Call number 48 (the original) back to #1 and put the new voice in memory slot #48. Enter **SW 1 4**
and then copy #48 to the desired slot. (2 ~ 47)

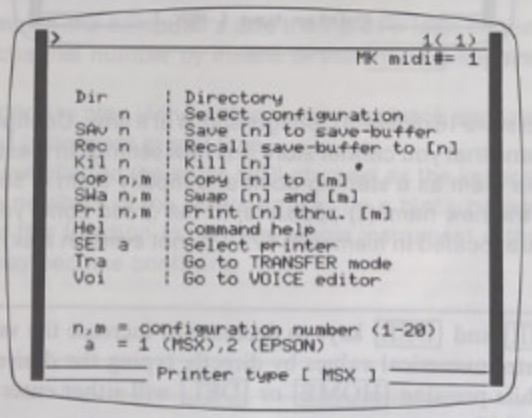
NOTE: (1) Though it may seem somewhat intricate, this is the only way to preserve the existin
memory order. If you do not care about the slot number of a particular voice, you
do not need to copy it.
(2) Be sure to proceed in this order (edit, recall, swap, copy), lest one of your voices shoul
be lost.

### *Starting from Voice Initialize*

Basically, everything is the same as for the Edit process, except that you first enter **K n** (n represent
the number you want to initialize). The "killed voice", too, is sent to the Save buffer and can be recall
if desired.

★ As long as you do not carry out any transfer, nothing is changed on the FB-01 itself even thou
its display might suggest the contrary (which is not always the case). If you switch your comp
off without transferring your data (to the FB-01, on disk or tape), the new voice is lost, whe
the original voice is preserved.

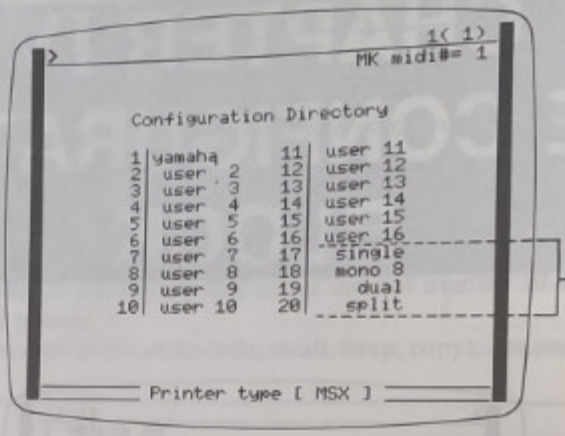
# CHAPTER IV
# THE CONFIGURATION BLOCK



# CREATING A CONFIGURATION

The Configuration block is mainly performance-oriented, i.e. this is where you will decide how the FB-01 is going to combine the voices, thus turning them into instruments (see the manual of your FB-01).
Here, too, you can work with the Save buffer. This buffer operates just like the buffers in the Voice block, so please refer to page 35.
The Command menu of the Configuration block is the same as the one of the Voice block (except for **Voi** which replaces **CON**). So switch to the Directory.

*Fig. 37 Directory of the Configuration Block*

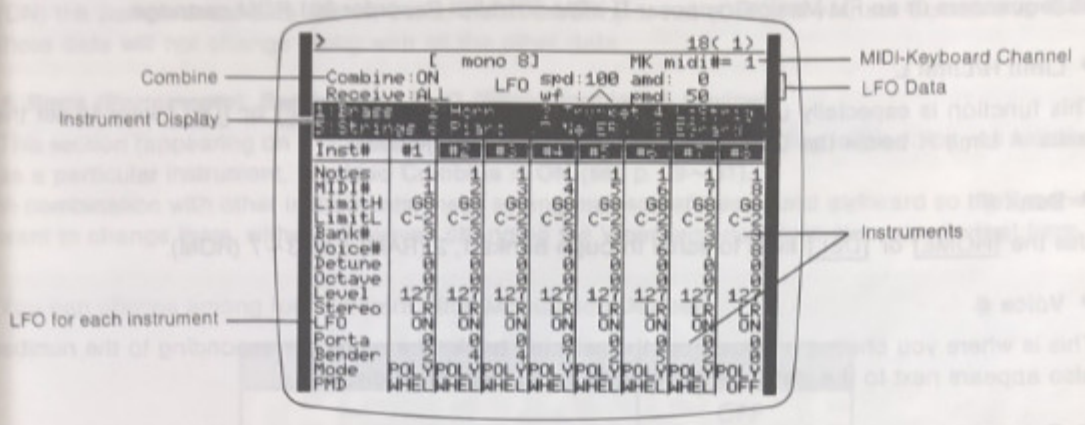



The YRM-506 allows you to store 16 different Configurations at a time. Configurations 17 ~ 20 are preset configurations, which means that you cannot store any new settings in these four memories. However, you can edit them, i.e. take them as a starting point and modify them in such a way as to meet your needs. But, even though the new name(s) appear(s) in the green zone, you will not be able to save new configurations that are located in memories 17 ~ 20 (not even on disk).

NOTE: Use the [HOME] and [DEL] keys to decrease or increase the values or to select another setting. You can also enter numerical values by directly typing the desired number. Holding down [INS] while pressing [HOME] or [DEL] will either enter the lowest/highest value or de-/increase in steps of 10.

Switch to the Edit mode of the Configuration block's Main Display (see p. 20). You can use the [F5] key to check out the various applicable keys as well as their functions. Two key lists (one for the Command mode and one for the Edit mode) will provide an answer to most of your questions.

*Fig. 38 The Main Display of the Configuration Block*




Let us first concentrate on the Instrument section before turning to the function parameters.

## *MK midi # (MIDI-Channel of your Keyboard)*

This function is used to match the computer's and the FB-01's MIDI-channel to the channel of your keyboard. Decrease the channel number by means of the [HOME] key and increase it by means of the [DEL] key.
You can also use this function to play along with a sequenced track and use a reserved MIDI channel, thus triggering the desired instrument in real time.
The instruments that are switched to the same MIDI-channel as the keyboard will appear on a white background, whereas the numbers of the others appear on a black background.
Furthermore, you can use this function to try every single instrument without having to set or reset its MIDI-channel, which may become confusing.

## *Configuration Name*

This is where you type the name (see p. 32 for selectable characters). Do not use more than eight characters (including blanks). Pressing the [HOME] and [DEL] keys here, will restore the original name.

## *Instrument Data*

- Notes

This is where you assign the number of notes to an instrument. Do not forget that the FB-01 can only muster eight voices, so be careful to distribute them properly. Actually, a star and a beep will tell you that you are trying to assign a ninth note.

• **MIDI #**

Here, you can assign each instrument a different channel. The FB-01 thus is ideal for devices such as sequencers or an FM Music Composer II YRM-501/MIDI Recorder 301 ROM cartridge.

• **Limit H/Limit L**

This function is especially useful for live performances. Use the [HOME] or [DEL] keys to set the limits. A Limit H below the Limit L and vice versa will be rejected.

• **Bank #**

Use the [HOME] or [DEL] keys to scroll through banks 1, 2 (RAM) and 3~7 (ROM).

• **Voice #**

This is where you choose a voice from the selected bank. The name corresponding to the number also appears next to the instrument's number in the Instrument display.

• **Detune**

Allows you to slightly detune an instrument within a configuration without changing the voice data. Use [HOME] to decrease and [DEL] to increase the value. Pressing [HOME] / [DEL] while holding down [INS] de-/increases the value in decimal steps, or sets the maximum/minimum value.

• **Octave**

Allows you to transpose either one or two octaves up or down, thus creating lots of new possibilities when triggering several instruments by means of the same device, or when splitting up your keyboard (to play chords of the same octave with both hands).

• **Level**

Due to the EG settings, the volume of the instruments will differ. Here, you can correct this by reducing the level of louder voices, thus mixing all the instruments.

• **Stereo**

The default setting is **LR**, meaning that the instrument is output via the left and the right channel. **L** stands for left and **R** outputs the instrument via the right channel.

## *The Function Parameters of the Configuration Block*

• **LFO (for each Instrument)**

Here you decide whether or not the LFO data appearing in the upper right corner will affect a particular instrument (#1~#8). There is only one LFO, so that all instruments whose LFO is switched ON will have the same modulation.
It is the last voice you specify that determines the LFO setting. So if you first select instrument 2~8 and then #1, the LFO data of instrument 1 will be the starting point for further modifications (if desired).

• **spd (Speed), wf (Wave form), amd (Amplitude Modulation Depth), pmd (Pitch Modulation Depth)**

If the data of the last instrument specified are not convenient, you can change them here. They affect all those instruments whose LFO is set to **ON**.
Note that the speed value is only half that of the voice mode, i.e. a CON **spd** setting of 100 equals 200 in the Voice block.

• Combine

This parameter allows you to decide whether the selection of another instrument is to include (**ON**) the performance data (porta, bend, mode, pmdev.) or not (**OFF**). If you set Combine to **OFF**, these data will not change along with all the other data.

• Porta (Portamento), Bender, and PMD (Pitch Modulation Device)

This section (appearing on a blue background) displays the data belonging to the voice you selected as a particular instrument, provided **Combine** is **ON** (see p. 29~31).
In combination with other instruments, these setting may sometimes sound awkward so that you will want to change them, without, however, changing the V performance data. You can do that here.

You can choose among four different Pitch Modulation Devices:

| Device | Display |
|---|---|
| — | OFF |
| Aftertouch | TOUC |
| Modulation Wheel | WHEL |
| Breath Controller | BRTH |
| Foot Controller | FOOT |

• Receive

Allows you to determine which note numbers the FB-01 will respond to. When set to **ALL**, it can be triggered by any note number, while **ODD** only accepts odd numbers and **EVEN** only even numbers. Note that this setting affects all instruments and that the selection of either **ODD** or **EVEN** is most effective when you use a second FB-01.

## *Further Features*

• Instrument Copy

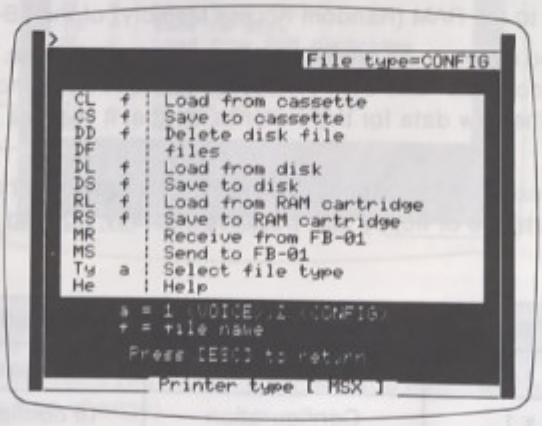
You can copy any instrument data to any other by moving the cursor to the instrument block you wish to copy and pressing the [TAB] key. The Command area will read **Inst copy x to**, x representing the instrument you wish to copy. Specify the target instrument by pressing the appropriate key ([1] ~ [8]).
You can interrupt the copy function by pressing the [ESC] key BEFORE you specify a target.

★ You can also recall the previous instrument setting. Press [CTRL] + [TAB] and the Command area will read **Restore inst x?**. Hit either the [Y] or the [RETURN] key if you wish to carry out this operation. If not, hit the [N] or the [ESC] key. Mind that you can only restore data that were modified by the last copy operation.

### *Configurations using New Voices*

If you create a new Configuration after you have edited or created a few voices, those new voi
will not appear as instruments. This indicates that the computer sends its instrument commands
the FB-01 which generates the desired sounds. However, the FB-01 can only generate sounds wh
data are in its memories, not the ones you have just created and that are still in the computer's memo
Therefore, you had better first transfer the new voices to the FB-01, so that it is able to generate
you have just created and maybe wish to use in a Configuration.

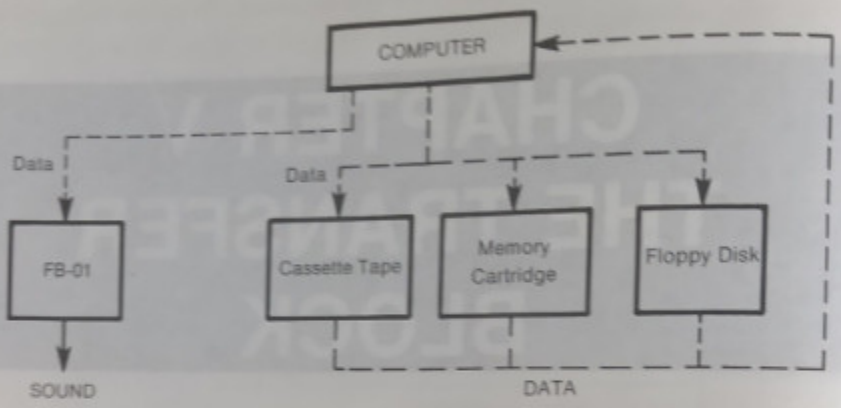
# CHAPTER V
# THE TRANSFER BLOCK



## *Some Basic Knowledge about the Transfer of Data*

The computer cannot store any data permanently: as soon as you turn it off, everything will be lo
which is inevitable if you do not transfer the data to a storing device (provided, you want to prese
them).

*Fig. 39 Data Transfer*




Basically, there are two types of data transfer:

(1) Data that are **sent** to the RAM (Random Access Memory) of the FB-01 in order to be used.

(2) Data that are **stored** merely to be preserved. If you want to use them, you have to transfer the
once again to the computer and then send them to the RAM memory of the FB-01. By doi
so, you substitute the new data for the old ones, so that it seems a good idea to store all th
data.

Once the number of files exceeds the capacity of the FB-01's RAM, you had better store everythi
onto cassette, memory cartridge or floppy disk because that way, nothing will be erased by mistak

The FB-01's capacity is:

| Memory space | Block | Equals |
|---|---|---|
| RAM x 2 | Voice | 96 voices |
| RAM x 1 | Configuration | 16 configurations |

If you load a new file (= a group of 48 voices or 16 configurations) into the FB-01's RAM, you w
the old file, which may not have been your intention. This is why you ought to store everything, tho
allowing you to freely use the RAM for ping-pong operations.
Since the FB-01 features 2 voice RAMs, you can load two voice files of your own making at a tim
which puts 96 voices at your disposal.

## *The Data Types*

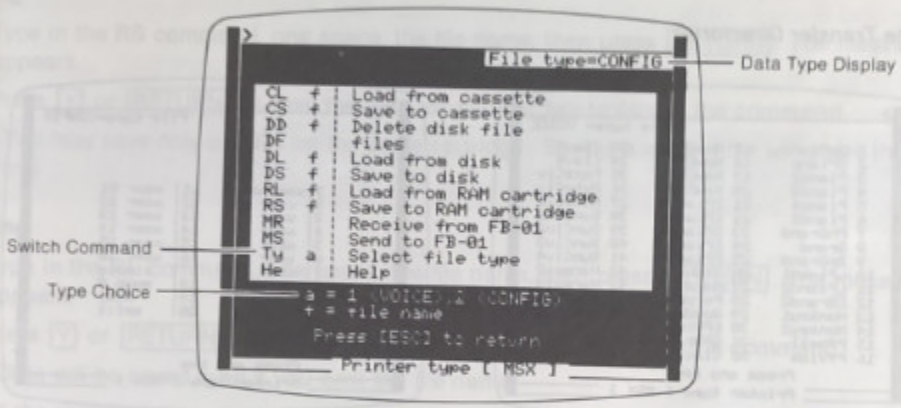
- **Voice Data**

Data created in the Voice block concerning voice data.

- **Configuration Data**

Data concerning instruments and their combination rather than voices.
Though this appears to be stating the obvious, it is worth remembering whenever you switch to the Transfer block. One cannot tranfer both kinds of data at the same time. This is why upon switching to the Transfer block you automatically select the data type of the block you are coming from. On page 12 it reads that one has to press the ESC key to exit the Transfer block, which takes you back to the block you came from. This might suggest, that you first have to call the Configuration block before going to the Transfer block if you wish to transfer CON data.
However, there is a command that makes this unnecessary.

*Fig. 40 File Type Parameters*




If you want to switch from the Voice data to the Configuration data, enter **Ty 2** (enter **Ty 1** if you wish to transfer Voice data again). The data you are going to tranfer onto the FB-01 or a storing device will be CON data. However, if you hit the ESC key, you return to the block you originally came from (regardless of a data type change).

NOTE: The data type selection also applies to the loading operations from a storing device. If you selected the wrong data type but the right file name, the Command area will read **Not found** even though the file is on the tape, disk or memory cartridge.

## *FB-01*

When the computer is switched on, it automatically loads Voice and Configuration data. Only if you wish to transfer new data to the FB-01 will you have to specify their type.
Do not forget to turn the FB-01's memory protection off. For safety reasons you have to do this on the Sound Generator itself.

**Saving**

(1) Select the proper data type.

(2) Type **MS**, followed by the number of the RAM (1 or 2) you want to send it to. The Command area will read **Sure?**, so either hit the [Y] or the [RETURN] key.

★ Press [N] (or any other key) or [ESC] to interrupt the transfer.

(3) As soon as the saving operation is completed, the FB-01's display will read **dump/received!**

**Loading**

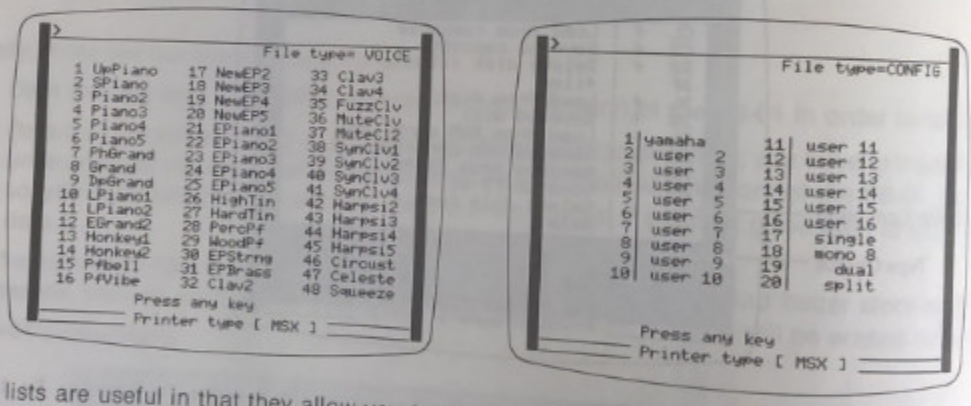
(1) Select the proper data type.

(2) Type **MR** followed by the number of the voice bank you want to load (ROM files may be loaded too). There is only one CON memory bank. The Command area will read **Sure?** so either hit the [Y] or the [RETURN] key.

★ You can stop the loading operation by either pressing [N] (or any other key) or [ESC].

Depending on the data type, you will be provided with a list of the data that are now in the computer's memory.

*Fig. 41 The Transfer Directories*




These lists are useful in that they allow you to check whether the right file has been loaded, and to relaunch the transfer operation without having to go through the call operations (T block and data type) again (after you "pressed any key"). However, one cannot call them directly, because they only fulfill the same function as the Directories of the Voice and Configuration blocks. They only appear after a successful data transfer.

## *Cassette Recorder*

**Saving**

(1) Press the playback and record button of the cassette recorder.

(2) Type in the **CS** command, one space and the file name, then press [RETURN]. The message **Sure?** appears.

(3) Press [Y] or [RETURN] to save the data. To cancel the command, press any other key.

(4) When saving is completed, press the STOP button of the recorder.

**Loading**

(1) Position the tape at the beginning of the file to be loaded or rewind it completely.

(2) Type in the CL command, one space, the filename, then press [RETURN]. The message Sure? appears.

(3) Press [Y] or [RETURN], then press the playback button of the recorder. Press any other key to cancel the function.

(4) When loading is completed, the new File name is displayed. Press the stop button of the recorder.

★ The Command menu re-appears after you pressed any key.

★ The tape will run until the specified filename is found, indicating the ones he is skipping.

★ You may interrupt loading by pressing [CTRL] + [STOP].

★ If you omit to specify a file name, the first data file encountered on the tape is loaded.

## *Data Memory Cartridge (UDC-01)*

**Saving**

(1) Type in the RS command, one space, the file name, then press [RETURN]. The message Sure? appears.

(2) Press [Y] or [RETURN] to save the data, or another key to cancel the command.

★ You may save only one file on the same cartridge. Saving a second file will erase the previous one.

**Loading**

(1) Type in the RL command, one space, the file name, then press [RETURN]. The message Sure? appears.

(2) Press [Y] or [RETURN] to load the data, or another key to cancel the command.

★ Data will be saved even if you omit the file name.

★ If the specified file name differs from the file name recorded on the cartridge, the data are not loaded.

★ When loading is completed, the new Directory is displayed. Press any key and the Command menu re-appears.

## *Floppy Disk Drive*

★ Only one disk drive can be used.

★ A floppy disk drive unit cannot be used with a synthesizer unit other than SFG-05.

**Saving**

(1) Type in the DS command, one space, the file name, then press [RETURN]. The message Sure? appears.

(2) Press [Y] or [RETURN] to save the data, or another key to cancel the command.

★ Use the FORMAT instruction of the MSX BASIC to format the disk before trying to save on a new disk.

**Loading**

(1) Type in the DL command, one space, and the file name, then press [RETURN]. The message Sure appears.

(2) Press [Y] or [RETURN] to load the data of the specified file name, or another key to cancel the command.

**Deleting**

This is used to erase a file from the disk.

(1) Type in the DD command, one space, and the file name, then press [RETURN]. The message Sure? appears.

(2) Press [Y] or [RETURN] to delete the data of the specified file name, or another key to cancel the command.

**File list**

This command displays the list of data stored on the floppy disk. Please keep in mind that an expected file name that does not appear may belong to the other block.

(1) Type in the DF command, one space and a file name, then press [RETURN]. Next? appears when there are too many file names to display in the lower portion of the Filer.

(2) Press [Y] or [RETURN] to go ahead with the list, or another key to cancel the command.

★ Only the names of those files of the same data type are displayed. Files containing other kinds of data are not displayed.

★ Hit the [ESC] key to return to the Command menu.

# APPENDIX

## *Basics of Voice Creation using FM Sound Generation*

The simplest algorithm possible for use with FM Sound Generation is one having a single carrier a a single modulator. The first step is to master the basics of voice creation using only this simple gorithm. Of course, all 8 algorithms available have 4 operators, so you will have to simply use 2 of 4. The "unused" operators can be turned off during editing by pressing CTRL plus the number the operator. For permanent disabling of an operator, set the output level (O) to zero (0). The wavef of the sound can be altered by the manipulation of the parameters of the algorithm. The following ite may be altered to obtain major changes in the sound:

*Table 3 The fundamental parameters of a sound*

| Item | Abbreviation in the FM Voicing Program | min setting — Sound change — max setting |
|---|---|---|
| Output level of carrier | O (output level) of each operator | 0 ← Minimum level → 127 Maximum level |
| Output level of modulator | | 0 ← Mellow tone → 127 Bright tone |
| Feedback level | Fb (Feedback Level) | 0 ← Normal tone → 7 Bright tone (noise) |
| Carrier frequency | F (frequency) and IF (Odd-Harmonic Frequency) of each operator | 0.50 ← F → 15 Low pitch High pitch<br>0.50 ← IF → 25.95 |
| Modulator frequency | | 0.50 ← F → 15 Close harmonics Separated harmonics<br>0.50 ← IF → 25.95 |

The frequency of the modulator and carrier shown is not the set value. It is, instead, the final frequen ratio determined by F and IF (refer to page 23). The following items are the same.

Skillful manipulation of the above parameters allows the use of the FM Sound Generation section t determining pitch, timbre and volume.

### Algorithm

If you are not already there, press F1 to return to the command area and clear the data of voice numb one using KI 1, then switch the unit to the EDIT mode (by pressing F1). Enter the following data

**Algorithm → 5**
**OP1, 2 → ON**
**OP3, 4 → OFF**

**(OP is the abbreviation for operator)**

**Output Level of Carrier**

This can be considered to be the audio signal volume control because the carrier output is converted to an audio signal output.

**OP2 Output level → 0 ~ 127**

**Output Level of Modulator**

In the FM Sound Generation process, the modulator output signal modulates the carrier to produce harmonics which did not exist in the original carrier. This creates the tone or timbre and thus the output level of the modulator can be considered to be equivalent to the timbre control. (This is an oversimplification of this process as modulators can affect volume, and carriers can affect timbre.)

**OP1 Output level → 0 ~ 127**

Raising the output level of OP 1 (modulator) will cause the generation of brighter voices.

**Feedback Level of an Operator**

Feedback means that the operator (always OP1 in the FB-01) is frequency modulating itself. Applying feedback to the carrier (OP1 is a carrier in algorithm 8), will affect timbre in almost the same way as adjusting the output level of a modulator. However, operator 1 has the function (of modulator) in all but one algorithm. When feedback is applied to operator 1 and that operator is serving as a modulator (as it does in algorithm 5) , the additional modulation will further strengthen the effect of that operator and you may wish to lower its output level.

**Feedback level → 0 ~ 7**

Setting the output of the modulator to a high level (more than 115) and then increasing the feedback level (assuming OP1 is a modulator) will tend to generate noise. The noise components will vary according to the set modulator frequency. The same effect can be obtained by employing up to three modulators in series with one carrier and setting the output of each modulator to a high level.

**Carrier Frequency**

The output of the carrier is converted to actual audio signals. When there is one carrier, the pitch of the audio signal is determined primarily by the carrier frequency (modulators can affect this, too). What happens when there are two carriers? The following example uses OP4 as well to provide an answer to that question.

**OP2 → ON**
**OP4 → ON**
**OP1, 3 → OFF**

The following three effects can be created by altering the ratio between the pitch of the two carriers.

- When the pitch ratio of the two carriers is set to low integers (1:1 through 1:6)

**OP2 Frequency → 0 ~ 6**
**OP4 Frequency → 1**

The pitch of the two carriers will harmonize to create a new voice (as does the coupler effect of an organ). In this case, the carrier having the lower frequency determines the perceived pitch.

- **When the pitch ratio of the two carriers is set to high integers (1:7 through 1:15)**

**OP2 Frequency → 7 ~ 15**

The pitch of the two carriers is far apart and two separate sounds can be heard: a high one and a low one. If the pitch ratio does not contain harmonics of 2, 3 or 5 (for example 1:7), the pitch of the two carriers will not harmonize and a dissonant sound will be heard.

- **When the ratio is non-integer**

**OP2 Frequency → 1**
**IF value → 1 ~ 3**

The pitch ratio can be turned into a non-integer through the use of the Odd-Harmonic Frequency feature. There will be absolutely no harmonization and the sound will seem to come from two separate sources.

Voice effects which can be created by altering the pitch ratio of the carriers

| Pitch ratio | Effect |
|---|---|
| Low integer 1:1 ~ 1:6 | Perfect harmonization of the two carriers<br>A new voice is created (Coupler effect) |
| High integer 1:7 ~ 1:30 (= 0.5:15) | The two sounds seem separated |
| Non-integer 1:1.41 ~ 1:51.9 (= 0.5:25.95) | The two sounds are totally separate |

**Modulator frequency**

The modulator is the signal which,when fed into the carrier, creates harmonics which were not in the original carrier. This produces the timbre characteristics of various voices. The modulator frequency (or, more correctly, the frequency ratio in relation to the carrier) determines the frequency of the harmonics to be produced. The modulator output level determines the relative level of each harmonic. A feel for the use of this function is very important when creating original voices.

**AI → 5**
**OP1, 2 → ON**
**OP3, 4 → OFF**
**OP1 Output level → 115**
**Feedback level → 0**

- **When the pitch of the modulator is higher than that of the carrier**

Leave the pitch of the carrier (OP 2) at 1 and raise the pitch of the modulator (OP 1).

**OP1 Frequency (F) → 0 ~ 15**
**IF value → 0 ~ 3**

Moderately increasing the frequency of the modulator (raising the pitch ratio in relation to the carrier) will cause the generation of higher-frequency harmonics and a brighter tone. Further increases will create higher harmonics while simultaneously creating harmonics lower than the carrier pitch. As the pitch ratio of the modulator to the carrier approaches the maximum, the normal pitch relationship may be destroyed and the timbre may suddenly change to a new one. This effect is created when the higher harmonics extend beyond the audible range and the lower pitch takes over the control of the pitch effects.

- **When the pitch of the modulator is lower than that of the carrier**

This permits the creation of various effects through the manipulation of the carrier (OP2 in this case).

**OP1 Frequency → 0**
**IF value → 0**
**OP2 Frequency → 0 ~ 15**
**IF value → 0 ~ 3**

## *The Concept of Algorithms*

Algorithms affect a great number of voice attributes. The algorithm currently being used for experimentation can create a large number of voices, but even more can be created with different algorithms. For the sake of clarity, the following description classifies algorithms by the number of carriers they contain.

**Algorithms having one carrier (1 ~ 4)**

When one of the operators is being used as a carrier, the rest may function as modulators. This means that bright sounds will probably be produced. Switching between the algorithms and comparing the generated voices will show that algorithm patterns having one carrier are used for the brightest sounds.

**OP1 ~ 4 Output level → 110**
**Feedback level → 0**
**Algorithm → 1 ~ 4**

When algorithm one is selected, setting the feedback and output levels of all the operators at their maximum, produces a voice containing excessive noise components.

**Algorithm → 1**
**OP1 ~ 4 Output level → 127**
**Feedback level → 7**
**OP4 Frequency → 15**
**IF value → 3**

This sound is called white noise. There is almost no pitch created by the carrier because all frequencies are present already. White noise means that noise components are randomly generated across the entire audio frequency range. This is similar to the sound of hiss when you blow through closed teeth, or the sound of the wind. (Analog synthesizers use a special noise generator to create this sound.)

Algorithm patterns using one carrier can be used to create voices having extreme harmonics, but subtle voices having complex waveforms can also be generated. It depends on the specific value selected for the output level of each modulator.

**Algorithms having two carriers (5)**

This type of algorithm is an all-purpose pattern which permits a wide variety of voices to be create
Elaborate voices can be produced because there are two modulators in addition to the two carrie
Shifting the pitch of the two carriers can create a chorus effect, or the algorithm can be divided in
two halves, each with completely different sounds, for more complex voices. For example, algorit
five can be used to create a flute voice. Operators three and four can be used to create the basic flu
"pure tone" sound, while operators one and two add a breathy character.

**Algorithms having three or four carriers (6 ~ 8)**

This type of algorithm pattern is used for the creation of rich and textured voices. For example, shift
the pitch of each carrier slightly will result in a chorus effect similar to the sound of a number of
struments being played simultaneously. Select algorithm eight and use the DETUNE feature to slig
shift the pitch of each of the four carriers relative to each other. This allows the creation of an ensem
(string, vocal, etc.). Algorithms, such as number eight, which have four carriers, are perfect for th
creation of organ-like voices through the coupler effect.

## *The Concept of Voice Creation*

The following is an actual example of how to create a voice from scratch. The example used is th
creation of the voice of an electronic piano.

**Voice creation flow chart**

There are a number of different procedures for the creation of voices. The approach outlined belo
is a reasonable way to proceed.

| Operation | Parameter of FB-01 Voicing Program |
|---|---|
| 1 Initialization of voice data | KI command |
| 2 Selection of algorithm | Al |
| 3 Setting of operator frequency | F and IF |
| 4 Setting output level of operators | O |
| 5 Setting | EG A, D, S, D and R |
| 6 Setting of key scaling | Ks, Kd and Rk |
| 7 Re-adjustment of voice data | |
| 8 Adding effects | LFO, Dt, Vo, and Va |

**Initialization of Voice Data**

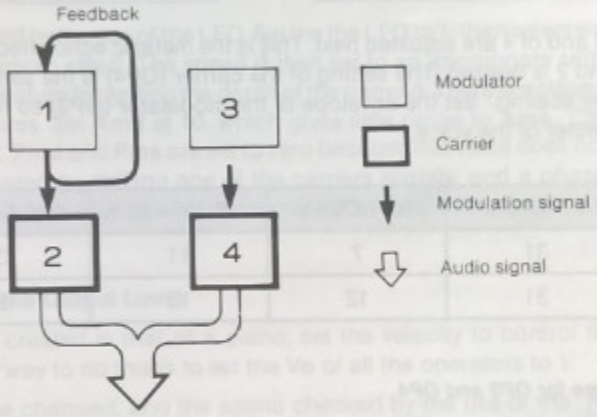
Initialize voice number one by using the KILL command. This is done by entering KI 1 followed
RETURN. Initialization of voice data means that the voice data is set to a state which can be like

to that of a blank sheet of paper. This does not mean there is no data but, instead, it means that there are certain parameters which create a "pure" sound which is then edited to obtain the desired voice.

**Selection of algorithm**

After the voice data has been initialized (using [F1], then KI 1), switch from the command mode to the edit mode. Voice number 1 was initialized so 1 is entered and the [RETURN] key pressed. The initialized voice data from voice 1 will be displayed on the screen. Algorithm 8 is selected for the initial voice. A different algorithm which is more suitable for the sound of an electronic piano is selected. Set AI to 5 for the selection of algorithm 5. This algorithm pattern has two carriers, is easy to use, and allows the creation of a relatively wide variety of sounds. In this example, OP1 and 2 are used for the main piano tone while OP3 and 4 are used to create a metallic echo-like "tine" sound.

*Fig. 42 Algorithm*




**Setting of operator frequency**

The next step is to set the frequency of each of the operators. The frequency can be set by F and IF, but in this example only F is set. The frequency of OP3, which is the modulator of OP4, is set to 10 in order to create a metallic ring. The other operators are all left at 1.

**Setting output level of operators**

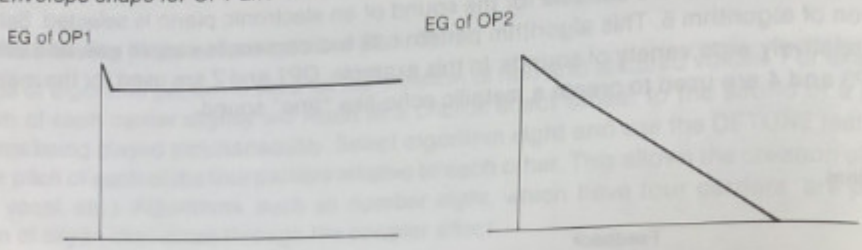
This step alters the output level of the modulators to adjust the timbre. When adjusting the level of OP 1, set OP 3 and 4 to OFF ([CTRL] + [3], [CTRL] + [4]) so that sound is output only from OP 1 and 2. Set OP 1 to about 115 for a fairly bright sound, and set OP 3 to 80 so that the pitch sensitivity is not decreased and a metallic echo-like sound is produced. There is only feedback for OP1, and it is set to 2 in order to increase the brightness of the voice.

**Setting EG**

Now it is time to set the volume and timbre envelopes. This will transform the voice, which now sounds like an organ, into that of an electronic piano. OP 1 ~ 2 and OP 3 ~ 4 should be adjusted separately, then put together in the final stage to let you hear the total sound. OP 1 ~ 2 are adjusted first. The attack of this portion of the voice is given greater emphasis by altering the OP1 and OP2 envelopes. OP 1 is the modulator. There will be a greater number of harmonics, but only on the attack, after which the character of the voice changes very little.

| | ATTACK | 1st-DECAY | SUSTAIN | 2nd-DECAY | RELEASE |
|---|---|---|---|---|---|
| OP1 | 31 | 15 | 13 | 0 | 6 |
| OP2 | 31 | 12 | 13 | 15 | 8 |

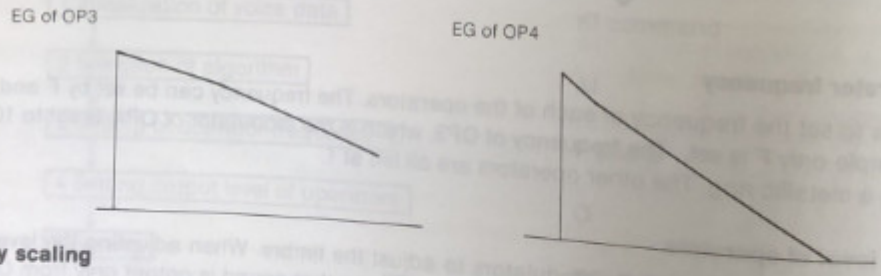
*Fig. 43 Envelope shape for OP1 and OP2*




The settings of OP3 and of 4 are adjusted next. This is the metallic echo effect, so an envelope sharpe than that of OP1 and 2 is desired. The setting of the carrier (OP4) is the same as that for OP2, and adjusted later by key scaling. Set the envelope of the modulator (OP3) so that there is relatively lit change in the character of the voice.

| | ATTACK | 1st-DECAY | SUSTAIN | 2nd-DECAY | RELEASE |
|---|---|---|---|---|---|
| OP3 | 31 | 7 | 11 | 3 | 6 |
| OP4 | 31 | 12 | 13 | 5 | 8 |

*Fig. 44 Envelope shape for OP3 and OP4*




**Key scaling**

The above setting will create a voice very similar to that of an electronic piano. Next, use key scalin to shorten the high notes and compensate for the high timbre notes which are too bright. Rate scalin adjusts the attack and release times of the notes, while level scaling is used for tonal character an volume. The level scaling curve is 0 in order to reduce the intensity of higher pitched sounds.

| | Ks | Kd | Rk |
|---|---|---|---|
| OP1 | 0 | 6 | 2 |
| OP2 | 0 | 3 | 2 |
| OP3 | 0 | 6 | 3 |
| OP4 | 0 | 4 | 3 |

The use of this key scaling procedure to edit the envelope shortens the overall length of the envelope across the keyboard, through more or higher notes. The original EG settings were selected with this scaling in mind. The length of the envelopes can be adjusted by the individual operator EG settings.

**Re-adjustment of voice data**

The setting of the voice components is now complete. However, slight changes in almost any setting such as the EG, can still change the voice. The final voice can be "fine tuned" by the adjusting the output level of the operators and the level of feedback. For example, if you think the metallic echo is too strong, the output level of operator four can be reduced. There will be cases where the maximum or minimum frequency of the operators is exceeded and the sound will thus automatically be lowered or raised by one octave. This is changed manually by the transposing (Tr) feature.

**Adding Effects**

Effects such as tremolo or chorus are added in this final step to make the created voice resemble that of an electronic piano even more.

The tremolo effect is added by the use of the LFO. Set the the LFO to 1, then select waveform two (triangle wave) for a moderate tremolo effect. The speed is then set to an appropriate setting of approximately 190 to 195. Use the Amd feature for setting the depth of the tremolo. There is a close relationship between the **Ams** and **Amd** features. Set **Amd** at 10, which gives little range to **Ams**. Change Ams to 1 for a very slight tremolo effect. **Pmd** and **Pms** are set to zero because this voice does not use a vibrato effect. The chorus effect is created by shifting one of the carriers slightly, and a phase effect is created by shifting one of the modulators slightly. This richer sound is obtained by setting the **Dt** of OP 1 to −3 and the **Dt** of OP 4 to 3.

**Velocity Sensitivity for the Output Level**

Finally, since the voice created is that of a piano, set the velocity to control the volume and voice character. The simplest way to do this is to set the **Vo** of all the operators to 1.

The velocity data can be changed, and the sound checked by the use of the [F2] and [F3] keys. If you are using a Music Keyboard (YK-01 or YK-10/20). If you are using a MIDI Keyboard, the velocity sensitivity setting can be checked immediately.

**Velocity Sensitivity for the Attack Rate**

This even enhances the realistic effect, provided you own a touch sensitive keyboard. Combined with the touch sensitivity for the output level, this parameter turns your FB-01 into a "real" instrument.

# SOME EXAMPLES OF SOUND CREATION

There is a shortcut which can be used to create sounds much more easily. This is through the copy... of existing voices. This is not simply wholesale imitation, but instead is the process of creating a n... voice while checking it against the sound of an existing voice. It is often much easier to modify an exist... voice to fit your image of some original sound you wish to create than to start from scratch. This sect... chooses a number of voices from those stored in the FB-01 and explains the process of sound creat... after the voice has been initialized.

## *The Creation of Brass Voices*

Let's create a voice in the FB-01 Sound Generator unit from scratch. This example uses voice one (Bra... of bank 3 as a base. Be sure to follow all the steps carefully when creating a voice from scratch.

**Algorithm**

The algorithm of Brass 1 is 3. This pattern uses one carrier, and is perfect for the creation of brill... brass sounds. The three modulators each with its own EG, permit the generation of a wide range ... changes within the harmonic structure.

**Operator output level and Feedback**

The output level of the carrier OP4 can be left at 123. The output level of OP1 ~ 3 can be moderat... adjusted within the range of 90 ~ 110. Feedback is very important for this voice and is set to its highe... value(7).

**Frequency of operators**

The basic setting of all the operators can be 1. OP2 can be set to 2 for a slight metallic echo, furth... improving the sound of the brass instrument. The output level of OP2 is set at 94 for a very subtle sou...

**EG**

The EG is also very important for creating a brass voice. All of the operators have a slow attack S... attack, or A, for the modulator (OP1) so that it is slightly slower than any of the carriers. This creat... the special attack characteristic that brass instruments have. If carrier (OP4) attack is slower than th... modulator attack, there will be no character change detectable in the attack section, and the sou... will resemble that of an organ. The A data (attack) of the three modulators should all differ slightly ... create even more realistic character changes.

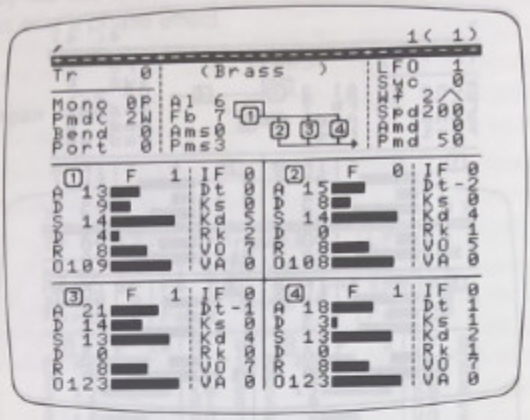
**Key scaling**

The sharpness of the higher keys will be lost when a slow attack envelope is set. The rate scaling featu... corrects this so that the voice sounds natural when fast passages are played. Rate scaling is set a... to 2 for all operators to preserve the rapid attacks of the higher notes of brass instruments.

**LFO**

With brass instruments, the pitch of notes played for a long time is going to waver no matter how go... the musician is. This effect is emulated by the LFO. Set the vibrato effect to a barely detectable le... (LFO assigned to pitch via Pmd and Pms).

*Fig. 45 Settings for a Brass Voice*




## *The Creation of String Voices*

The next example uses as its base Lo Strig, which is voice number 4.

**Algorithm**

Algorithm pattern 3 is also used for Lo Strig. This has one carrier and three modulators, an algorithm used for voices having a high degree of character change. It is used in this example to reproduce the complex sounds of string instruments.

**Frequency of operators**

OP1, 3 and 4 remain at 1. The pitch of OP2 is set to 5 for creating the delicate texture associated with string instruments.

**Output level of operators and Feedback**

The output level of the modulator should not be too high. The appropriate setting is about 80 to 120. If the output level of the modulators is raised above this, the voice will begin to resemble that of a horn instrument, with some additional noise components. The feedback is used to reproduce the feeling of the vibrating string, and is set to 7.

**EG**

String instruments also have a slow attack, so that attack, or **A**, of the carrier is slowed down slightly by setting it between 13 and 15. The modulators are set faster than the carrier. The **R** (release) of the carrier is also slowed down slightly (5-6) to simulate the sound of an ensemble. This causes the sound to linger after the key has been released.

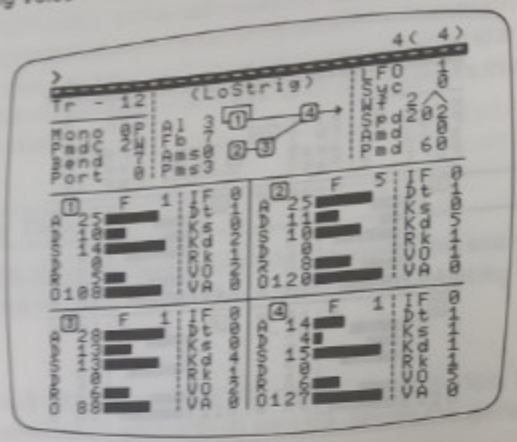
**LFO**

Vibrato is one the most important characteristics of string instruments. However, since this is an orchestral sound, there is no need for the deep vibrato heard with solo string instruments.

**Transposing**

Transposing lowers the pitch by one octave to obtain a richer middle and lower range sound.

*Fig. 46 Settings for a String Voice*




## *The Creation of Pipe-Organ Voices*

The final example uses Porgan 1 which is voice number 14. This voice uses two carriers.

**Algorithm**

Porgan 1 uses algorithm pattern 5, which has two carriers and two modulators. This "all-mighty" algorithm allows close control over the sound because the voice components can be divided into two parts. In this example, the voice is divided into the set of OP3 and 4, used for the deep reverberations of the pipe organ, and the set of OP1 and 2 for the high-frequency reverberations. Both of these can be programmed independently.

**Frequency of operators**

OP3 and 4 are set at 0 for the deep, low reverberations of the pipe organ. OP1 and 2 for the high-frequency reverberations of the organ are set to 8 and 4 respectively. The harmonic ratios are thus 1:8 and 4:8. This produces the couple effect of the organ (two pitches harmonizing to create a new sound).

**Output level of the operators and feedback**

Output level of the modulators must be prevented from becoming too high. There is no need to feedback.

**EG**

The attack of the pipe organ is probably not as slow as you think. If it is too slow, the sound will be to resemble the old foot pedal-driven organs. The appropriate level of the A of the carrier is 16 to 1 Taking the construction of a pipe organ and the conditions of the hall where it is played into account together with the intention of causing some reverberation to remain after the keys are released, the R setting of both the carrier and modulator is between 5 and 7.

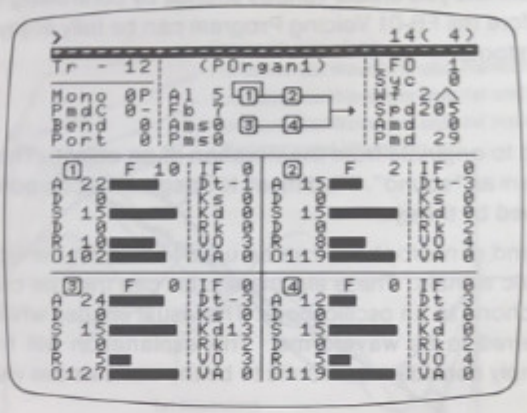
**Key scaling**

Rate scaling corrects the overly long reverberation that tends to occur after the higher keys are released. Level scaling is applied to the modulators and limits the frequency modulation on the higher keys for a clearer voice.

**Detune**

The sound is made richer by the use of the detune feature with the two carriers and two modulators. This provides both a chorus and a phase effect.

*Fig. 47 Settings for a pipe-organ voice*



# INTRODUCTION TO THE FM SOUND SYNTHESIS

## *Basic Knowledge needed to create Sound*

A piano and a flute both cause air to vibrate, which we perceive as sound. Both can play an "A" 440 Hz or so, depending on their tuning, yet each instrument has its distinctive sound. Differences the way each instrument creates sounds are identifiable, and explain why they sound different. Sy thesizers can be programmed to create sounds with similar pitches, but with different harmonic conte volume "envelopes", and so forth — factors that aid in creating widely varied sounds.

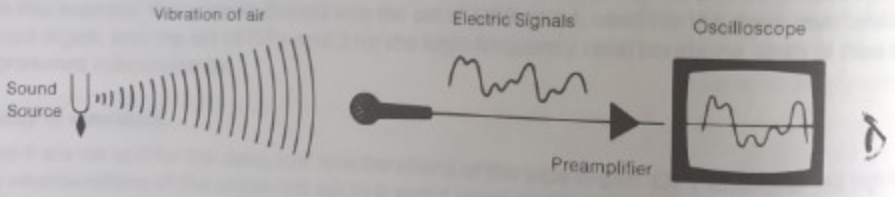
The FB-01 Voicing program lets you create various sounds by controlling the factors which compo that particular sound. Before the FB-01 Voicing Program can be fully enjoyed, the factors that gov the sound must be understood.

**What is sound?**

Sound can be considered to originate from the vibration of an object. This vibration passes throug the air and reaches our ears as "sound". It is difficult to imagine the components of this sound becau sound can not be perceived by the eye.

To help you visualize sound, a microphone can be used to convert the vibration of the air (change in air pressure) into electric signals. These electric signals can then be converted into visual image by connecting the microphone to an oscilloscope. The visual images which appear on the screen the oscilloscope are referred to as **waveforms**. This explanation will frequently refer to the ter waveform. It is best to simply consider waveforms to be the same as the visual image of a wave.

*Fig. 48 Visualisalization of a Waveform*




**The three components of sound**

- The Pitch

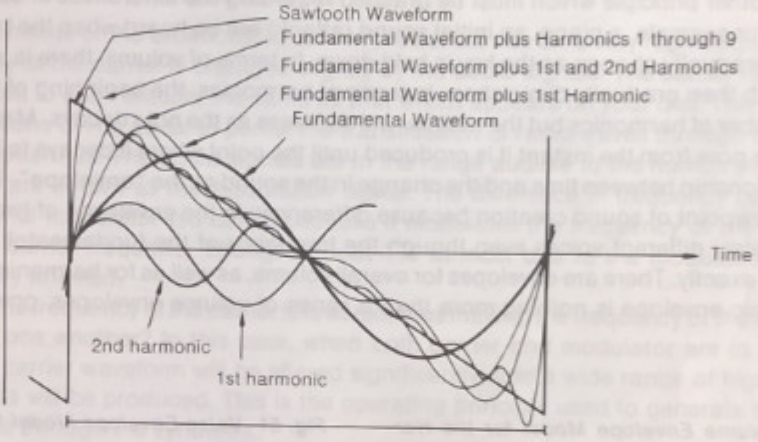
A piano or guitar produces a sound which has a fundamental frequency (or **pitch**) proportional to t length of the struck or plucked string. The pitch of the sound can be changed by altering the leng of the vibrating section of the string. This alters the number of times that the string will vibrate i given time period. For example, a low pitch means that the string is vibrating relatively slowly. Th principle allows the pitch of the sound to be expressed in terms of the number of vibrations per seco (frequency).

- The Timbre

However, while the pitch of a certain note is the same for a piano and guitar, the waveform and to character (**timbre**) are quite different. This is determined by the way that the sound is generated. T size and shape of these instruments are going to result in the strings of the instruments vibrating d ferently. The way the vibration is produced can be expressed by a waveform. The shape of many musi instrument waveforms may appear at first glance to have no rhyme or reason to them, but actu all waveforms are composites of sine waves. If we state this in reverse, a waveform of any shape des can be created by combining sine waves. For example, the diagram shows what happens when

waves which are multiples (double, triple, etc.) of the original sine wave are added. The wave begins to resemble a saw tooth wave as higher-multiple sine waves are added to the original sine wave. The original sine wave is called the **fundamental** and subsequent sine waves are composed of differring **harmonics**. The tone or timbre (waveform) of an instrument is determined by the number and relative volume level of harmonics.

*Fig. 49 Sawtooth Waveform as a Superposition of Sine Waveforms*




The following BASIC program will display the above diagram on your monitor screen, showing how adding harmonics progressively approximates the sawtooth waveform. This program also allows for similar representation of square and triangular waveforms. To stop this program, press CTRL + STOP.

```
10 DIM W(160):P=ATN(1)/20:SCREEN 0:COLOR 15,4,7:PRINT"Which waveform?":PRINT
20 PRINT"1=Saw tooth":PRINT"2=Square":PRINT"3=Triangle":PRINT:PRINT"1/2/3 ?";
30 A$=INPUT$(1):IF INSTR("123",A$)=0 THEN RUN 10 ELSE C=VAL(A$)
40 SCREEN 2:COLOR 15,4,7:OPEN"GRP:"AS1:H=0:N=1
50 ON C GOSUB 120,130,140:IF A<>0 THEN H=H+1:CLS:ON C GOSUB 170,180,190:ELSE 90
60 PRESET(16,180):PRINT#1,"Fundamental";:IF N>1 THEN PRINT#1,"+";H-1;"Harmonics"
70 GOSUB 200:PRESET(100,0):PRINT#1,"Hit Space Bar"
80 IF INKEY$<>CHR$(32) THEN 80
90 N=N+1:IF H<10 THEN 50 ELSE LINE(0,0)-STEP(255,8),4,BF
100 PRESET(16,0):PRINT#1,"Hit Space Bar to restart"
110 IF INKEY$=CHR$(32) THEN RUN 10 ELSE 110
120 A=2/N/P:RETURN
130 IF N MOD 2=0 THEN A=0 ELSE A=3/N/P:RETURN
140 IF N MOD 2=0 THEN A=0:RETURN:ELSE S=(N-1)/2
150 IF S MOD 2=0 THEN A=1 ELSE A=-1
160 A=A/10/(N*P)^2:RETURN
170 PSET(40,90):DRAW"U80 F160 U80 L160":RETURN
180 PSET(40,90):DRAW"U60 R80 D120 R80 U60 L160":RETURN
190 LINE(40,90)-STEP(160,0):LINE(40,90)-STEP(40,-80):LINE STEP(0,0)-STEP(80,160)
:LINE STEP(0,0)-STEP(40,-80):RETURN
200 F=0:FOR I=2 TO 160 STEP 2:HR=A*SIN(1*P*N):W(I)=W(I)+HR
210 PSET(40+I,90.5-HR):LINE(38+I,90.5-W(I-2))-(40+I,90.5-W(I)):NEXT:RETURN
```

The pitch of the sound is determined by the fundamental. Strictly speaking, pitch is a subjective value and also depends on absolute volume level. We often use the term pitch when we are really concerned with the fundamental frequency.

• **The Volume**

The amplitude of the vibrations (in the above example, the height of the sawtooth waveform) corresponds to the **volume** of the sound.
Thus, we can say that the subjective differences that we perceive in sounds are a product of the differences in pitch, tone, and volume. The three components of sound that affect these differences are the frequency of the fundamental, the waveform (or harmonic structure) and the amplitude.

**Changes in sound over a period of time**

There is another principle which must be grasped regarding the differences in sound. When a note is played on, for example, a piano, an initial sound (attack) will be heard when the key is first struck. The sound will gradually change as the key is held down. In terms of volume, there is a sudden, loud sound which then gradually diminishes. In terms of harmonics, the beginning of the note will contain a large number of harmonics but the number will decrease as the note decays. Many complex changes occur in the note from the instant it is produced until the point where it decays to inaudibility. We refer to this relationship between time and the change in the sound as the "**envelope**". This is very important from the viewpoint of sound creation because differences in the envelopes of two voices will result in two completely different voices even though the frequency of the fundamental and each harmonic may match exactly. There are envelopes for overall volume, as well as for harmonic structure. However, the harmonic envelope is nothing more than a series of volume envelopes: one for each individual harmonic.

*Fig. 50 Volume Envelope Model for the Harmonic Envelope*

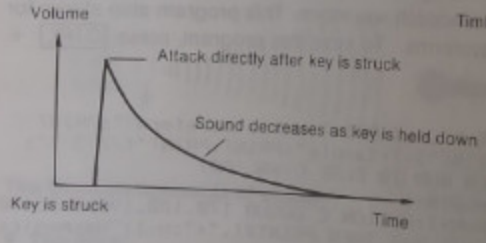
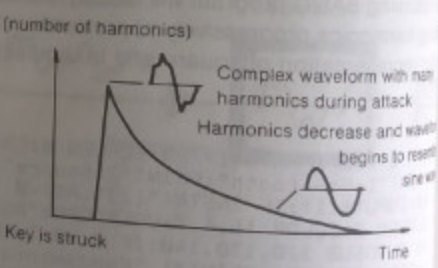



*Fig. 51 Voice Envelope Model Fundamental of a Piano Note*




**What is sound synthesis?**

The electric signals visualized in Fig. 48 can be re-converted into sound by using an amplifier/speaker system. Actually, an electric guitar works according to this principle: the sound created by the string vibrations is converted into electric signals by pick ups, then the electric signals are sent to an appropriate amplifier. This amplifier is provided with several control functions such as volume, tone, allowing for an easy control of the output sound, that is impossible with acoustic instruments.
Sound synthsizers use a different method: electronic circuitry directly produces electric signals. Thus a synthesizer does produce sound by itself and, as a consequence, the electric signals generated by a synthesizer are completely free of ambient noises. A sound synthesizer essentially consists of a multitude of oscillators (circuits generating elementary waveforms) associated with several control functions allowing you to combine elementary waveforms in order to obtain a desired resulting waveform.

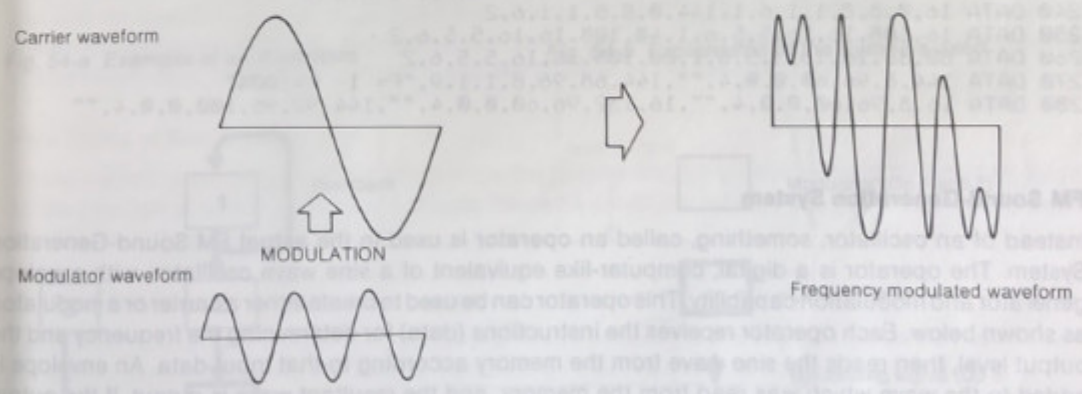
**What is FM?**

You probably associate the word "FM" with a type of radio transmission. The "FM" band on your radio and the "FM"of "FM Sound Generation" are the same. They both stand for "**Frequency Modulation:**". This is the technique of varying the frequency of a sound by the use of another frequency.

Although both the FM of your radio and the FM of FM Sound Generation have the same narrow, technical meaning, the application is quite different.

The audio signals (contents of the broadcast)of an FM broadcast ride on a very high frequency radio **carrier**. The frequency of the carrier is changed slightly by the audio signals. The carrier frequency is the frequency allocated to each station, the same as that which appears on your dial. This frequency is extremely high (millions of Hz) so as to permit the transmission of radio waves through the air and reception with small antennas. The audio signals are in the range audible to the human ear (approx. 20 to 20,000 Hz) and are known as the modulation signal. The difference in frequency between the carrier and audio signal **modulator** (so called because it modulates the frequency of the carrier) is great. Therefore, the carrier frequency changes about 1% at most due to the modulation, and its waveform is not greatly affected.
What happens when the frequency of the carrier is lowered, thus making the frequency of the modulator and carrier closer to one another? In this case, when both carrier and modulator are in the audio frequency range, the carrier waveform will be altered significantly, and a wide range of high and low frequency components will be produced. This is the operating principle used to generate the sound of musical instruments through FM synthesis.

*Fig.52 Changes in the Waveform caused by FM*




FM Sound Generation allows direct control of the frequency, timbre and volume of sounds. This is a radical departure from analog synthesizers which have been used up to now. Analog synthesizers function by filtering out unwanted harmonics from harmonic-rich waveforms created in the sound-generation section (oscillator) to obtain a desired waveform. FM Sound Generation allows the desired waveform to be created directly by adding and modulating sine waves, allowing a much wider range of possible sounds with more precise control of harmonic structure. Traditional electric organs have used purely additive synthesis, where sine waves had to be supplied for each harmonic, but FM creates additional harmonics through the interaction of sine waves (modulation), and is therefore

more efficient. The efficiency of FM makes it possible to synthesize more complex sounds with far
complex circuitry than additive synthesis.

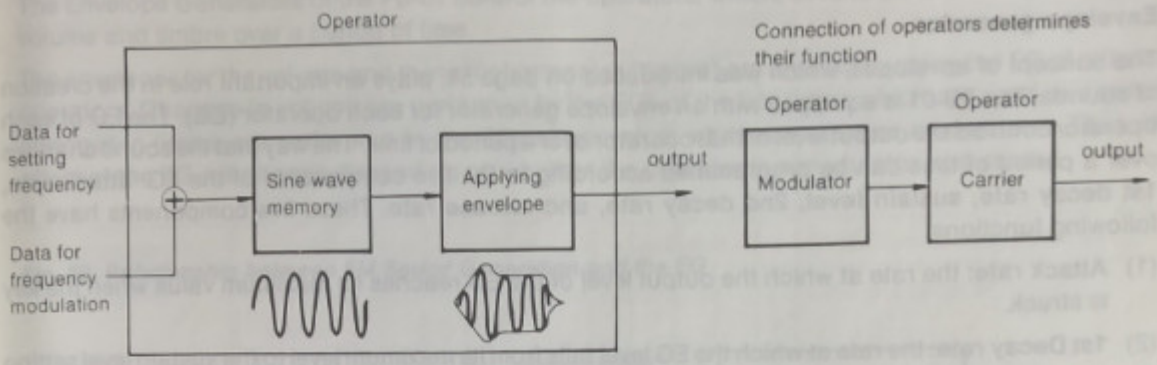
The following BASIC program will display diagrams similar to Fig. 52, giving also the waveform resu
from a pure additive synthesis (two carriers) for comparison. You may vary the amplitude of oper
1 by using the ↑ and ↓ cursor keys; the ← and → cursor key control its frequency. Press
space bar to enter the selected values. To stop this program, press CTRL + STOP. For each set
the FM waveform structure is more complex than the structure of the waveform obtained by pure
dition. You can also observe that a small change in modulator amplitude causes significant chan
in the FM waveform.

```
10 SCREEN 2:COLOR 15,3,7:CLS:OPEN"GRP:"AS1
20 P=ATN(1)/12:F=3:L=20:DIM W(3,1),SW(90):IL=11:GOSUB 130
30 PRESET(32,116):DRAW"C1 R8 BR16 R8 ND16 BR32 R8 U20 L8 R8 D10 R40"
40 GOSUB 140:J0=0:GOSUB 170:J0=1:IL=3
50 IF INKEY$=CHR$(32) THEN RESTORE    :FOR I=1 TO 3:
60 IF INKEY$=CHR$(32) THEN RESTORE 280:GOSUB 130:GOSUB 170
70 S=STICK(0):IF S MOD 2=0 THEN 60 ELSE IF S=1 THEN L=L+2 ELSE IF S=5 THEN L
80 IF L<0 THEN L=0:BEEP:GOTO 60 ELSE IF L>100 THEN L=100:BEEP:GOTO 60
90 IF S=3 THEN F=F+1 ELSE IF S=7 THEN F=F-.5
100 IF F>.5 THEN F=INT(F)
110 IF F<.5 THEN F=.5:BEEP:GOTO 60 ELSE IF F>10 THEN F=10:BEEP:GOTO 60
120 GOSUB 140:GOTO 60
130 FOR I=1 TO IL:READ X1,Y1,X2,Y2,X3,Y3,C,A$:GOSUB 160:NEXT:RETURN
140 LINE(16,68)-STEP(96,8),9,BF:PSET(17,69)
150 PRINT#1,"F=";RIGHT$(STR$(F),2);"  L=";RIGHT$(STR$(L),3);"%":RETURN
160 LINE(X1,Y1)-STEP(X2,Y2),C,BF:PSET(X1+X3,Y1+Y3),C:PRINT#1,A$:RETURN
170 FOR J=J0 TO 3:W(J,0)=0:NEXT:A=L/4:FOR I=2 TO 96 STEP 2:B=I*P
180 FOR J=0 TO 3:ON J+1 GOSUB 190,200,210,220:NEXT J,I:RETURN
190 W(0,1)=25*SIN(B):SW(I)=W(0,1):X=144+I:Y=38.5:GOSUB 230:RETURN
200 W(1,1)=A*SIN(F*B):X=16+I:Y=38.5:GOSUB 230:RETURN
210 W(2,1)=25*SIN(B+W(1,1)/2.5):X=16+I:Y=162.5:GOSUB 230:RETURN
220 W(3,1)=W(1,1)+SW(I):X=144+I:Y=142.5:GOSUB 230:RETURN
230 LINE(X-2,Y-W(J,0))-(X,Y-W(J,1)):W(J,0)=W(J,1):RETURN
240 DATA 16,0,8,8,1,1,6,1,144,0,8,8,1,1,6,2
250 DATA 16,108,16,16,5,5,6,1,40,108,16,16,5,5,6,2
260 DATA 80,88,16,16,5,5,6,1,80,108,16,16,5,5,6,2
270 DATA 144,8,96,60,0,0,4,"",144,68,96,8,1,1,9,"F= 1  L=100%"
280 DATA 16,8,96,60,0,0,4,"",16,132,96,60,0,0,4,"",144,92,96,100,0,0,4,""
```

**FM Sound-Generation System**

Instead of an oscillator, something, called an operator is used in the actual FM Sound-Generat
System. The operator is a digital, computer-like equivalent of a sine wave oscillator, with envel
generator and modulation capability. This operator can be used to create either a carrier or a modul
as shown below. Each operator receives the instructions (data) for determining the frequency and
output level, then reads the sine wave from the memory according to that input data. An envelop
added to the wave which was read from the memory, and the resultant wave is output. If the ou
is to be used as an audio signal, this operator is the carrier. If the output is sent to the next oper
to control modulation, the operator is a modulator.

*Fig. 53 Configuration of Operators*




Envelopes are produced by the envelope generator. The envelope controls the change in output level over a period of time for the carrier (which controls the volume), and the change in output level for the modulator over a period of time (which controls the timbre).

The FB-01 uses up to four operators to create each sound. Since eight sounds can be generated simultaneously by this unit, there are 32 operators in all.

The way the four operators in a given voice are "connected", and how they function as carriers or modulators, follows specific patterns. These patterns are called **algorithms**. If there is only one carrier and one modulator, a simple FM sound (voice) can be generated. The use of four operators allows for the creation of voices having very complex harmonic structures.

Given four operators, there is a large number of possible patterns, but eight of the most useful algorithm patterns have been selected for the FM Sound Synthesizer unit in order to make the creation of sounds more predictable.

*Fig. 54-a Example of an Algorithm*

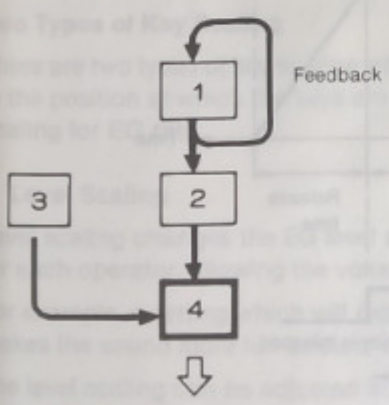
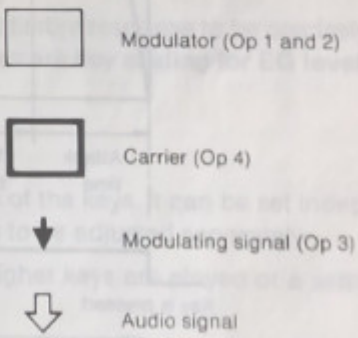



*Fig. 54-b Explanation of the Symbols used*




**Feedback** means that a fraction of the signal output by an operator is re-injected in the same operator, resulting in a special auto-modulation. Feedback is used to obtain a large number of harmonics (bright sound) and to create noise.

**Envelope generator**

The concept of envelopes, which was introduced on page 54, plays an important role in the creat of sounds. The FB-01 is equipped with an envelope generator for each operator (**EG**). The EG of e operator controls the output level of that operator over a period of time. The way that the sound chan over a period of time can be programmed according to the five components of the EG: **attack ra 1st decay rate, sustain level, 2nd decay rate,** and **release rate.** These five components have following functions.

(1) **Attack rate:** the rate at which the output level of the EG reaches its maximum value when the is struck.

(2) **1st Decay rate:** the rate at which the EG level falls from its maximum level to the sustain level set

(3) **Sustain level:** the level sustained after the note moves from 1st decay.

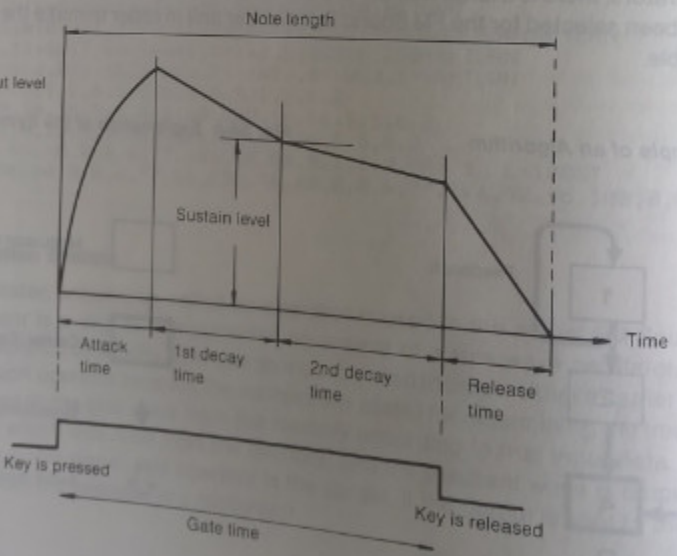
(4) **2nd decay rate:** the rate at which the EG level falls to zero from the level set as the sustain le

(5) **Release time:** the rate at which the EG level falls from the point where the key is released to wh it becomes 0.

The period of time the key is held down is called the **gate time.**

The period of time sound is emitted is called the **note length.**

*Fig. 55 The parameters controlled by the Envelope Generator*

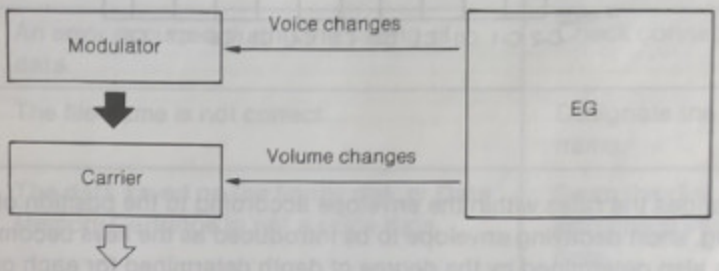


**The relationship between FM Sound Generation and the EG**

The Envelope Generators of the FB-01 control the operators, which, in turn, determine the changes in volume and timbre over a period of time.

The envelopes for the volume and those for harmonics (timbre) are created by using the EG of different operators. Changes in volume are performed by the EGs of the operators which are used as carriers; changes in timbre are performed by the EGs of operators which are used as modulators. Thus, the effect of the EG will change depending on whether the operator is a modulator or a carrier.

*Fig. 56 Relationship between FM Sound Generation and the EG*




## *Key Scaling Feature*

**What is Key Scaling?**

The volume and timbre envelopes of the high and low sections of a piano will differ slightly. This is true not only for the piano but for all acoustic instruments. The FB-01 has **key scaling** features which allow the envelope generation to be changed according to the notes played. The key scaling feature allows subtle nuances of the sound to change with the position of the keys struck.

**Two Types of Key Scaling**

There are two types of key scaling which allow the volume and timbre response to be precisely tailored to the position at which the keys are struck. These two features are **key scaling for EG level** and **key scaling for EG rate**.

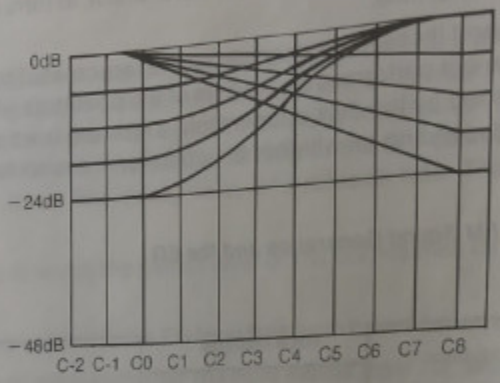
- Level Scaling

Level scaling changes the EG level according to the position of the keys. It can be set independently for each operator, allowing the volume and timbre responses to be adjusted separately.

For example, a setting which will reduce the volume as the higher keys are played or a setting which makes the sound more full-bodied, are both possible.

The level scaling can be adjusted according to two different laws of variation, which are represented in Fig. 57 as two families of curves. One shows the level decreasing as the keys become higher in pitch (straight lines). The other shows that the level decreases as the keys become lower in pitch. Both are set by the depth of level scaling.

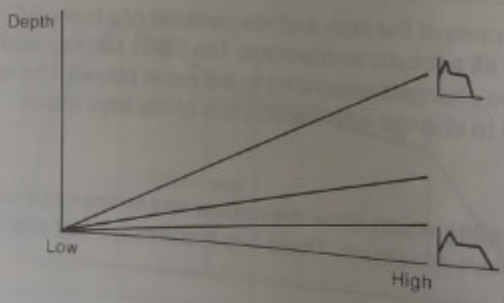
*Fig. 57 Level Scaling*




- **Rate Scaling**

Rate scaling changes the rates within the envelope according to the position of the keys. This allo a sharp attacking, short decaying envelope to be introduced as the keys become higher. The amou of rate scaling is also determined by the degree of depth determined for each operator.

*Fig. 58 Rate Scaling*



# ERROR MESSAGES

The voice or Configuration number of the voice or Configuration data stored in the temporary storage buffer (Save Buffer) is usually displayed on the right side of the screen. However, other messages also are displayed in this area when the necessity arises. The meanings of these messages are as follows:

| Message | Cause | Remedy |
|---|---|---|
| Bad argument | The data following the command is incorrect. | Enter the correct data. |
| Bad command | The command was not correctly entered. | Enter the correct command. |
| Read error | An error occurred during the loading of data. | Check connections. |
| Write error | An error occurred during the saving of data. | Check connections. |
| Bad name | The file name is not correct. | Designate the correct file name. |
| Not a voice | The data saved on the floppy disk or Data Memory Cartridge in not a voice data. | Swap the disk or cartridge with one containing voice data. |
| Not ready | Designated external storage device is not connected. | Connect the device. |
| Not found | Designated file was not found. | Check the file name and designate the correct file name. |
| W protect | The floppy disk is write protected. | Undo the write protection. |
| FD not ready | The floppy disk is not inserted into the disk drive. | Insert the floppy disk properly into the drive. |
| Disk full | Saving onto full floppy disk was attempted. | Delete unnecessary files, or use a new disk. |

# AVAILABLE COMMANDS

Here is a list of all the commands used in the FB-01 Voicing Program. Once you know how to operate this program, all you need is this list and the list of the keys you are to use (see p. 6).

| Command | Function | Block | Page |
|---|---|---|---|
| CL | Loads data from a cassette recorder | T | 42 |
| COP | Copies data from voice/instrument n to m | V/CON | 19 |
| **CON** | Calls the Configuration block | V | 11 |
| CS | Saves data onto cassette | T | 42 |
| D | Displays the Directory (list of file names) | V/CON | 17 |
| DD | Erases a file on the floppy disk | T | 43 |
| DF | Displays a list of the files on disk | T | 43 |
| DL | Loads a file from disk | T | 43 |
| DS | Saves a file on disk | T | 43 |
| H | Takes you back to the command menu | V/CON | 18 |
| K | Initializes the data of voice/instrument n | V/CON | 18 |
| MR | Loads Voice/Configuration data from FB-01 | T | 45 |
| MS | Saves Voice/Configuration data on FB-01 | T | 45 |
| n | Selects another voice/instrument | V/CON | 17 |
| P | Prints the data of voices/instruments n ~ m | V/CON | 19 |
| R | Restores the original voice/instrument data | V/CON | 17 |
| RS | Saves Voice/Configuration data onto Memory Cartridge | T | 47 |
| RL | Loads Voice/Configuration data from Memory Cartridge | T | 47 |
| SA | Loads data into the save buffer | V/CON | 17 |
| SE | Selects the printer type | V/CON | 19 |
| SW | Swaps data numbers n and m | V/CON | 19 |
| T | Calls the Transfer block | V/CON | 19 |
| T | Selects the data type (V or CON) | V/CON | 17 |
| V | Calls the Voice block | T | 41 |
| | | CON | 17 |

n, m, and a : A number to be specified.
f : A file name to be specified.

# COMPATIBILITY WITH THE SFG VOICE DATA

- Basically, the voice data of the FB-01 are compatible with those of a Yamaha FM Synthesizer Unit (SFG-01 or SFG-05). Therefore, the voice data of the SFG can be transferred to the FB-01 and vice versa. However, there are some differences concerning the parameters.

*Fig. 59 Parameters available only on one device*

| FB-01 | SFG |
|---|---|
| Velocity Sensitivity for the Attack Rate | LR |
| Mono/Poly | Noise Enable |
| PMD for the Controller | Noise Frequency |
| Pitchbender Range | |
| Portamento Time | |

These parameters will be set to 0 in the transfer process from the SFG to the FB-01 and vice versa.

- With some parameters the outcome differs:

  (1) LFO speed

  (2) Envelope change rate

  On the FB-01 they will be rated slightly higher even though the same value was assigned to the parameter.

NOTE: Due to differences in the hardware, the overall sounds on the SFG will be slightly harsher than the ones on the FB-01.

[ FB-01 Voicing Program ]
YRM-506 MIDI Implementation Chart

Date : Apr.30.1985
Version : 1.00

| Function ... | | Transmitted | Recognized | Thru | Remarks |
|---|---|---|---|---|---|
| Basic | Default | 1 | x | 1-16 | |
| Channel | Changed | 1-16 | x | 1-16 | !config mode! |
| Mode | Default | 3 | x | 3,4 | |
| | Messages | x | x | | |
| | Altered | ********** | x | | |
| Note Number | | 36-84 | x | 0-127 | |
| | | ********** | x | 0-127 | |
| Velocity | Note ON | o,v=1-127 | x | o | |
| Number | Note OFF | o,v=0 | x | o | |
| After | Key's | x | x | x | |
| Touch | Ch's | x | x | o | |
| Pitch Bender | | x | x | o | |
| | 1 | x | x | o | Pmd |
| | 2 | x | x | o | Pmd |
| | 4 | x | x | o | Pmd |
| Control | 7 | x | x | o | Volume |
| | 10 | x | x | o | PAN(L,L/R,R) |
| Change | 64 | x | x | o | sustain |
| | 65 | x | x | o | portamento |
| | 66 | x | x | o | sostenute |
| Prog Change | True # | x | x | x | |
| | | ********** | x | x | |
| System Exclusive | | o | o | x | |
| System Common | Song pos | x | x | x | |
| | Song sel | x | x | x | |
| | Tune | x | x | x | |
| System Real Time | Clock | x | x | x | |
| | Commands | x | x | x | |
| Aux Mes- sages | Local ON/OFF | x | x | x | |
| | All Notes OFF | o(123) | x | x | |
| | Active Sense | x | x | x | |
| | Reset | x | x | x | |
| Notes | | | | | |

Mode 1 : OMNI ON, POLY  Mode 2 : OMNI ON, MONO
Mode 3 : OMNI OFF, POLY  Mode 4 : OMNI OFF, MONO

o : Yes
x : No

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