

## **General Notice**

When using this document, keep the following in mind:

1. This document is confidential. By accepting this document you acknowledge that you are bound by the terms set forth in the non-disclosure and confidentiality agreement signed separately and /in the possession of SEGA. If you have not signed such a non-disclosure agreement, please contact SEGA immediately and return this document to SEGA.
2. This document may include technical inaccuracies or typographical errors. Changes are periodically made to the information herein; these changes will be incorporated in new versions of the document. SEGA may make improvements and/or changes in the product(s) and/or the program(s) described in this document at any time.
3. No one is permitted to reproduce or duplicate, in any form, the whole or part of this document without SEGA'S written permission. Request for copies of this document and for technical information about SEGA products must be made to your authorized SEGA Technical Services representative.
4. No license is granted by implication or otherwise under any patents, copyrights, trademarks, or other intellectual property rights of SEGA Enterprises, Ltd., SEGA of America, Inc., or any third party.
5. Software, circuitry, and other examples described herein are meant merely to indicate the characteristics and performance of SEGA'S products. SEGA assumes no responsibility for any intellectual property claims or other problems that may result from applications based on the examples describe herein.
6. It is possible that this document may contain reference to, or information about, SEGA products (development hardware/software) or services that are not provided in countries other than Japan. Such references/information must not be construed to mean that SEGA intends to provide such SEGA products or services in countries other than Japan. Any reference of a SEGA licensed product/program in this document is not intended to state or simply that you can use only SEGA'S licensed products/programs. Any functionally equivalent hardware/software can be used instead.
7. SEGA will not be held responsible for any damage to the user that may result from accidents or any other reasons during operation of the user'S equipment, or programs according to this document.

NOTE: A reader's comment/correction form is provided with this document. Please address comments to :

SEGA of America, Inc., Developer Technical Support (att. Evelyn Merritt)  
150 Shoreline Drive, Redwood City, CA 94065

SEGA may use or distribute whatever information you supply in any way it believes appropriate without incurring any obligation to you.



SEGA OF AMERICA, INC.  
Consumer Products Division

SEGA Confidential

# **DSP Linker User's Manual**

Doc. # ST-070-R1-031094

## READER CORRECTION/COMMENT SHEET

### Keep us updated!

If you should come across any incorrect or outdated information while reading through the attached document, or come up with any questions or comments, please let us know so that we can make the required changes in subsequent revisions. Simply fill out all information below and return this form to the Developer Technical Support Manager at the address below. Please make more copies of this form if more space is needed. Thank you.

### General Information:

Your Name \_\_\_\_\_ Phone \_\_\_\_\_

Document number ST-070-R1-031094 Date \_\_\_\_\_

Document name DSP Linker User's Manual

### Corrections:

Chpt.	pg. #	Correction

Questions/comments: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

### Where to send your corrections:

Fax: (415) 802-1717  
Attn: Evelyn Merritt  
Developer Technical Support

Mail: SEGA OF AMERICA  
Attn: Evelyn Merritt  
Developer Technical Support  
150 Shoreline Dr.  
Redwood City, CA 94065

# DSP Linker

## User's Manual

1. Introduction .....	3
About this Manual .....	3
Overview .....	3
Installation .....	4
Quick Start .....	4
2. Menus .....	6
File Menu .....	6
Edit Menu .....	7
Window Menu .....	7
GlobalCoef Menu .....	8
Process Menu .....	9
Option Menu .....	9
Software EG/LFO Menu .....	9
3. Files Handled through Linker .....	11
Link Information File (YLI) .....	11
Link Information Result File (LRI) .....	11
Executable File (EXL) .....	11
Binary Executable File (EXB) .....	11
4. Algorithm Edit .....	12
Module Layout .....	12
Connections .....	13
Selecting the Module and Connection .....	14
Module ID Assignment .....	15
Module ID Reassignment .....	17
Parameter Edit .....	17
Definition/Use/Cancellation of Global Coefficients .....	18
Specifying the Modulator Input Buffer .....	20
SizeToFit Function .....	21

(There is no page 2 in the original Japanese document.)

SEGA Confidential



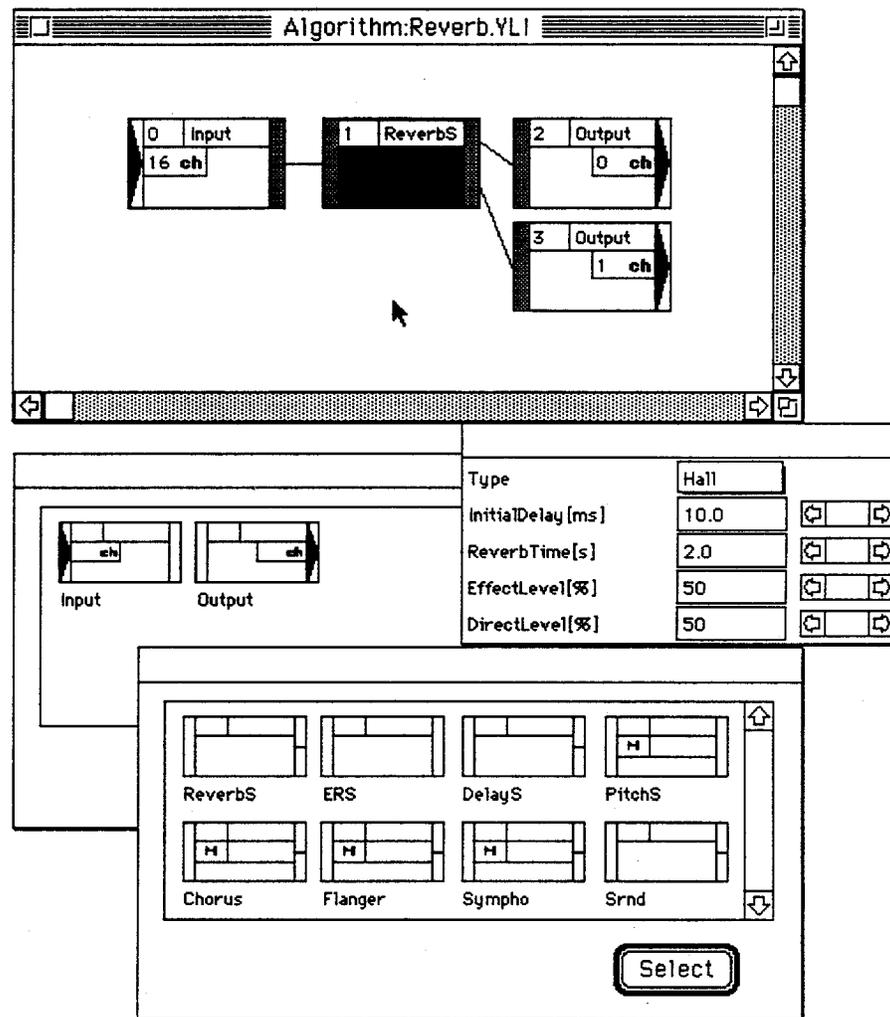
# 1. Introduction

## About This Manual

This manual explains how to operate the “SCSP/DSP/Linker.”

## Overview

Each “executable DSP microprogram” is prepared by linking modules that offer individual functions. There are two types of modules: the “Effect modules” and “I/O modules.” The order in which these modules are linked and connections for the I/O are defined through graphic display. An example of linker display is shown below.



Minimum hardware requirements:

- Personal computer system (Macintosh or Windows machine).  
(A separate SCSI-I/F board is needed for the Windows Machine.)
- SCSP software development board
- SCSI cable for connecting the above

## Installation

Copy onto the appropriate place on the hard disk from the master disk.

## Quick Start

This section covers the operation of SCSP/DSP/Linker from start to quit.

1. Open the Linker Application  
Double-click the "Linker" icon in the Finder to start the application.
2. Open a New Algorithm  
Select "New" from File menu, enter a filename, and press the Return key to open a new Algorithm Edit window. A ".YLI" extension is automatically added to the filename.
3. Verify the SCSI ID  
The SCSP/DSP/Linker automatically sets the communication SCSI ID for the development board during start-up. Select "SCSI ID" from the option menu to make sure that this ID is identical to the hardware switch SCSI ID set-up of the development board.

---

**\* WARNING:**

IT IS POSSIBLE TO CHANGE THE SCSI ID AT THIS POINT BY SETTING THE ID AND CLICKING "OK." HOWEVER, WHEN THE SCSI ID IS SET UP INCORRECTLY, CONTENTS IN THE MEMORY DEVICE (HARD DISK, ETC.) CONNECTED THROUGH THE SCSI MAY GET DESTROYED. PLEASE USE EXTRA CAUTION.

---

4. Design the Effect Algorithm
  - 4-1. Layout the DSP Input Output Modules  
Select the "I/O Modules" from window menu and open the "I/O Module" window. Double-click the "Input (to DSP)" module or "Output (from DSP)" module in the "I/O Module" window, or select one of them and click the "Select" button. The module will be laid out at the position last clicked on the Algorithm Edit Window.

**Note:** If necessary, drag the "I/O Module" window so that it does not be overlapped with the Algorithm Edit window. This way the "I/O Module" window is always visible. This makes it easier to continuously layout the modules.



- 4-2. Layout the Effect Module  
Select the "Effect Modules" from the window menu and open the "Effect Module" window. Follow the same instructions for the DSP I/O Module to layout the Effect Modules.
- 4-3. Interconnect Modules  
Connect the modules laid out in the Algorithm Edit window. Then, click the output port of the module from which the output sound data is taken. Finally, click on the input port of the module where sound data goes for module connection. This operation determines the sound data flow among modules.
5. Link  
Select "Link" from the Process menu to link the Effect algorithms that have been generated. If link was successful, the "Link Result Information" Dialog box will open. This dialog box contains information on the status of DSP-related hardware resources.
6. Download  
Select "Download" from Process menu to download the linked Effect algorithm into the target (development boards) hardware. At this stage, the DSP starts operating according to the Effect algorithm that the DSP produced.
7. Edit Effect Parameter  
Double-click a blank portion (where characters are not displayed) within each module laid out inside the Algorithm Edit window (or select "Parameters" from window menu after select) to open the Parameter Editor window. Use the mouse to operate the scroll bar inside this window or enter numeric values directly into the text box and press the return key. Results are reflected in the effect on a real-time basis. However, a real time parameter edit is no longer effective as soon as the sound data path is changed by the modification. (Under this condition, "Download" on the Process menu is grayed out.) In such cases, real time parameter edit can be started again with another link and download.
8. Save File  
Up until this point, information regarding linked and downloaded Effect algorithm has only been stored in host machine memory. The file has not been saved. When the Effect algorithm is complete, select "Save" from File menu to save the file.
9. End Linker Application  
Select "Quit" from the "File" menu to terminate the Linker application.

## 2. Menus

### File Menu

#### New

Opens a blank algorithm edit screen. After selecting this item, enter the algorithm name (link information filename). The “.YLI” extension is automatically added to the filename.

#### Open

Opens the algorithm stored in the Link Information File (YLI). The Link Information File is selected through the standard file open dialog box immediately after this item have been selected. After the Algorithm edit window opens, the specified file is read the algorithm is displayed.

#### Save

Saves the algorithm under edit as a Link Information File (YLI). The storing name becomes the current algorithm name. Expansion Executable Format file (EXL) and Binary Executable file (EXB) are also output at the same time.

#### Save As...

Saves the algorithm under edit to a Link Information File (YLI). A new filename is entered into the standard save dialog box. The Expansion Executable Format file (EXL) and Binary Executable Format file (EXB) are also output at the same time.

#### Close

Closes the Algorithm Edit Window under edit.

#### Quit

Closes the Linker.



## **Edit Menu**

### **Undo**

Undoes the last edit command performed.

### **Cut**

Cuts the module and connection selected. When a module is cut, lines connected to the module are also deleted. The deleted module and information associated with it are stored in the Paste buffer.

### **Copy**

Stores the selected module and its information into the Paste buffer.

### **Paste**

Modules that have been stored in the Paste buffer by Cut and Copy are displayed in the Algorithm Edit Window. The display position is where the mouse was clicked last in the Algorithm Edit Window.

### **Select All**

All modules and connection lines are selected.

## **Window Menu**

### **EffectModules**

Opens the Effect module window. If this window is already open but behind other windows, this command will bring it to the front. See “[4] Algorithm Edit, [1] Module Layout,” for module layout method.

### **I/OModules**

Opens the I/O module selection window. If this window is already open but behind other windows, this command will bring it to the front. See “[4] Algorithm Edit, [1] Module Layout.” for module layout method.

### **Parameters**

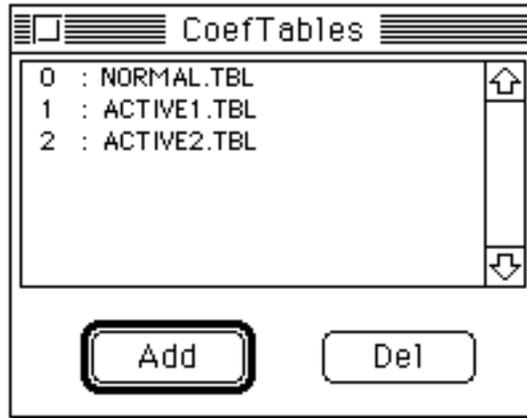
Opens the Parameter Edit window for the module selected. Selecting this item is equivalent to double-clicking the module selection field.

### **SizeToFit**

Reduces the size of Algorithm Edit window content to display the entire algorithm on the screen. It is not possible to edit the algorithm while this command is in effect. In addition, this function will not work if the algorithm initially fits on one screen. To go back to the original size, select this item again. A check mark appears on the left of the menu, while the reduction is being displayed.

### CoefTables

Opens the “coefficient table allocator” for handling the coefficient table data on the linker. By registering a coefficient table file in the “coefficient table allocator,” the coefficient table data are linked to the executable format file so that the Effect module requiring a coefficient table can be used.



The ADD button is used for registering an additional coefficient table file. The DEL button is used for deleting the coefficient table file in a selection mode. Once a file is deleted, the subsequent coefficient table files will have their numbers shift. Therefore, it is necessary to reassign the coefficient table numbers specified of the modules.

**Note:** The coefficient table files are data files containing binary data of the A00H size, and their extension is “.TBL”. They are used by the dynamic filter module. Resonance and other filter characteristics can be modified by changing the coefficient table file.

### GlobalCoef Menu

#### DefineGlobal

Opens the global coefficient definition window. If this window is already open but is behind other windows, then this command will bring it to the front.

#### AlterToGlobal

Opens the global coefficient use window. This item can be selected only when the coefficient selected on the Parameter Editor window can be altered to global. As a rule, parameters displayed in [%] units can be altered to global.

#### RevertToLocal

Reverts the global coefficients selected in the Parameter Editor window back to local. This command can be selected only when the Parameter Edit window is active.



## **Process Menu**

### **Link**

Checks the number of program steps and whether the available internal memory under the current algorithm structure exceeds the limitations imposed by hardware or not, and displays the result of the check.

### **Download**

Transfers the data prepared through menu item “Link” to the SCSP in an executable format.

## **Option Menu**

### **RingBuffer**

Displays the dialog box for specifying the size of ring buffer used by the current algorithm.

### **SCSI ID**

Transfers data through a SCSI to the SCSP on the SCSP/DSP/Linker. The SCSI ID is automatically set when the Linker starts up. Normally, when this menu item is selected, a dialog box appears for resetting an ID.

## **SoftwareEG/LFO Menu**

This is a menu for defining the parameters for generating EG/LFO wave forms (SoftwareEG/LFO) through the sound CPU. Although it depends on the sound CPU load, the SoftwareEG/LFO realizes virtually up to a maximum of 32 devices EG/LFO elements through software.

### **NumberOfElements**

Opens the “NumberOfElements” dialog box (discussed later) when selected.

### **MasterSwitch**

Opens the “MasterSwitch” dialog box (discussed later) when selected.

### **#0 ~ #31**

Opens the “SoftwareEG/LFOElement” window (discussed later) corresponding to the number of the menu item selected. Active display results when this window is already open.

### **Dialog/Window**

#### **“NumberOfElements” Dialog Box**

The maximum number of usable SoftwareEG/LFO elements is set through this dialog box. When setting the value in this dialog box to N, and N = number of elements, then Element#0 to Element#(N-1) becomes effective.

Only the element data within the range defined as being effective are linked to the executable file.

### **“MasterSwitch” Dialog Box**

Each element’s ON or OFF is set through the check boxes in this dialog box. The check box numbers represent the SoftwareEG/LFO element numbers.

### **“SoftwareEG/LFO Element” Window**

- **EG/LFO Switching Radio Button**  
This radio button is used for setting whether that element functions as an EG or LFO. All displays related to functions of the side not selected will become grayed-out displays.
- **MIDI Ch**  
Sets which MIDI Ch receives the Note information for driving the EG.
- **Hold Time**  
Sets the Hold time in [ms] units.
- **Hold Level**  
Sets the EG level during Hold.
- **Attack/Decay/Slope/Release Rate**  
Sets Rate for each of the Attack/Decay/Slope/Release states.
- **Attack/Decay/Slope/Release Level**  
Sets Level for each of the Attack/Decay/Slope/Release points.
- **Graph**  
Calculates the elapse changes of time in EG from the setting value of each EG parameter, and displays the result in a graph. Time axis can be scaled up or down and moved by the setting of the two radio buttons.
- **Radio Button for Setting the Time Axis Scale (Magnification)**  
The EG graph time axis is scaled up or down by setting this radio button.
- **Radio Button for Setting the Time Axis Origin**  
The EG graph time axis origin is set at the head of one of the EG graph segments by setting this radio button.
- **Amplitude**  
Sets the LFO amplitude.
- **Frequency**  
Sets the LFO frequency.



### **3. Files Handled through Linker**

#### **Link Information File (YLI)**

This file is opened and saved through the file menu. It stores information on links, i.e. how and which modules are linked.

#### **Link Information Result File (LRI)**

This file stores information of the amount of hardware resource usage, memory allocation, etc. for the execution format file transferred to the SCSP.

#### **Executable File (EXL)**

In addition to the DSP microprogram, this file stores filename, ring buffer size, coefficient table numbers, and coefficient table data. It outputs when a link information file is saved.

#### **Binary Executable File (EXB)**

This is a binary file in the format used for outputting the executable file to a spare program area on the target board.

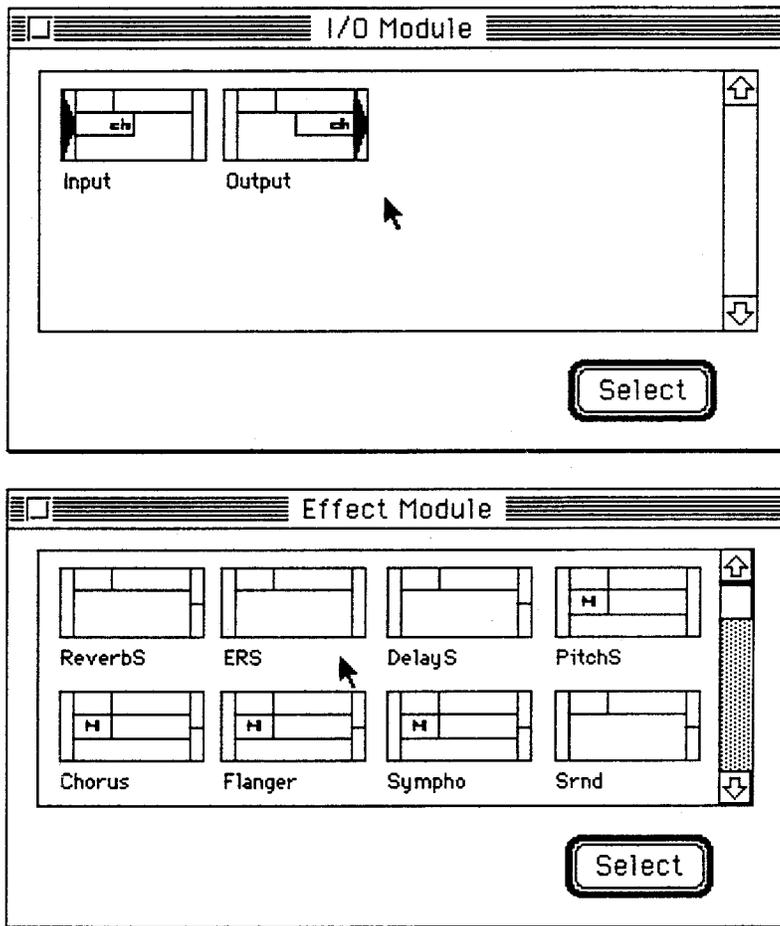
## 4. Algorithm Edit

Modules are specified for linking, and module connections are specified in the Algorithm Edit window to create the link information.

### Module Layout

The modules are laid out as follows:

1. From the Window menu, choose the "I/O Modules" when laying out I/O modules or "Effect Modules" when laying out effect modules to open their respective module selection windows (figures below).



2. Next, click on the module in the module selection window to be laid out, and then click the "Select" button. A shortcut is also available by double-clicking the module inside the module selection window. The module will be laid out in the Algorithm Edit window where it was last clicked. If the Algorithm Edit window has not been clicked at all, then the module will be placed at the upper right corner.
3. After a module is laid out, it can be dragged to a new position.

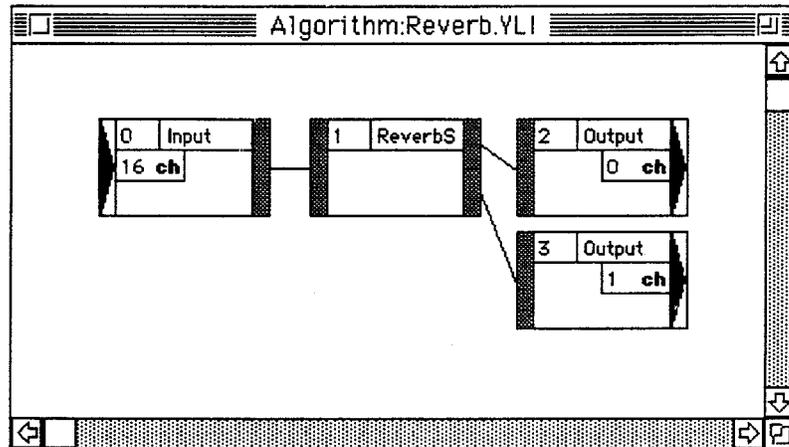


## Connections

Intermodule connection is achieved by clicking the connecting module input port and output port in order.

1. Click the port of the first module. The port and the connection to the port will go to the selection mode. That is, a port and the line connected to it are selected when the first port is clicked. The line will be deleted if "Clear" in the Edit menu is selected or if the Delete key is pressed at this point.
2. Click the port of the second module. When a second port is clicked, it will be connected to the port clicked first. The connection will be checked whether these ports can be connected. If they cannot be connected, the port selected with the first click will be disengaged. Instead, the port selected with the second click will now be considered as the first selection (state).

The following connections are possible.

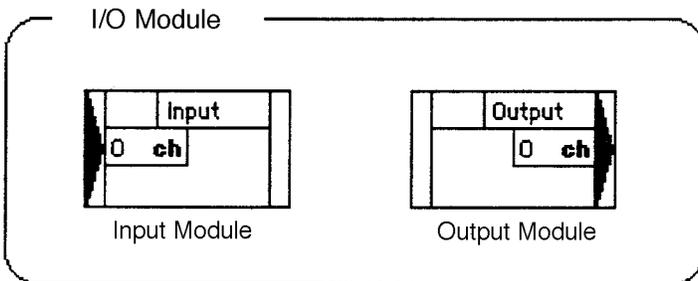
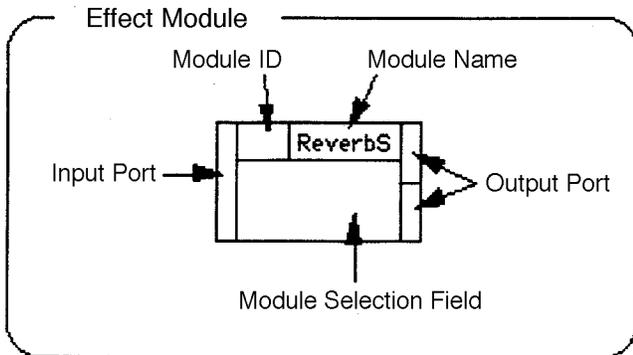


**Note:** Please take the following into consideration in the connection operation.

- Sound data can be branched off from 1 output port to several input ports; however, when mixing sound data from several output ports to a single input port, Mixer module must be used.
- It does not matter whether or not there is an unconnected module output port or not; however, all input ports must be connected. Use a dummy for unconnected input ports. In order to avoid the effects of the dummy connection on sound data, adjust parameters inside the module if necessary.

## Selecting the Module and Connection

The module and connection (connecting lines) must first be selected before cutting or copying. The followings are the module displays.



The module can be selected by clicking the module selection field, ID display field, or name field. When selected, the module selection is displayed in black, with its border (frame) emphasized.

Click while pressing the Shift key when selecting multiple modules.

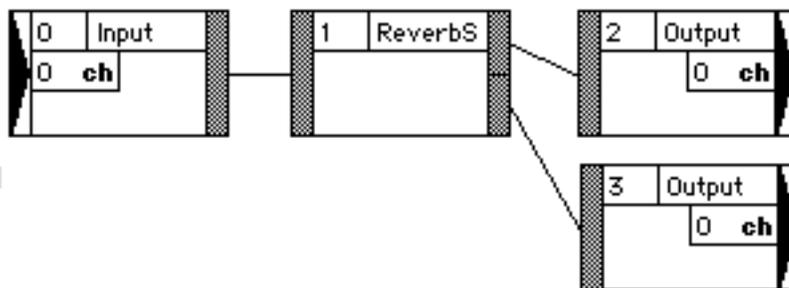


## Module ID Assignment

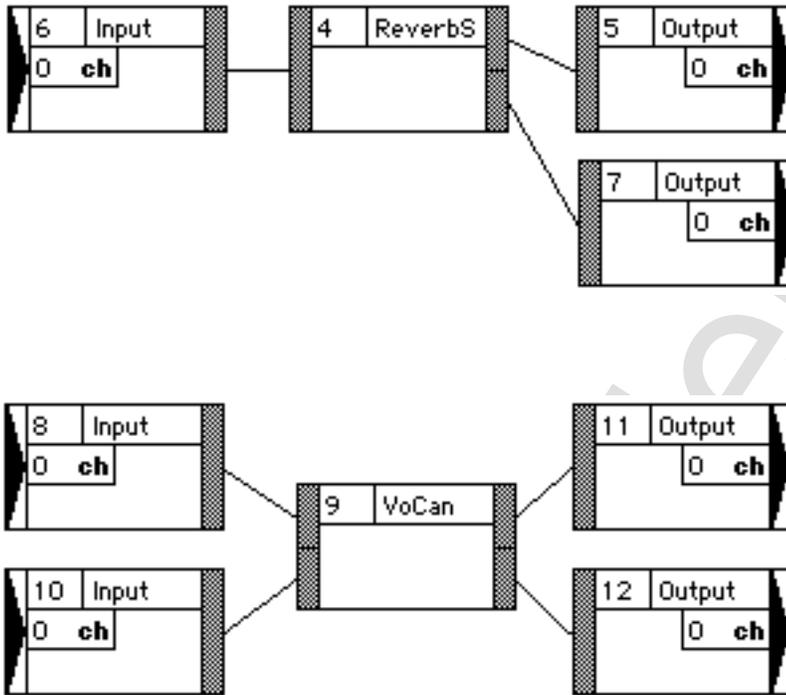
Module ID is assigned to each module when connection is performed. As a rule, these IDs must increase sequentially from the input side toward the output side. The IDs are assigned in the order they were connected. Note the following:

- If a newly connected module does not have an ID number, then it will be assigned with an ID number that is numbered one higher than the highest assigned ID.
- If both modules connected to a line have no ID numbers, then the module on the output side will be assigned a lower ID number and input side, a higher ID number.
- When a module is deleted, the ID numbers will be decremented so that they will be continuous.
- As a basic rule, it is recommended that modules be connected from the input side to the output side. That is, module ID numbers are assigned to each module in the order of connection (from the input module to the output module). If this procedure is not followed, or the connection is performed partially, the module ID order will be affected, and as a result, erroneous operations such as oscillation and changes in the sound quality could occur. In this case, renumber the module ID appropriately. (By double-clicking the module ID field, the dialog is displayed for renumbering.)
- The module with multiple input ports has a bigger ID than any of module IDs that are connected to all the input ports. If this is not the case, oscillation or changes in the sound quality could occur. (“Voice cancel [VoCan]” needs special attention.) Renumber the module ID appropriately. (Double-click the module ID is displayed to open the dialog for renumbering.)

The following is an example of the correct module ID assignments.



An example of the incorrect module ID assignments.



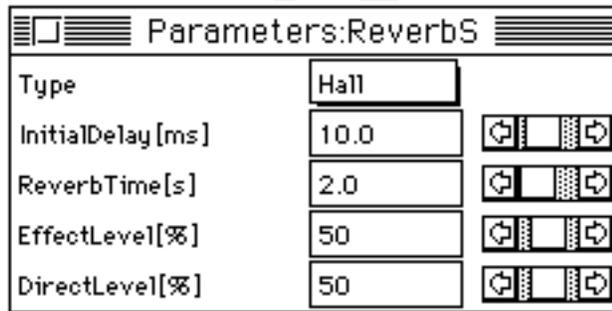
## Module ID Reassignment

Linking is performed in the order of module IDs. The numbers are assigned to modules in the order in which they are connected. If an error should occur, it would be necessary to reassign the module ID numbers.

1. Double-click the module whose ID number needs to be reassigned.  
The Renumber dialog box will open.
2. Enter a new value and click "OK."  
The module ID number will change. If this new ID number is already assigned to another module, or the ID numbers become discontinuous as a result of this change, then other ID module numbers will automatically change.

## Parameter Edit

1. Double-click the module selection field.  
The Parameter Editor window will open.



2. Enter a number by adjusting the scroll bar with the mouse, or clicking the value display field and change the value.

## Definition / Use / Cancellation of Global Coefficients

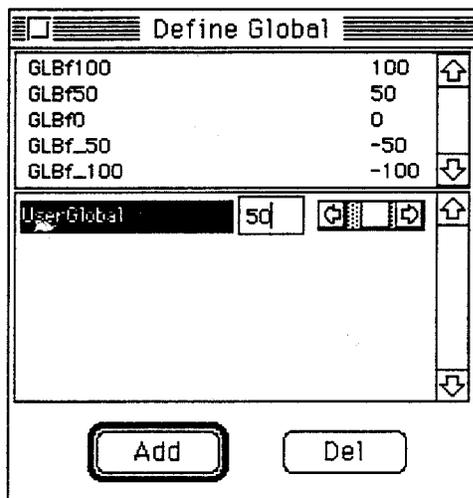
Global coefficients are coefficient data (data stored in the coefficient RAM on the DSP) that may be shared among multiple Effect modules. This function offers the following advantages by globalizing the parameters:

- Saves coefficient RAM space on the DSP.
- Makes it easier to simultaneously change the parameters for multiple modules.

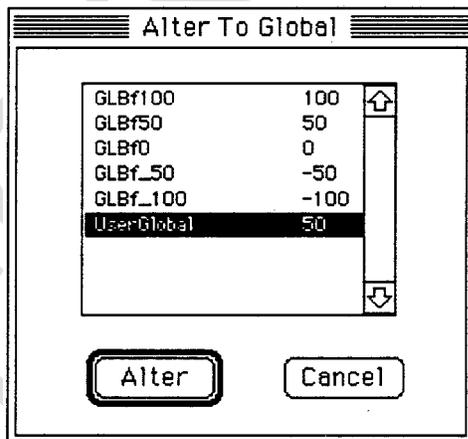
For each module, only those parameters expressed in “%” units in the Parameter Editor Window can be limited to global. One user defined global information exists for each algorithm.

The globalized parameters can be edited in the Define Global Window. By editing in the Define Global Window, parameters globalized with the same global coefficient will link and change.

### • DefineGlobal Window



### • AlterToGlobal Window



### **Definition of Global Coefficients**

1. Select "DefineGlobal" in the GlobalCoef menu.  
The DefineGlobal window will open.
2. Add a parameter by clicking "Add," and delete the parameter selected by clicking "Del."

Change a value using the keyboard or scroll bar.

### **Use of Global Coefficients**

1. Select a parameter to be altered to global in the Parameter Editor screen.
2. Select "AlterToGlobal" in the GlobalCoef menu.  
The "AlterToGlobal" window is open.
3. Select the global that is going to be used and click "Alter."  
The global is confirmed and returns to the parameter edit window. The parameter that has been selected through the "AlterToGlobal" menu is displayed in the Parameter Edit window value field as being global.

### **Cancellation of Global Coefficients**

1. Open the parameter Edit window.
2. Select the global coefficient that is no longer going to be global.
3. Select "RevertToLocal" in the GlobalCoef menu to cancel global. The global is canceled. The value specified globally appears in the coefficient value display field of the canceled coefficient .

## Specifying the Modulator Input Buffer

Some module symbols may come with an "M" button. The links will not be executed without setting these numbers unless the modulator input buffer number (DSP input buffer number) is set.

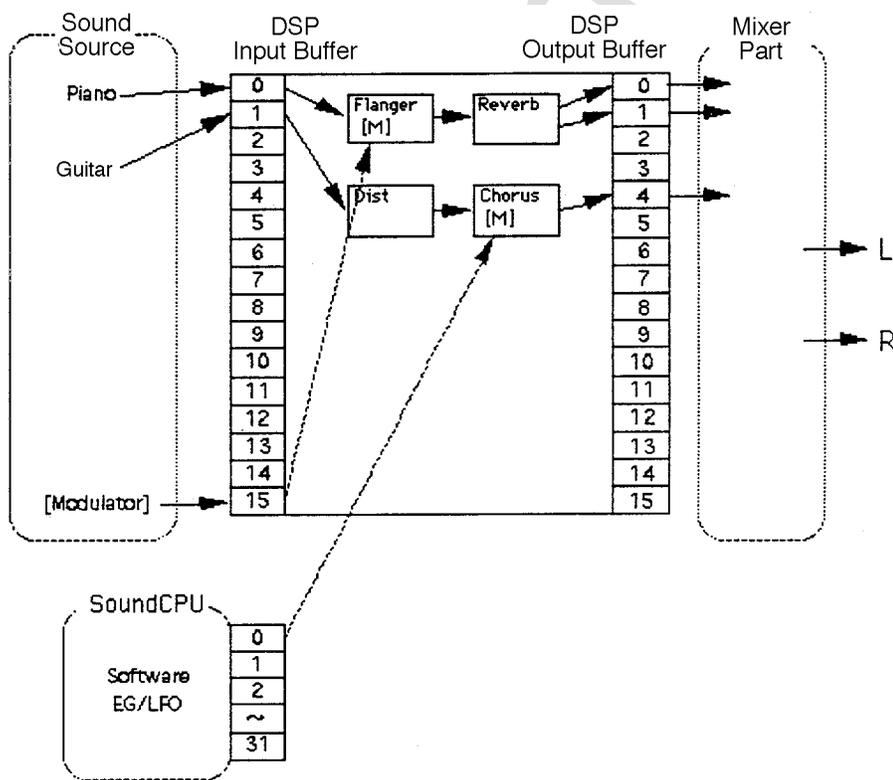
SoundSlotEG/LFO drive module: 0~15

SoundSlotEG/LFO drive module: 0~30

1. Click the M module. The modulator input buffer setup dialog box is open.
2. Enter the DSP input buffer number and click "OK". The buffer number is set.

### The Modulator Input Buffer

The modulator input buffer is a buffer used for incorporating the wave forms created by the SCSP sound source (SoundSlotEG/LFO) or sound CPU (SoftwareEG/LFO) into the DSP as LFO or EG. As far as hardware is concerned, a part of the DSP input buffer for playing the sound (for the SoundSlotEG/LFO) or a part of the DRAM for the DSP (for the SoftwareEG/LFO) is allocated and used for this purpose. See below for details.



### **SizeToFit Function**

Sometimes the entire module in the Algorithm Edit window may not fit on the screen. In such cases, select "SizeToFit" in the Window menu. The algorithm display size will be scaled down in the Algorithm Edit window, so that the entire algorithm can be viewed. A check mark appears in the menu while the SizeToFit display is active. The algorithm cannot be edited while the SizeToFit display is active. This function uses up a large amount of personal computer memory; thus caution should be paid.

SEGA Confidential