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PatchTalk Guide

Overview

The Galaxy package contains modules that enable it to work with a wide variety of synthesizers and MIDI devices by describing how Galaxy needs to interact with a given synthesizer. Galaxy also allows you to create modules for other synthesizers or MIDI devices that either didn’t exist at the time this version of Galaxy was created or that we didn’t know about.

PatchTalk Basics

Before you attempt to create your own custom modules, you should be familiar with:

- Hexadecimal numbers.
- The MIDI specification, particularly the format of system-exclusive messages.
- How to read the section of MIDI device manufacturers’ manuals dealing with system-exclusive messages.
- The basic concepts and principles involved in programming. If you've never done any programming, you might want to try learning HyperTalk (the language built into Apple's HyperCard) before trying to learn PatchTalk; the languages are similar, and there are many books and HyperCard stacks that you can learn from.

To create your own custom (or user-defined) module:

- Define the patch types that the device supports.
- Create a new device that uses these patch types.
- Write the scripts for each patch type.

PatchTalk is the language for describing how Galaxy should work with a given MIDI device. To create a Galaxy module for a new MIDI device, you write several small texts, called scripts, to describe the ways your MIDI device works for each patch type in the device. Scripts written in PatchTalk describe:

- Loading and sending a patch from a MIDI device.

  (Get Patch and Send Patch scripts)
- Loading and sending an entire bank of patches from a MIDI device.

  (Get Bank and Send Bank scripts)
- Translating the patch name in a patch to and from ASCII.

  (To Display Name and To Device Name scripts)
- The numbering of the MIDI device's patches.

  (Patch Number script)

When Galaxy performs an operation with your MIDI device, it follows the instructions in one or more scripts that you have written to find out how to interact with the MIDI device. This is called "running" a script.

The descriptions that follow provide information about Galaxy and PatchTalk that are necessary in order to write scripts and create custom modules. However, you also need information about your particular MIDI device and how it talks to computers over MIDI (often referred to as its "system exclusive implementation"). This information may be in the manuals that came with your device, or you may have to request it from the company. In either case, be prepared to spend some time reading the documentation and experimenting with your MIDI device to understand how it really works.

Skim the examples of custom modules in this section and on the Galaxy disks. You should find a device similar to yours that already has a custom module written for it. Look at the scripts and the information entered in dialog boxes to get ideas for creating your own custom modules. Learning from examples is probably the clearest way to find out how to program your own modules.

NOTE: Many of the modules included with Galaxy were not created in the manner described in this section (many modules were written in C). As a result, the Define Custom Patch Type and Define Custom Device dialog boxes for these patch types won't be accessible, and there are no PatchTalk scripts to read.

Defining Patch Types

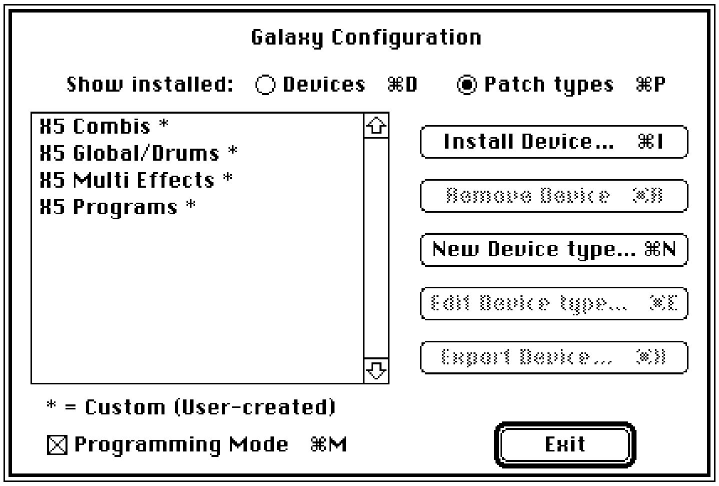
To create a custom module for Galaxy you create a custom device and one or more custom patch types. This is done by filling out dialog boxes accessed from the Galaxy Configuration dialog box. Patch types are created first, followed by the custom device. The following discussion details these two steps.

Each MIDI device can have one or more patch types. For example, a synthesizer might have voices and set-ups; a drum machine might have tone parameters, patterns, and songs. Almost every device has a system setup area that can be implemented as a single patch type. For each type of information your MIDI device has you'll need to create a new custom patch type.

To create a new custom patch type:

① Choose Setups>Galaxy Configuration.

② Check Programming Mode in the lower left of the dialog box.



Galaxy Configuration

Show installed: ○ Devices ⌘D ● Patch types ⌘P

K5 Combis *
K5 Global/Drums *
K5 Multi Effects *
K5 Programs *

* = Custom (User-created)

☒ Programming Mode ⌘M

Figure 1.1: Check Programming Mode; select Patch Types

③ Click the Patch Types radio button in the upper right of the dialog box.

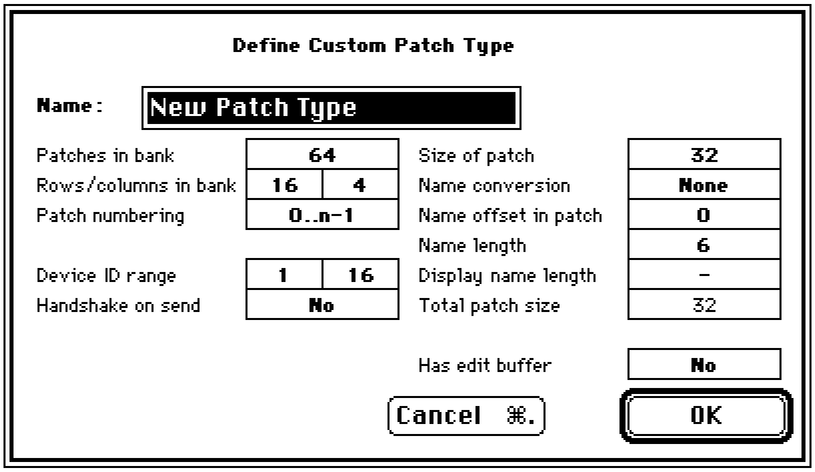
④ Click the New Custom button to open the Define Custom Patch Type dialog box.

To make changes to an existing patch type:

① Click the Patch Types button in the Galaxy Configuration dialog box.

② Select the patch type and click the Edit button to open the Define Custom Patch Type dialog box.

Alternately, you could simply double-click the patch type.



Define Custom Patch Type

Name: New Patch Type

Patches in bank 64
Rows/columns in bank 16 4
Patch numbering 0..n-1
Device ID range 1 16
Handshake on send No

Size of patch 32
Name conversion None
Name offset in patch 0
Name length 6
Display name length -
Total patch size 32

Has edit buffer No

Figure 2: Define Custom Patch Type Dialog Box

Fill in the fields of the Define Custom Patch Type dialog box as follows:

Name

Enter the name of the patch type. This must be unique among all patch types in your system. Therefore, put the device model number in the name, for example, “DX7 Voices” or “MultiVerb Patches.”

Patches in Bank

Enter the number of patches that the MIDI device stores of this type in its memory. Some devices can store more than one bank For example, there might be an internal bank and a bank stored in a card. In that case, enter the number of patches stored in *one* of those banks.

Rows/Columns in Bank

These let you set the number of rows (count down the screen) and columns (count across the screen) in a bank window. Setting either number will set the other number to a useful value given the number of patches in a bank.

Patch Numbering

This is the way patches are referred to on the MIDI device. Note that while MIDI always numbers patches from 0 to 127, most MIDI devices use a numbering system that the manufacturer thinks will be more convenient for the user. This option lets you set up the patch type so that Galaxy will use the same method in bank windows that the MIDI device uses. The options are:

- 0…n-1: The patches are numbered and the first one is 0. For example, there are 100 patches in a bank and they are numbered 0 through 99.
- 1…n: The patches are numbered and the first one is 1. For example, there are 64 patches in a bank and they are numbered **1** through 64.
- 11…88: The patches are numbered in groups of 8. For example, there are 16 patches in a bank and they are numbered: 11, 12, 13, 14, 15, 16, 17, 18, 21, 22, 23, 24, 25, 26, 27, 28.
- Custom: The patches are numbered in some other scheme. For example, the patches might be named IA-6, or P22. This option tells Galaxy to use a script you write to generate the numbering. If you want to get going quickly, you can choose the most appropriate option from one of the three preset options, and come back to the custom option later.

Device ID Range

The first numerical defines whether the device ID is 0 or 1 based. The second numerical defines the highest device ID number possible for that device. If your device doesn't appear to have a setting for a device ID then it's probably the same as the MIDI channel within the range 1 to 16.

Handshake on Send

This option tells Galaxy if the MIDI device needs to communicate back to Galaxy even when Galaxy is only sending patch information to the device. If you need to use any of the Receive commands in your Send scripts (see PatchTalk Commands, later in this section), then set this to yes.

NOTE: Galaxy will not work properly with MIDI patchers and your custom patch type if this option is not set correctly.

Size of Patch

Enter the number of bytes in a single patch. This will generally be the number of data bytes that the MIDI device sends for each patch. Some MIDI devices, however, transmit two bytes for each byte in a patch (this is called "nibblized" data) and therefore the size of the patch is only half of what is sent. Furthermore, a few MIDI devices require you to get several pieces of information for each individual patch. In this case you'll need to add up the sizes of each piece. Consult the manual for your MIDI device carefully when choosing this number.

Some patch types don’t have a standard size. Examples are sequence and/or pattern data in most drum machines. For these types, set this value to bulk (by typing 0 into the numerical or sliding it all the way down). Then your patch type will operate like the other bulk patch types of Galaxy.

NOTE: When writing scripts for bulk patch types, you must use the SendBulk and ReceiveBulk PatchTalk commands, instead of the other MIDI transfer commands.

Name Conversion

This tells Galaxy how to display the name for each patch. Galaxy needs to have access to an ASCII representation of the name for each patch, which is the standard way computers store letters. Although, many MIDI devices use this code, some use other codes, and some don’t even have names in their patches at all. There are four settings to let Galaxy know how to handle the names for the patch type:

- None: There is no conversion necessary. The name is contained in the patch data transmitted by the MIDI device (after denibblizing the data, if necessary) as standard ASCII symbols. This is the most common option to choose.
- Table: The name is in the patch, but uses a different code (although still one letter per byte). You will have to write a script that converts from one letter in the patch’s name into ASCII and vice versa. Often you can tell this because the documentation with the MIDI device will have a table in it showing which code values correspond to which letters and symbols.
- Script: The name is some special format. You will need to write a script that decodes the format into a full name and vice versa. The documentation for the MIDI device should contain the complete details of how to convert the name information in the patch.
- Not In Patch: There is no name information in the patch. This is common with many effects units. In this case, Galaxy will keep track of a name for each patch to display in the bank window, but this information is neither transmitted to, nor received from the MIDI device.

Name Offset in Patch

The number of bytes into the patch data that the name (in any format) starts. If it starts at the first byte in the patch, then the offset is 0. This value is not used (and you can’t set it) if there is no name in the patch data (Not In Patch selected for name conversion).

Name Length

The number of bytes for the name in the patch data. This is generally the number of characters in a patch name (None or Table selected for name conversion) but may be different if the name is in some special format (Script selected). This value is not used (and you can’t set it) if there is no name in the patch data (Not In Patch selected).

Display Name Length

If the number of characters used for a name by Galaxy is different than the number of bytes stored in the patch data (if Script is selected for **name conversion**) or there is no name in the patch data at all (Not In Patch selected), then this is the number of characters Galaxy should use to display the patch name.

Total Patch Size

This value is cannot be set. It simply reports the total number of bytes Galaxy will be using to save each patch.

Has Edit Buffer

This indicates whether the MIDI device has an edit buffer for the patch type. An edit buffer is a separate area from the bank of patches in which many MIDI devices store the current patch being played and edited. If your device has one, and you set this to **yes**, then when you send an individual patch from Galaxy, the edit buffer will be used (the Send Patch script will create the UseEditBuffer variable and set it to true). Otherwise, Galaxy will use the last patch location, which will overwrite that patch.

Defining Custom Devices

After you have created a new patch type for each of the MIDI device's patch types, you will need to create a new device type that uses them. A device type defines the device's name, which patch types occur in a device, and in what banks the patch types occur.

To define a custom device:

① Choose Setups>Galaxy Configuration.

② Click the Devices button in the Galaxy Configuration Dialog Box.

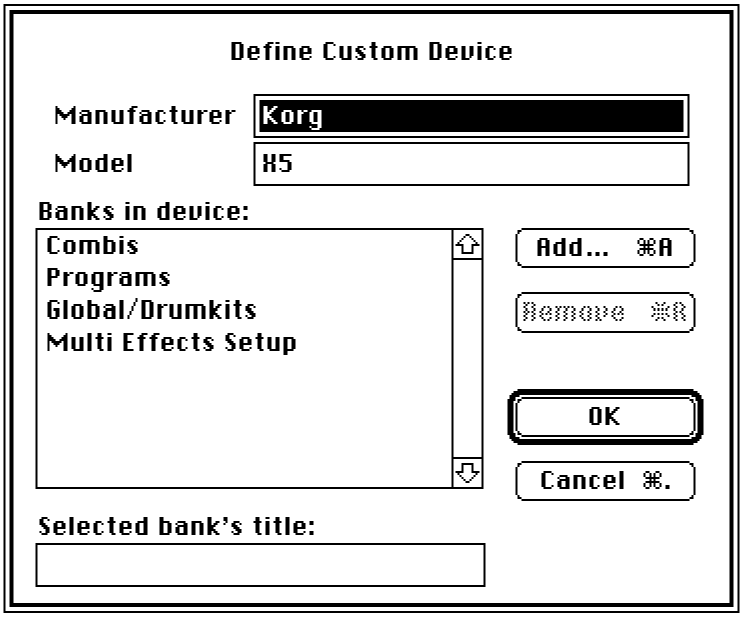
③ Click New Custom to open the Define Custom Device dialog box.

To make changes to an existing device type:

① Click the Devices button in the Galaxy Configuration dialog box.

② Select the device type and click the Edit button to open the Define Custom Device dialog box.

Alternately, you could simply double-click the device type.



Manufacturer Korg

Model X5

Banks in device:

Combis
Programs
Global/Drumkits
Multi Effects Setup

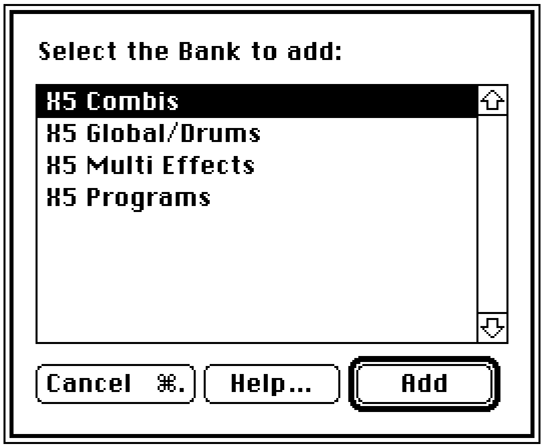
Selected bank's title:

Figure 3: Define Custom Device Dialog Box

③ Fill in the Manufacturer and Model fields with the appropriate names.

④ Click Add to add banks.

You will see a dialog box of patch types to choose from.



Select the Bank to add:

X5 Combis
X5 Global/Drums
X5 Multi Effects
X5 Programs

Figure 4: Banks to Add Dialog Box

New banks are added after the selected bank, or at the beginning when no existing bank is selected. You can click on any entry in the bank list and change its name by typing in the lower text box labeled Selected bank's title. This will change only the way the label appears in bundles, where it is convenient not to have the model number repeated again (since the model number is usually part of the patch type name, as described in the "Define Custom Patch Type" section).

Furthermore, some MIDI devices have several banks of the same patch type. In this case, you can add the same patch type two or more times (once for each bank), as long as you change each name. For example a synthesizer may have an internal bank and a card bank of voices. First add the patch type for voices to the device, rename it to "internal voices," then add the patch type again and rename the second one to "card voices."

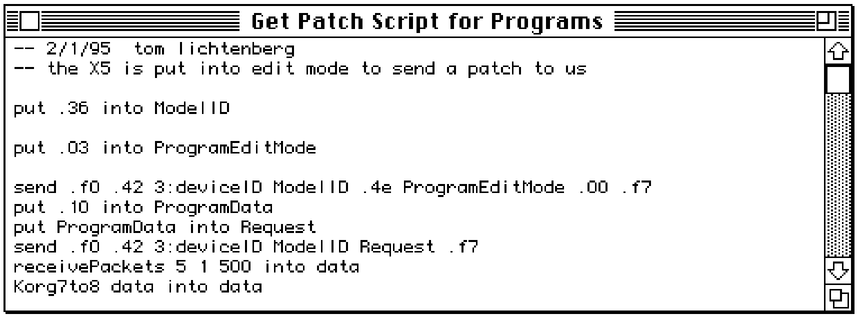
PatchTalk Scripts

After you have created a device and its patch types, you'll need to create a set of scripts for each patch type:

- Create a new bank for the new patch type by choosing File>New Bank.

  The Custom menu appears next to the Load/Send menu. It contains a command for each script.
- Choose an item from the Custom menu to edit the script for it.

  A text editing window containing that script opens so you can enter and edit the script.



```
-- 2/1/95  tom lichtenberg
-- the X5 is put into edit mode to send a patch to us

put .36 into ModelID

put .03 into ProgramEditMode

send .f0 .42 3:deviceID ModelID .4e ProgramEditMode .00 .f7
put .10 into ProgramData
put ProgramData into Request
send .f0 .42 3:deviceID ModelID Request .f7
receivePackets 5 1 500 into data
Korg7to8 data into data
```

Figure 5: Script Editing Window

Get Patch and Send Patch

You write these scripts to describe how to transfer a single patch to or from the MIDI device. They usually instruct Galaxy to send system exclusive data to the MIDI device and, in the case of Get Patch, to receive it as well. There might also be PatchTalk instructions for decoding or encoding the data before and after transmission over MIDI.

Typical format for a Get Patch script:

① Send a System Exclusive request to the MIDI device.

② Receive the patch data using Receive or ReceivePackets.

③ Process the data received if necessary.

④ Store the received data into the variable Patch.

Typical format for a Send Patch script:

① Process the patch data if necessary.

② Send the data out in the format that the MIDI device expects.

The types of processing that may be necessary include bit conversions or rearranging the data into an easily usable format. It is recommended that you use ReceivePackets when receiving data from the device because this command can automatically strip off header and trailer bytes from the system exclusive data. Galaxy patches usually do not contain header/trailer bytes or checksum. When sending data to the device you may have to “checksum” the data sent. PatchTalk has commands that handle a wide variety of checksum methods.

Get Bank and Send Bank

These scripts are similar to the Get and Send Patch scripts, except they describe how to transfer a whole bank of patches at a time. They are optional—if you leave them blank then the patch scripts will be called repeatedly for each patch in the bank, although this will be somewhat slower.

To Display Name and To Device Name

Some MIDI devices do not store the name of a patch in a way the Galaxy can read (which is a standard code called ASCII). In these cases, you write these scripts to describe how to convert to and from the particular code the MIDI device uses. Because of the special nature of this script, saving this script can take a long time.

Patch Number

Many MIDI devices do not number their patches in one of the common numbering schemes that Galaxy knows (1—n, 0—n-1, or 11—88). For example, some use a scheme that runs A1, A2, A8, B1, etc. In these cases, you can write this script to instruct Galaxy how to number the patches the way your MIDI device does. Because of the special nature of this script, saving this script can take a long time.

Saving and Exporting PatchTalk Modules

The patch and device types you create with Galaxy are stored in a file called Galaxy Librarian Modules. Scripts are treated as parts of a patch type. For safe backup of your work, and to be able to share it with others, you'll probably want to make copies of your custom patches and devices.

To save a copy of a custom device and the patch types it contains:

① Open the Galaxy Configuration dialog by choosing Setups>Galaxy Configuration.

② Click the Devices button, if it's not already the current choice.

③ Select the device you want to export.

Only custom devices, marked by asterisks, are exportable.

④ Click the Export button.

⑤ Name the file in the standard way, and click the Export button in the standard "Save As" dialog box to save the module.

Modules that you create in this way will always contain one device and all of the patch types contained in it. You (or a friend) can re-install these modules into Galaxy in the same manner that you installed the modules that came with Galaxy.

Send Opcode Your Modules!

Opcode will periodically release additional Galaxy modules. We hope that eventually MIDI manufacturers will write them before they release new devices but, in the meantime, if you want to share your work with other Galaxy users, send us your modules. We'll be collecting them for possible inclusion with future versions of Galaxy.

PatchTalk Help

A summary of PatchTalk is available as on-line help. To open a help window, choose **PatchTalk** from the System 7 Help menu.

(

Figure 6: System 7 help menu icon appears on upper right of Macintosh screen.

PatchTalk Commands

Commands are the instructions you write in PatchTalk scripts. They instruct Galaxy to perform very specific functions. When a script is run, each command in the script is executed in sequence. Remember that while Galaxy tries to do as much for you as possible, when it's running a script, it can only do exactly what is stated.

The following list of commands describes both how to use them in a script and what they do when run by Galaxy. The format of the command is given first, then a description of what the command does, followed by some examples. Keep these points in mind when looking at the format lines:

- Words in boldface, such as **Receive**, are typed just as they appear.
- Words in italics are replaced by one or more words that are appropriate, for example *ListOfValues* may be replaced by 3 + 4.
- Groups of words in braces, such as {**into** | **after**} are choices separated by the vertical bar. You can choose one of the options.
- Any text after two dashes ('**- -** ') is a comment. Galaxy will ignore whatever is there through the end of the line. A long dash will also work ("—", typed as Option-Shift-dash).
- Some parts of a command are optional. This is noted in a comment. Note that if you include optional parts you must write them in the order they appear in the format line.
- Upper and lower case letters make no difference: **put**, **Put**, and **PUT** are all the same.

- While some formats are shown on several lines for clarity, PatchTalk commands are written one line per command. (See “PatchTalk Notes” for a way to get around this limitation.)

Send

Send *ListOfValues*

This transmits the data in the *ListOfValues* to the MIDI device. Any data may be sent: system exclusive commands, note commands, patch data. It’s up to you to ensure that valid MIDI messages are sent and that any device IDs or channel assignments get encoded into the data (see the second example).

```
Send $F7                  send an end-of-system-exclu-
                          sive message
Send ($C : DeviceID) $7F  send a patch change to patch
                          127. Note the use of adding the
                          Device ID variable to send the
                          program change on the right
                          channel.
```

SendBulk

SendBulk

This sends the contents of a bulk window to the MIDI device. Use the ReceiveBulk command to get the data. Use this only with patch types that have their Patch Size set to Bulk.

Receive

Receive *MaximumSize* *{* **into | after** *}* *Destination*

require *ExactSize* **bytes** --optional

timeout after *Time* *{***seconds | milliseconds** *}* --optional

wait *UserMessage* --optional

This gets *one* system exclusive message over MIDI and places it into or after the *Destination*. Any additional data beyond the number stated, *MaximumSize,* are lost.

The optional require clause specifies the exact number of MIDI bytes required. If a different number of bytes is received (too many or too few), then the operation fails and the user will get a message. Use this whenever you know exactly how many bytes the MIDI device should send to you.

The optional timeout clause specifies the amount of time to wait for a message. If this time is exceeded, the receive command will fail and the user will get a time out message. Note that s and sec are acceptable abbreviations for seconds, as are ms and msec for milliseconds. If no timeout is specified, a default timeout will be used.

The optional wait clause puts a text message up for the user and waits indefinitely for the first byte of any MIDI message. This is used when a MIDI device requires the user to press a button on the device itself to initiate the transfer of patch data to Galaxy.

Receive 68 into TheData	*get up to 68 bytes into the variable theData*
Receive 8+PatchSize into TheData timeout after 500 msec	*get a sys-ex message that is 8 bytes larger than the patch size, but wait up to 500 milliseconds for the data*
Receive 8+PatchSize into TheData wait "Now Push the Send Key"	*get data, but put up a message for the user and wait indefinitely for the data*

ReceivePackets

ReceivePackets *HeaderSize TrailerSize MaximumSize*

{ **into | after** *} Destination*

*r***equire** *ExactSize* **bytes** --optional

*t***imeout after** *Time {***seconds | milliseconds** *}* --optional

*w***ait** *UserMessage* --optional

This is very similar to Receive only it provides some very convenient features. This message will receive as much data as the MIDI device sends to Galaxy, across several system exclusive messages if necessary. Furthermore, the command will strip off *HeaderSize* bytes from the front and *TrailerSize* bytes from the end of each system exclusive message received. Note that *MaximumSize* refers the maximum size of each individual system exclusive message, not the whole set of messages.

The other parameters are just like those in the Receive command.

ReceivePackets 6 2 BankSize+6+2 into theData	*get up to BankSize bytes into the variable theData from multiple system exclusive messages, throwing away the first 6 and last 2 bytes of each message*
ReceivePackets 6 2 BankSize+6+2 into theData timeout after 250 msec	*as above, but only wait up to 1/4 second for the data to arrive*

ReceiveBulk

ReceiveBulk *MaximumSize --optional*

timeout after *Time {***seconds | milliseconds** *}* --optional

wait *UserMessage* --optional

Like ReceivePackets, this command gathers all data the MIDI device has to send. However, it takes the data exactly as received and places it into the bulk window. Use this only with patch types that have their Patch Size set to Bulk. Setting *Maximum Size* to 0 will tell Galaxy to allocate half of the available memory for bulk operations. ReceiveBulk, unlike ReceivePackets, will accept non-system exclusive data.

The other options are just like the Receive command.

Delay

Delay *Time {* **seconds | milliseconds** *}*

This causes Galaxy to wait the specified time before doing anything else. Some devices require short pauses before sending or receiving MIDI data. Consult the MIDI device’s manual for its requirements.

Delay 50 msec	*wait 1/20 of a second*
*Delay 2*60*60 seconds*	*wait 2 hours while you go eat dinner*

Abort

Abort *ErrorMessage*

This stops Galaxy from running the script any further, and displays an optional error message for the user. You might use this command when you detect the MIDI device is sending bad MIDI information.

Abort	*cancel operation of the script*
Abort “The MIDI data was bad! Check the device.”	*tell the user of a problem with the device*
Abort “Bad data received make sure AppleTalk is OFF”	*tell the user to turn off AppleTalk*

Put

Put *ListOfValues {* **into | after** *} Destination*

This command puts the result of the *ListOfValues* into the *Destination*. The *ListOfValues* may be either a number, a string, or a list of arithmetic expressions and strings separated by spaces. The *Destination* can be an existing or a new variable.

Put 9 into x	*x now has 9 in it*
*Put x*3 into y*	*y now has 27 in it*
Put “Hello” into x	*x now has “Hello” in it*
Put “World” after x	*x now has “Hello World” in it*
Put temp[23,10] into Patch[0,10]	*replace 10 bytes of Patch starting at offset 0 with 10 bytes of temp at offset 23*
Put $C:DeviceNumber y into z	*z has a program change 27 message in it*

NOTE: “After” can only be used with an array that already exists. See the section “Putting Empty into a Variable” for more information.

Nibblize
DeNibblize
Checksum
Checksum0

Nibblize *ListOfValues {* **into | after** *} Destination*

DeNibblize *ListOfValues {* **into | after** *} Destination*

Checksum *ListOfValues {* **into | after** *} Destination*

Checksum0 *ListOfValues {* **into | after** *} Destination*

These commands all perform the same function as the Put command. However, each of them does something to the data before it is placed into or after the *Destination*.

Nibblize expands the data to twice its size by placing the upper and lower 4 bits (a nibble) of each byte into separate bytes. The upper nibble precedes the lower nibble in memory. Many MIDI devices use this simple encoding of patch data for transmission. We encourage you to store patches in denibblized format for efficient use of disk space and memory.

NOTE: One good clue as to whether the data is nibblized is whether the size of the data that the device sends you is twice as large than what is specified in its MIDI specification.

DeNibblize contracts the data to half its size by combining each pair of bytes into a single byte. It is the reverse of Nibblize.

Checksum sums every byte and appends the low-byte of the total to the end of the data. Some MIDI devices require this value to be placed near the end of the data portion of all system exclusive messages. See the MIDI device’s manual for details.

Checksum0 is like Checksum only the reverse of the low-byte of the total is appended to the data. Some MIDI devices, such as some by Roland, use this form of checksum.

View

View Variables

This pauses a script and opens a dialog box displaying the contents of all currently defined variables. It is useful for debugging your script. Temporarily add it at various points if you want to check what your script is doing. Strategic points to view variables are just before a Send command and just after a Receive command.

```
View Variables              stop and look at the
                            variables
```

PatchTalk Control Structures

Control Structures are PatchTalk commands that direct Galaxy how to interpret other PatchTalk statements. They allow you to choose among two or more groups of statements and/or repeatedly execute a group of statements. Since they contain other commands, these statements may take up several lines in a script.

If

```
If Condition Then
   Commands
Else --optional
   Commands
EndIf
```

If the test indicated by *Condition* is true, then the first set of *Commands* is run by Galaxy. Otherwise the second set of *Commands* is run. Note that the second set of commands is optional and, if not provided, no commands will be run if the condition is false.

Note that the word then is optional.

```
If PatchNumber < 64           check if the number is less
                              than 64
Put “A” into BankLetter       if so, then we’re in bank A
Else                          else the number is greater
                              than or equal to 64
Put “B” into BankLetter       and then we’re in bank B
EndIf                         finish the If
If x=16; put 0 into x;        one line version of “if x
EndIf                         is 16 then set it to zero”
```

Repeat

```
Repeat
   Commands
Until Condition
```

The group of *Commands* is executed repeatedly until the test specified in *Condition* is no longer true. The *Commands* are executed at least once.

```
Put 0 into PatchNum
Repeat
   Send SysExHeader PatchNum Patch F7
   Put PatchNum+1 into PatchNum
Until PatchNum is PatchesInBank
Put "" into Alphabet
Put 0 into HowMany
Repeat
   Put 'A' + HowMany after Alphabet
   Put 1 + HowMany into HowMany
Until howMany = 26
```

PatchTalk Variables

A variable is a named place where a value can be stored. It is like a mailbox with an address where the address is the variable's name. While Galaxy is running a script, a variable may hold different values at different times. You can change the value stored in a variable with the Put statement. You can use the value stored in a variable in any expression by typing the variable's name. See the Put statement (in the previous section) for an example of what happens to a few variables.

Many variables already exist in PatchTalk. These are special places that Galaxy will put important information and expect information when running your scripts. Below is a list of all these variables and what information you will find in them. Many of the descriptions refer to “the patch type” or “the device” or “the bank.” Remember that each script is written for a specific patch type for a specific MIDI device. When Galaxy runs the script, it is because you're working with a bank of information for that MIDI device.

All values are zero based. This means that, for example, the sixteen channels of MIDI are numbered 0 through 15 in PatchTalk scripts. Another example is that the one hundred and twenty eight patches are numbered 0 to 127. Please note that this is true in a script no matter what options have been checked in the Define Patch Type dialog.

Different variables are available in different scripts. Be sure to use only the variables available in a given script or you will get an error message. Following the description of each variable is its data (number or string) and if it can not be changed (fixed).

Variables for All Scripts

DeviceID

The device ID of the MIDI device being talked to, which is displayed in the bank and bundle windows (number, fixed).

PatchSize

The size, in bytes, of a single patch. This does not include any additional information that Galaxy needs for each patch (if total patch size differs from patch size in the Custom Patch Type dialog box). That information is maintained separately and you don’t ever see it (number, fixed).

BankSize

The size in bytes of a bank of patches (number, fixed).

PatchesInBank

The number of patches in a bank of the patch type (number, fixed).

BankTitle

The name of the bank as it appears in a bundle window. If you have the same patch type added to a device several times with different names (for example, you might have card voices and internal voices), then this is the name of the bank you’re working with. If the bank is not part of a bundle, then this variable is the empty string.

Get Bank and Send Bank Scripts

Bank

The collection of all the patches being edited. Contains the patch data for all the patches in the bank. Cannot be changed in the Send Bank script (string). When writing a Get Bank script, you will load data into Bank. Similarly, when writing a Send Bank script, you will send data that is contained in Bank.

Patch

This is the patch data in Bank for the patch whose number is PatchNum. Changes to this variable change the appropriate data in Bank also (string).

PatchNum The number of the patch whose data is in the variable Patch (number). Changing the value stored in PatchNum will also change the data that Patch contains.

Get Patch and Send Patch Scripts

Patch The patch data to be sent to or received from the MIDI device. When writing a Get Patch script, you will load data into Patch. Similarly, when writing a Send Patch script, you will send data that is contained in Patch. Note that the variable **Patch** does not work with the variable PatchNum as it does in the Get Bank and Send Bank scripts (string).

DevicePatchNum The number of the patch in the MIDI device to get from or send to. Be sure to check the UseEditBuffer variable first, because if it's set to true DevicePatchNum does not exist (number, fixed). If UseEditBuffer is set to false, and DevicePatchNum is examined in the Get Patch script, DevicePatchNum will contain the location of the currently selected patch in Galaxy's bank window. In the Send Patch script, DevicePatchNum will contain the last patch location if UseEditBuffer is set to false.

UseEditBuffer Is set to true if the script should get from or send to the edit buffer on the MIDI device. If your device doesn't have an edit buffer, this variable should always be set to false. When this is false, you should get from or send to location DevicePatchNum (condition, fixed).

To Device Name and To Display Name

The following apply when Name Conversion in the Define Custom Patch Type dialog is set to Script:

DeviceNameLength The number of bytes used for the name in the patch (number, fixed).

DisplayNameLength The number of bytes used for displaying the name (number, fixed).

DevicePatchName The name of a patch in the MIDI device's format. The To Display Name script converts from this to the variable DisplayPatchName (string).

DisplayPatchName The name of a patch as displayed by Galaxy. The To Device Name script converts from this to the variable DevicePatchName (string).

The following occurs when Name Conversion in the Define Custom Patch Type dialog is set to Table:

NameChar

Set to a value ranging from 0-127. The script should convert this value (to display or device format) and store it back into NameChar (number).

Patch Label Script

PatchLabel

Set this variable to the label to be displayed for the patch number in PatchNum (string).

PatchNum

The number to be converted to a custom patch label (number, fixed)

User-defined Variables

Your own variables may have names that are up to thirty-one characters in length. They must begin with a letter. To create a variable, simply use the Put command to store some value in it. Such as:

```
Put 67 into MyHeightInInches

Put “Frederick” into MouseName
```

PatchTalk Notes

Commands

Commands are written one to a line. If you’d like to write one command across several lines (for clarity), then you can hold down the Option key when you press return. This will insert a “¬” character that tells Galaxy that the command continues on the next line. You can also put more than one command on a single line by separating them with a semicolon. Here are some examples:

```
Receive 1024 into midiBytes¬
timeout after 2 seconds       this command takes two
                              lines
Put 5 into x; Put x*x into y  two commands on a line
If x = 0 then; Put 1 into x;  a one line If command
EndIf
If x > 0; Put x into
AbsoluteX
Else Put 0-x into AbsoluteX;  a two line If command
EndIf
```

Numbers

Anywhere a numeric value is needed you can enter any of the following: a decimal number, a hexadecimal number, a variable, or a numeric expression. Numeric expressions can use any of the standard math operations. Some examples are:

123	a decimal number
$F0	a hexadecimal number
.C0	another hexadecimal number
Size+10	the contents of the variable Size plus 10
2*(X+5)	a mathematical expression
‘A’	the ASCII numeric value for the character A (65)
0-5	negative 5 (you can’t type in negative numbers directly).

The operators and functions understood in PatchTalk are:

+	Addition	15+4 is 19
-	Subtraction	15-4 is 11
*	Multiplication	15*4 is 60
/	Integer Division	15/4 is 3
mod	Modulo	15 mod 4 is 3
<<	Shift Left	15<<4 is $00F0
>>	Shift Right	15>>4 is $0000
:	Nibble concatenation	15:4 is $F4
Byte (value)	Forces value to fit in a byte	Byte ($f0f1f2f3) is $F3
Word (value)	Forces value to fit in a word (two bytes)	Word ($f0f1f2f3) is $f2f3
Byte3 (value)	Forces value to fit in three bytes	Byte3 ($f0f1f2f3) is $f1f2f3
Long (value)	Forces value to fit in a long (four bytes)	Long ($f0f1f2f3) is $f0f1f2f3
Sizeof (value)	The size of value in bytes	Sizeof (“abc”) is 3.
To7BitHex (value)	Converts from 8-bit-per-byte format to 7-bit-per-byte	To7BitHex ($f123) is $36223
To8BitHex (value)	Converts from 7-bit-per-byte format to 8-bit-per-byte	To8BitHex ($f123) is $38a3
‘characters’	The numeric value of the characters (up to four)	‘A’ is 65

Strings/Arrays

You can refer to a portion of a variable’s contents by typing a range. The range is specified by two numbers in square brackets separated by a comma (“[offset, length]”) after the variable’s name. The first value is the offset in bytes into the variable. The second is the number of bytes to use. You can omit length and it will default to one byte. You can also replace length with “to end” or “end” and the rest of the variable will be used.

Some examples of Strings and Arrays include:

Put “Johnson” into FullName	*put a string into a new variable*
Put FullName[0,4] into ShortName	*put “John” into another new variable*
Put FullName[0] into Initial	*just the first character: ‘J’*
Put FullName[4,3] into AWord	*put “son” into another new variable*
Put FullName[4,to end] into AWord	*same thing*
Put “woo” into AWord[1]	*change middle character to “woo”*
Put “ed” after AWord	*add “ed”*
Put “ny” into FullName[4,to end]	*change ending; now is “Johnny”*
Put FullName “ ” AWord into Text	*“Johnny Swooned”*
Put empty into AnEmptyArray	*now you can “put...after” with this array*

Strings are characters enclosed in double quotes, such as “Johnson” above. The following characters have special meaning in an ASCII string:

¬ (Option-L)	*Continues the string on the next line (all characters to the end of the line including the next Return are ignored). Note that typing Option-Return will enter this character.*
\ (backslash)	*The escape character. It removes special meaning from some characters and adds meaning to others. The following characters are given special meaning when following the escape character. Any characters not listed here are inserted literally (are given no special meaning) when following the backslash.*
r or *n*	*Inserts a Return character into the text*
(Return)	*Same as r or n, but also inserts a new line in the script*
t (Tab)	*Inserts a Tab character into the string (the Tab key may also be pressed)*
” (double quote)	*Terminates the string*

Lists of Values

Some commands, notably Put, allow you to work with a list of values at once. These lists can be made by simply typing one or more numeric expressions and strings separated by spaces. Some examples are:

42	list of only one number
20 + 2 * 16 >> 1	another list of a single number (36)
“Hello”	list of the bytes $48, $65, $6C, $6C, $6F
$C0 $34	a list of two bytes
14-4 4*5	the list of two bytes, 10 and 20
.F0 “Moo” 4*5	a list of the several bytes $F0, $4D, $6F, $6F, 20
X Y	a list of whatever is in X followed by whatever is in Y

Conditions

A condition is used in the conditional commands, If and Repeat, to decide which commands to run. Conditions are just a form of expression using special test operators. Some examples are:

DeviceId > 16	list of only one number
PatchNum = Data	are the two things equal
(X > 5) And (X < 15)	are the two things equal

The full list of conditional operators is:

= or is	equality	3 = 3 is true	3 = 4 is false
<	less than	3 < 3 is false	3 < 4 is true
<= or ≤	less than or equal	3 ≤ 3 is true	3 ≤ 4 is true
>	greater than	3 > 3 is false	3 > 4 is false
>= or ≥	greater than or equal	3 ≥ 3 is true	3 ≥ 4 is false
<> or ≠	not equal	3 ≠ 3 is false	3 ≠ 4 is true
condA **And** condB	true if both conditions are true		
condA **Or** condB	true if either condition is true		
Not cond	true if the condition is false and vice versa		

Operator Precedence

In the absence of parentheses, the following order of precedence is used for numeric expressions. The operators within the same row have equal precedence. Those with highest precedence are listed on the first row. Sub-expressions are evaluated from right to left.

```
Not
:
*     /     ÷
+     -
<<    >>
<     <=    ≤     =     is    ≥     >=    >     <>    ≠
And
Or
```

Messages

A few commands use messages. These are pieces of text that are displayed for you under various circumstances. Messages are simply text between double quotes:

```
  Abort “The device sent bad MIDI”
  Receive .100 wait “Hit send on the MIDI Device”
```

Custom Menu

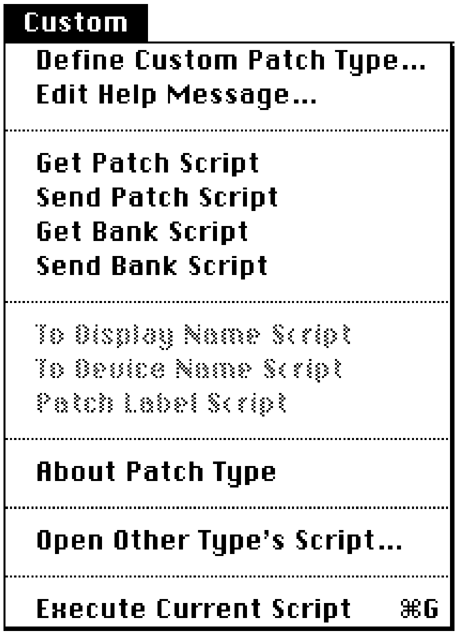


Figure 7: Custom Menu

NOTE: To access the Custom menu, you need to have Programming Mode checked in the Define Device dialog box, and have a bank or a bundle window active.

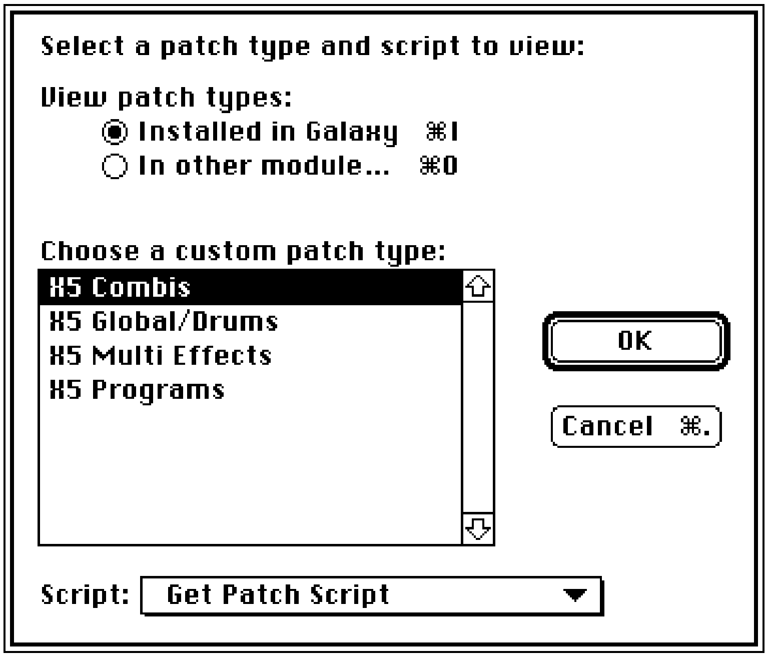
Define Custom Patch Type Opens the Define Custom Patch Type dialog for the patch type contained in the active bank or library window.

Edit Help Message Opens a dialog where you can enter a short message, which the user will see if she chooses Help when a bank of this type of patches is active.

Scripts: Get Patch, Send Patch, Get Bank, Send Bank, To Display Name, To Device Name, Patch Label Opens a text editing window for the specified script. Choose File>Save to save the edited script. If you have unsaved changes when you close a script editing window, you'll be asked if you want to save them. The Custom menu remains available while the script window is active.

About Patch Type Here's where you, the author of the custom librarian module, get to tell us about yourself and your endeavor. Put whatever you like here.

Open Other Type's Script Opens a dialog box where you can select a script from a different patch type (even one that isn't currently installed into Galaxy!) to read.



Select a patch type and script to view:

View patch types:

● Installed in Galaxy ⌘I
○ In other module... ⌘O

Choose a custom patch type:

- X5 Combis
- X5 Global/Drums
- X5 Multi Effects
- X5 Programs

Script: Get Patch Script

Figure 8: View Script Dialog Box

Click Installed in Galaxy to choose among patch types currently installed in Galaxy. Click In other module to choose a module document from which you want to select a patch type. The patch types installed in Galaxy, or in the selected module document, appear in the scrolling list. Select a patch type in the list, and select a script from the pop-up menu at the bottom of the window, then click OK to open a script editing window. You won't be able to make changes to scripts opened in this way, but it can be very useful for basing a new script on an existing one.

Execute Current Script

Runs the script in the active script editing window, operating on the topmost bank window of the proper patch type.

Patchtalk Troubleshooting

As with any task, if something goes wrong you'd like to know what it is so you can fix it. PatchTalk is a tool for performing tasks for Galaxy—when a task doesn't perform its function properly, you'll want to find out what's wrong and correct the problem. This is called debugging.

Viewing the Contents of Variables

The PatchTalk View Variables command can be used for debugging, as well as learning about PatchTalk and your MIDI device. Use it to view all the currently-defined variables and their values within a running script. Refer to the description of the View Variables command earlier in this section for a description of its syntax.

You can use View Variables to:

- Look at the sys-ex header you're sending to the device.

  By viewing the data in the sys-ex header right before you send it, you can verify that you built it correctly. Sometimes you may find that you left out a byte, or inserted a byte when you meant to insert a long word (4 bytes).
- Look at the data the device is sending back.

  If you verify that the data you are receiving is correct, you can know that the problem is not a bug in the device or a result of an incorrect sys-ex header. You can then concentrate on determining why it's not making it into the bank properly.

- Examine the contents of bank or patch as they are changed.

  By viewing variables immediately before and after a command that changes the contents of bank, patch, or any other important variable, you can determine whether the change is taking effect properly.

  If not, many times you may find that the wrong part of the variable is being changed, or that the patch size or name offset defined for this patch type is incorrect.

  If so, you can concentrate on the commands after this one in the script since you have determined that it's correct up to this point.
- View the patch data dumped from the device using its front panel.

  This is useful both to check the sys-ex header of the data it sends (to make sure you found it correctly in the device's manual) and to make sure you're getting the same thing when you ask for it over MIDI (as opposed to using the device's front panel).
- Decipher the encoding scheme of a patch when the device's User Manual is unclear. See "Deciphering Patch Data," which follows shortly.

Common Problems

The device does not respond to my MIDI messages

The MIDI cables are not connected from the interface to the device properly.

The computer is not connected to the MIDI interface properly.

- Is OMS MIDI Setup in the Setups menu notified of the proper port (printer or modem)?
- If you're using the MIDI Manager: Is the port you're using turned on and is Galaxy connected to the OMS MIDI Manager driver in PatchBay?
- The interface does not have power.

You are not sending a proper system exclusive message

Ask yourself the following:

- Does the message begin with F0?
- Does the message end with F7?
- Does the sys-ex data match the specification in the device's User's Manual?
- Is the deviceID variable (if used), set to the correct value?
- Is the size of the sys-ex message correct?
- If a checksum is included, is it correct?
- Have you checksummed the proper data?
- Do any of the values in the data exceed $7F?

You are sending to the device too soon after it has sent data

Some devices require a time delay after it has sent or received data before another message can be sent to it. Check the device's User's Manual to see if this applies. Use the command Delay to introduce delays between system exclusive messages.

The device has a bug in its MIDI implementation.

Be careful about assuming this. Make sure your current setup works with other devices by plugging the same MIDI cables into other devices. Then check the MIDI specification and all data you sent and received. If you still believe it is a bug in your device, call the manufacturer. Be aware that some devices may not be changed just because you have reported a bug. Try to work around the bug if at all possible.

The patch name is set incorrectly (or becomes garbage) when receiving

The received data is incorrect.

- View the data immediately before placing it in Patch or Bank and determine its validity.

The patch size, name offset, or name length is specified incorrectly.

- Check the Define Custom Patch Type dialog. Make sure that if the device does not support a name for this patch type that you add Name Length to the size of the raw patch (as stored in the device).

The data is somehow encoded.

- You may find this information in the device's User's manual—and then again, you may not. If the information isn't there, try altering the patch in the device and then sending back what it sent you. If this works (the old patch is received correctly) see "Deciphering Patch Data," which follows. One good clue as to whether the data is nibblized is whether the size of the data that the device sends you is bigger than what is specified in its MIDI specification.

Deciphering Patch Data

You may not be able to tell by looking at the device's User Manual whether the patch data is being encoded as it's sent or not. If you're having trouble displaying the patch's name, or if the size of the data the device sends is larger or smaller than the size specified in the MIDI specification, all or part of the data may be encoded.

A common way of encoding MIDI data in sys-ex messages is nibblizing. This is the process of converting one byte into two bytes. The first byte contains the upper four bits of the original byte and the second byte contains the lower four bits. There are two consequences of this that you can look for when trying to determine if data is nibblized:

- The data is twice as large as it would be if it were not nibblized.
- No bytes have their high bit set (have values ≥ $80).

Also beware of strange things like only part of the patch being nibblized. This is the case for MKS-70 Patches and the User Manual says nothing about the data being nibblized.

Error Messages

There are many types of errors that can occur while a script is being processed. These include: memory shortages, constraint violations, semantic errors, and syntax errors. When an error is encountered, the script is aborted. Sometimes a patch or bank has already been altered, in which case the changes remain in effect. If the bank is not correct, it is set to the correct size, and any partial or missing patches are set to the empty patch. You define the empty patch by selecting a patch you want considered as empty, then choosing Edit>Set Empty Patch. Although the data is probably meaningless when a script terminates after reading only part of the bank, this should not be a problem since it is expected that the script will be fixed and re-executed to overwrite any invalid data in the bank.

When a fatal error occurs (one which immediately terminates execution of the script) the script is opened and the insertion point is placed as close as possible to the end of the offending command. You may then fix the problem and click on a bank window to gain access to the Load/Send menu and run the script again.

Constraint Violations

Constraint violation errors occur as a result of violating some range or length constraint. For instance, if you specify a byte range for a variable that extends past the data, or if you use too many characters in a variable name. The length violations are merely an inconvenience to you, but let you know when you exceed the limitations of PatchTalk. The range violations, however, are extremely helpful. They save you hours of frustration because they point out flaws in your logic immediately, since you should never access data that is meaningless. Therefore, examine your script with care after one of these messages until you understand what you are doing wrong and can decide on a correct way to accomplish your purpose.

Semantic Errors

Semantic errors occur when the command is understood (parsed correctly) but does not make sense under the rules imposed by PatchTalk semantics. Examples of semantic errors in PatchTalk are:

- Specifying a range for a numeric variable.

  For example, number[1], is meaningless in PatchTalk and is therefore not allowed. Note that neither a length nor a position is allowed.
- Specifying a range for a variable with no value.

  This is a special kind of constraint violation, since any range specified falls outside the range of data bytes.

- Putting data after a numeric variable.

  You can only add data to the end of a string variable. Numeric variables can only have their contents replaced completely.

- Putting data after a range of data in a variable (e.g., “Put F7 after Packet[1, 50]”).

  There is nothing conceptually wrong with this—it is just not supported by PatchTalk in this way. To do this in PatchTalk, put the data into the next position. That is, “Put F7 into Packet[51]”.

- Attempting to use the bulk commands on a non-bulk bank.

  ReceiveBulk and SendBulk may only be used on bank windows defined as Bulk in the Define Custom Patch Type dialog box.

- Using unknown units.

  PatchTalk currently supports seconds (must begin with “s”) and milliseconds (must begin with ms).

- Accessing a variable that does not exist (has not been defined by putting data into it).
- Using a string variable as a number without specifying a range.

  Up to 4 bytes of a string variable may be used as a number (in a numeric expression). Both a starting position and a length must be specified (e.g., “Put SysExHeader[8, 4] << 2 into Address”).

- Specifying a position or length of a range less than 1.

  The first byte of a variable is 1, so the position cannot be less than this. If the length is not specified, it is taken to be 1, but no less than 1 byte of data can be used for anything, so the length (if specified) must be greater than zero.

- Specifying a numeric string (in single quotes) of more than 4 characters (e.g., “'ABCDE'”).

Syntax Errors

Syntax errors occur when a command cannot be interpreted. This occurs when the command does not conform to the syntax specification of PatchTalk. If the problem is known, it is identified by an error message. Otherwise, you are simply notified that a syntax error has occurred. Examples of a syntax errors are:

- Not following a command with a command terminator (semicolon or carriage return).
- An unmatched parenthesis (e.g., “3 + 4)”)
- A non-terminated quote (e.g., “View Variables “Sending the bank”)
- A negative number (e.g., “-2”—to get a negative number, subtract it from zero, e.g., “0 - 2”)
- Using a single minus sign for a comment—comments are either two consecutive minus signs, or a single dash (Shift-Option-minus).

PatchTalk Tips

Putting Empty into a Variable

If you have a succession of statements that put a value after a variable, the empty command may help you. Putting empty into a variable creates the variable but does not put a value into it. Because PatchTalk does not let you put a value after a variable unless the variable already contains a value, empty is a convenient way around this.

```
put empty into Abank
put 0 into i
repeat
   send .f0 .43 .00 .07 .f7
   receivePackets 4 2 100 after Abank
   put i + 1 into i
until i = 10
```

In the above example, empty was used to create a variable Abank. As i is incremented, receivePackets puts the data after Abank. By putting empty into Abank, an initial receivePackets 4 2 100 *into* Abank line is not needed.

Using PatchNum in Get and Send Bank Scripts

Some PatchTalk scripts may require additional processing of bank data received on a patch by patch basis. Take for example a script that examines a parameter in each patch and alters the data in the patch accordingly. The following script examines parameter 32 and based on the result, prefixes an asterisk to the beginning of the patch name which starts at offset 33.

```
repeat
   put 0 into PatchNum
   put Patch[32] into mode
   if ( ((mode = 2) or ( mode = 7 ) or ( mode = 9 ) or
   ( mode = 10 )) and Patch[33] <> '*') ) then
      put Patch[33,9] into Patch[34,9]
      put '*' into Patch[33]
   endif
   put PatchNum + 1 into PatchNum
until PatchNum = 64
```

PatchNum is set to zero, then incremented by one through each pass of the repeat loop. As PatchNum is incremented, Patch points to the next patch of data. The script examines the number stored in Patch[32] and stores the value into mode. If mode is equal to 2,7,9 or 10 and the first character of the name is not already an asterisk (*), the script moves the first 9 characters of the name to the right by one, thus making the first character location free, then places a ‘ * ’ character into the first character location for the patch name.

Creating Custom Patch Labels

Some MIDI devices label their patches in different formats. A popular method is to number 128 patches as a11 - b88. The following script creates a custom patch label displaying patch labels as a11-b88.

```
if (patchNum<64) then
   put patchNum into x
   put “a” into PLabel
else
   put patchNum - 64 into x
   put “b” into PLabel
endif
put (x/8)+1+'0' after PLabel
put (x mod 8)+1+'0' after PLabel
put PLabel into PatchLabel
```

Using Sizeof and Abort for Error Checking

Some MIDI devices cannot respond to a data request and require you to initiate the data dump manually. If you make a mistake and press the wrong buttons or if AppleTalk happens to be on, wrong data may be received by Galaxy. If Galaxy gets wrong data, a script error message may appear. To stop this from happening, you can check the size of the received data to the size that you expect and post a message if the data was wrong.

Example:

```
ReceivePackets 4 2 80+4+2 into inData
if sizeof( inData) <> 80 then
   Abort “Wrong data received or AppleTalk is ON”
endif
```

This script will abort and display a message if 80 bytes of data were not received.

Sending Other MIDI Messages

Remember that PatchTalk does not limit you to sending system exclusive messages only. The Send command can transmit any type of MIDI message. Feel free to utilize program changes when a parameter change is unavailable, as well.

Extending PatchTalk

Extending the PatchTalk commands will give you additional power to manipulate data within PatchTalk. The PCmd is the simplest external function both to create and to use. It is used exactly the same way as the Put command and is, in fact, how the Checksum and Checksum0 commands are implemented.

The *Cmd is much more general. It accepts any number of parameters consisting of numbers and handles to data. In the event that something goes wrong, it is also allowed to return a custom error message to PatchTalk.

External Put Commands (PCmds)

```
CommandName ListOfValues { into | after } Destination
```

This command has the same form as Put and may therefore create new variables and modify existing ones (if the same variable is specified for *ListOfValues* and *Destination*). It is provided to allow new transformations to be written similar to Nibblize and Denibblize. Put merely transfers the data without modification. Your PCmd can therefore simulate Put by simply doing nothing. Nibblize and Denibblize happen to expand or collapse the data, but this is not necessary. Checksum merely appends a single byte—which turns out to be a very helpful transformation. You may write your own PCmd if you have a development system that can generate code resources. This is how you would define the procedure in THINK C.

```
pascal void myProc (dataHandle)

Handle dataHandle;

{

....

}
```

It is defined as a Pascal procedure to allow Pascal programmers to write PCmds. The handle dataHandle consists of the data specified by *ListOfValues*. It is modified directly by the procedure to return the result. When it returns, the data in the handle is placed in the variable specified by *Destination*. Note that dataHandle is *not* locked.

The C code for Checksum and Checksum0 is supplied in the files “Checksum.c” and “Checksum0.c” respectively. Feel free to use these functions as starting points for your own PCmds. If you don't have a development system and you really need a custom function, get a friend to do it for you in exchange for the module you're writing (assuming she owns Galaxy).

The code resource must have type ‘PCmd’ and the same name as specified by *CommandName*.

General External Commands (*Cmds)

When a PCmd is not powerful enough to accomplish the task at hand, consider writing a more general external command, a *Cmd. *Cmds allow an arbitrary number of numeric and variable parameters to be passed to them. They perform a task by altering memory, just like a PCmd, but they are more powerful, since they accept more input. In addition, they allow a more specific error message to be given in case they don’t succeed.

Their PatchTalk syntax is:

```
CommandName arg1, arg2, arg3, …, argN
```

As with PCmds, *Cmds are code resources that are called according to Pascal calling conventions. They also take a single argument. But this is where they differ. The argument is a parameter block—a structure containing all the parameters. The following is a list of constant values followed by the basic structure of the parameter block.

The args (the arguments) are numeric expressions and string variables separated by commas.

```
/** Error Types (for resultCode)*/

   enum { NoError, BadParamCount, NeedMemoryError, Gener-
   alFailure, CustomErrorMsg };

   /** Parameter Types (for paramType) */

   enum { NumericType = 1, StringType = 2 };
```

/** Data fields are of this type: */

```
typedef union {
long                       longNumber;
Handle                     handle;
} LongOrHandle;
/** The following structure occurs once for each
parameter: */
typedef struct {
LongOrHandle               param;
int                        paramType;
} CommandParameter;
/* The parameter block */
typedef struct {
int                        resultCode;
/* result of *Cmd (initially NoError) */
Str255                     errMsg;
/* string to be displayed when CustomErrorMsg' is
returned */
Byte                       reserved[6];
int                        numParams;
/* the number of parameters actually sent to us */
CommandParameter           par[10];
/* numParams defines the number of array elements
which actually occur */
} GeneralCmdParamBlock;
```

Defining this structure in your development environment makes it easier to refer to the parameters from within your *Cmd.

*Cmd Errors

The first two fields are used for reporting errors to the user. The field resultCode may have one of the listed error values where NoError is 0, BadParamCount is 1, etc. The resultCode field is set to NoError upon entry, so you do not need to set it if all goes well. If an error occurs, however, resultCode may be set to indicate the type of error. If it is anything but NoError, the current script will be aborted.

The first three error codes tell the user that an incorrect number of parameters was passed, the command ran out of memory, and the command failed, respectively.

The value CustomErrorMsg, however, allows the *Cmd to display any error message it wants. To return a custom error message, create a handle containing the message (using PtrToHand, for instance). Then set errMsg to this handle and resultCode to CustomErrorMsg. When you return, PatchTalk displays the message and disposes of this handle for you. Note that the maximum custom error message length is 255 characters and must be a Pascal string.

The numParams field contains the number of parameters passed to the *Cmd. It should be checked to make sure it is the number expected and, if not, BadParamCount should be returned in resultCode immediately.

The Parameters

The fields following numParams are pairs of parameters (4 bytes) and their types (2 bytes). Each parameter's type should be checked and an error returned if it is not the type expected. It could be disastrous if you use a long integer as a handle.

Examples

The C source code is supplied for the PatchTalk *Cmds Separate and Collate in the files "Separate.c" and "Collate.c" respectively. You may use these routines as a starting point when defining your own *Cmds.

Passing String Data to External Commands

Both types of external commands pass string data only as the contents of a variable. Note that this results in a handle being passed. The external command may do whatever it wishes to the data in this handle, but it may not dispose the handle (although it may empty it so that it contains 0 bytes of data).

Also be aware that all handles are *not* locked.

External Command Code Resources

These external commands are implemented as code resources of the type 'PCmd' and '*Cmd' as their names imply. You may put them in the resource fork of Galaxy while you're testing them, but they should be placed in the module's resource fork that uses them before you distribute the module.

Note that when you export a module, any external commands that it uses are not automatically exported. You must manually copy them from Galaxy's resource fork into the module's resource fork using ResEdit.