

# MIDI Implementation

Model: SH-32

Date: Dec. 12, 2001

Version: 1.00

## 1. Receive Data

### ■ Channel Voice Messages

#### ● Note Off

Status	2nd byte	3rd byte
8nH	kkH	vvH
9nH	kkH	00H
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
kk = note number:	00H - 7FH (0 - 127)	
vv = note off velocity:	00H - 7FH (0 - 127)	

#### ● Note On

Status	2nd byte	3rd byte
9nH	kkH	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
kk = note number:	00H - 7FH (0 - 127)	
vv = note on velocity:	01H - 7FH (1 - 127)	

#### ● Polyphonic Key Pressure

Status	2nd byte	3rd byte
AnH	kkH	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
kk = note number:	00H - 7FH (0 - 127)	
vv = Polyphonic Key Pressure:	00H - 7FH (0 - 127)	

#### ● Control Change

##### ○ Bank Select (Controller number 0, 32)

Status	2nd byte	3rd byte
BnH	00H	mmH
BnH	20H	llH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
mm, ll = Bank number:	00 00H - 7F 7FH (bank.1 - bank.16384)	

MSB	LSB	
085	000	Performance
086	000	User Rhythm
086	064	Preset Rhythm
087	000	User Patch
087	064	Preset Patch

##### ○ Modulation (Controller number 1)

Status	2nd byte	3rd byte
BnH	01H	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv = Modulation depth:	00H - 7FH (0 - 127)	

##### ○ Portamento Time (Controller number 5)

Status	2nd byte	3rd byte
BnH	05H	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv = Portamento Time:	00H - 7FH (0 - 127)	

\* The Portamento Time parameter will change.

##### ○ Data Entry (Controller number 6, 38)

Status	2nd byte	3rd byte
BnH	06H	mmH
BnH	26H	llH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
mm, ll = the value of the parameter specified by RPN/NRPN		
mm = MSB, ll = LSB		

##### ○ Volume (Controller number 7)

Status	2nd byte	3rd byte
BnH	07H	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv = Volume:	00H - 7FH (0 - 127)	

\* The Level parameter will change.

\* In Performance mode, the Part level parameter will change.

##### ○ Balance (Controller number 8)

Status	2nd byte	3rd byte
BnH	08H	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv = Balance:	00H - 7FH (0 - 127)	

\* The Oscillator Balance parameter will change.

##### ○ Panpot (Controller number 10)

Status	2nd byte	3rd byte
BnH	0AH	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv = Panpot:	00H - 40H - 7FH (Left - Center - Right)	

\* The Pan parameter will change.

\* In Performance mode the Part pan parameter will change.

##### ○ Expression (Controller number 11)

Status	2nd byte	3rd byte
BnH	0BH	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv = Expression:	00H - 7FH (0 - 127)	

##### ○ Hold 1 (Controller number 64)

Status	2nd byte	3rd byte
BnH	40H	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv = Control value:	00H - 7FH (0 - 127)	0-63 = OFF, 64-127 = ON

##### ○ Portamento (Controller number 65)

Status	2nd byte	3rd byte
BnH	41H	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv = Control value:	00H - 7FH (0 - 127)	0 - 63 = OFF, 64 - 127 = ON

\* The Portamento Switch parameter will change.

##### ○ Sostenuto (Controller number 66)

Status	2nd byte	3rd byte
BnH	42H	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv = Control value:	00H - 7FH (0 - 127)	0 - 63 = OFF, 64 - 127 = ON

##### ○ Legato Foot Switch (Controller number 68)

Status	2nd byte	3rd byte
BnH	44H	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv = Control value:	00H - 7FH (0 - 127)	0 - 63 = OFF, 64 - 127 = ON

\* The Legato parameter will change.

##### ○ Sound Variation (Controller number 70)

Status	2nd byte	3rd byte
BnH	45H	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv = Control value:	00H - 7FH (0 - 127)	

\* The Unison Switch parameter will change.

##### ○ Resonance (Controller number 71)

Status	2nd byte	3rd byte
BnH	47H	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv = Resonance value:	00H - 7FH (0 - 127)	

\* The Filter Resonance parameter will change.

##### ○ Release Time (Controller number 72)

Status	2nd byte	3rd byte
BnH	48H	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv = Release Time value:	00H - 7FH (0 - 127)	

\* The Amp Release Time parameter will change.

## ○Attack Time (Controller number 73)

<u>Status</u>	<u>2nd byte</u>	<u>3rd byte</u>
BnH	49H	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv = Attack time value:	00H - 7FH (0 - 127)	

\* The Amp Attack Time parameter will change.

## ○Cutoff (Controller number 74)

<u>Status</u>	<u>2nd byte</u>	<u>3rd byte</u>
BnH	4AH	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv = Cutoff value:	00H - 7FH (0 - 127)	

\* The Filter Cutoff parameter will change.

## ○Decay Time (Controller number 75)

<u>Status</u>	<u>2nd byte</u>	<u>3rd byte</u>
BnH	4BH	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv = Decay Time value:	00H - 7FH (0 - 127)	

\* The Amp Decay Time parameter will change.

## ○Vibrato Rate (Controller number 76)

<u>Status</u>	<u>2nd byte</u>	<u>3rd byte</u>
BnH	4CH	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv = Vibrato Rate value:	00H - 40H - 7FH (-50 - 0 - +50)	

\* The Pitch Fine parameter of OSC2 will change.

## ○Vibrato Depth (Controller number 77)

<u>Status</u>	<u>2nd byte</u>	<u>3rd byte</u>
BnH	4DH	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv = Vibrato Depth Value:	00H - 40H - 7FH (-50 - 0 - +50)	

\* The Pitch Fine parameter of OSC1 will change.

## ○Vibrato Delay (Controller number 78)

<u>Status</u>	<u>2nd byte</u>	<u>3rd byte</u>
BnH	4EH	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv = Vibrato Delay value:	00H - 7FH (0 - 127)	

\* The PWM Depth parameter of OSC1 will change.

## ○General Purpose Controller 5 (Controller number 80)

<u>Status</u>	<u>2nd byte</u>	<u>3rd byte</u>
BnH	50H	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv = Control value:	00H - 40H - 7FH (-64 - 0 - +63)	

\* The Amp Depth parameter of LFO1 will change.

## ○General Purpose Controller 6 (Controller number 81)

<u>Status</u>	<u>2nd byte</u>	<u>3rd byte</u>
BnH	51H	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv = Control value:	00H - 40H - 7FH (-64 - 0 - +63)	

\* The Filter Envelope Depth parameter will change.

## ○General Purpose Controller 7 (Controller number 82)

<u>Status</u>	<u>2nd byte</u>	<u>3rd byte</u>
BnH	52H	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv = Control value:	00H - 7FH (0 - 127)	

\* The Filter Attack Time parameter will change.

## ○General Purpose Controller 8 (Controller number 83)

<u>Status</u>	<u>2nd byte</u>	<u>3rd byte</u>
BnH	53H	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv = Control value:	00H - 7FH (0 - 127)	

\* The Filter Decay Time parameter will change.

## ○Portamento Control (Controller number 84)

<u>Status</u>	<u>2nd byte</u>	<u>3rd byte</u>
BnH	54H	kkH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
kk = source note number:	00H - 7FH (0 - 127)	

\* A Note-on received immediately after a Portamento Control message will change continuously in pitch, starting from the pitch of the Source Note Number.

\* If a voice is already sounding for a note number identical to the Source Note Number, this voice will continue sounding (i.e., legato) and will, when the next Note-on is received, smoothly change to the pitch of that Note-on.

\* The rate of the pitch change caused by Portamento Control is determined by the Portamento Time value.

## ○Effect 1 (Reverb Send Level) (Controller number 91)

<u>Status</u>	<u>2nd byte</u>	<u>3rd byte</u>
BnH	5BH	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv = Reverb Send Level:	00H - 7FH (0 - 127)	

\* In Performance mode the Part Reverb Send Level parameter will change.

## ○Effect 3 (Chorus Send Level) (Controller number 93)

<u>Status</u>	<u>2nd byte</u>	<u>3rd byte</u>
BnH	5DH	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv = Chorus Send Level:	00H - 7FH (0 - 127)	

\* The Intensity parameter will change.

## ○Effect 4 (Celeste) (Controller number 94)

<u>Status</u>	<u>2nd byte</u>	<u>3rd byte</u>
BnH	5EH	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv = Celeste:	00H - 7FH (0 - 127)	

\* The Effect Level parameter of Reverb/Delay section will change.

## ○Effect 5 (Phaser) (Controller number 95)

<u>Status</u>	<u>2nd byte</u>	<u>3rd byte</u>
BnH	5FH	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv = Phaser:	00H - 7FH (0 - 127)	

\* The Bias of Filter Env Depth parameter will change.

## ○RPN MSB/LSB (Controller number 100, 101)

<u>Status</u>	<u>2nd byte</u>	<u>3rd byte</u>
BnH	65H	mmH
BnH	64H	llH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
mm = upper byte (MSB) of parameter number specified by RPN		
ll = lower byte (LSB) of parameter number specified by RPN		

<<< RPN >>>

Control Changes include RPN (Registered Parameter Numbers), which are extended parameters whose function is defined in the MIDI specification.

When using RPNs, first the RPN (Controller numbers 100 and 101; they can be sent in any order) is transmitted to specify the parameter you wish to control. Then, Data Entry messages (Controller number 6 and 38) are used to set the value of the specified parameter. Once a RPN parameter has been specified, all further Data Entry message on that channel are considered to apply to parameter. In order to prevent accidents, when the desired setting has been made for the parameter, it is recommended that RPN be set to Null.

This device receives the following RPNs.

RPN	Data entry	Notes
<u>MSB, LSB</u> 00H, 00H	<u>MSB, LSB</u> mmH, llH	<u>Notes</u> Pitch Bend Sensitivity mm: 00H - 18H (0 - 24 semitones) ll: ignored (processed as 00H) Up to 2 octave can be specified in semitone steps.
00H, 01H	mmH, llH	Channel Fine Tuning mm, ll: 20 00H - 40 00H - 60 00H (-8192 x 50 / 8192 - 0 - +8192 x 50 / 8192 cent) * In Performance mode, the Fine Tune parameter of each Part (Performance parameter) will change.
00H, 02H	mmH, llH	Channel Coarse Tuning mm: 10H - 40H - 70H (-48 - 0 - +48 semitones) ll: ignored (processed as 00H) * In Performance mode, the Coarse Tune parameter of each Part (Performance parameter) will change.
7FH, 7FH	---, ---	RPN null RPN and NRPN will be set as "unspecified". Once this setting has been made, subsequent Data Entry messages will be ignored. (It is not necessary to transmit Data Entry for RPN Null settings.) Parameter values that were previously set will not change. mm, ll: ignored

## ●Program Change

Status	2nd byte
CnH	ppH
n = MIDI channel number:	0H - FH (Ch.1 - 16)
pp = Program number:	00H - 7FH (prog.1 - prog.128)

## ●Channel Pressure

Status	2nd byte
DnH	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)
vv = Channel Pressure:	00H - 7FH (0 - 127)

## ●Pitch Bend Change

Status	2nd byte	3rd byte
EnH	llH	mmH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
mm, ll = Pitch Bend value:	00 00H - 40 00H - 7F 7FH (-8192 - 0 - +8191)	

## ■Channel Mode Messages

### ●All Sounds Off (Controller number 120)

Status	2nd byte	3rd byte
BnH	78H	00H
n = MIDI channel number:	0H - FH (Ch.1 - 16)	

\* When this message is received, all notes currently sounding on the corresponding channel will be turned off.

### ●Reset All Controllers (Controller number 121)

Status	2nd byte	3rd byte
BnH	79H	00H
n = MIDI channel number:	0H - FH (Ch.1 - 16)	

\* When this message is received, the following controllers will be set to their reset values.

Controller	Reset value
Pitch Bend Change	+/-0 (center)
Polyphonic Key Pressure	0 (off)
Channel Pressure	0 (off)
Modulation	0 (off)
Expression	127 (max)
Hold 1	0 (off)
Sostenuto	0 (off)
RPN	unset; previously set data will not change
NRPN	unset; previously set data will not change

### ●All Notes Off (Controller number 123)

Status	2nd byte	3rd byte
BnH	7BH	00H
n = MIDI channel number:	0H - FH (Ch.1 - 16)	

\* When All Notes Off is received, all notes on the corresponding channel will be turned off. However, if Hold 1 or Sostenuto is ON, the sound will be continued until these are turned off.

### ●OMNI OFF (Controller number 124)

Status	2nd byte	3rd byte
BnH	7CH	00H
n = MIDI channel number:	0H - FH (Ch.1 - 16)	

\* The same processing will be carried out as when All Notes Off is received.

### ●OMNI ON (Controller number 125)

Status	2nd byte	3rd byte
BnH	7DH	00H
n = MIDI channel number:	0H - FH (Ch.1 - 16)	

\* The same processing will be carried out as when All Notes Off is received. OMNI ON will not be turned on.

### ●MONO (Controller number 126)

Status	2nd byte	3rd byte
BnH	7EH	mmH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
mm = mono number:	00H - 10H (0 - 16)	

\* The same processing will be carried out as when All Notes Off is received.

\* The Solo Switch parameter will On.

### ●POLY (Controller number 127)

Status	2nd byte	3rd byte
BnH	7FH	00H
n = MIDI channel number:	0H - FH (Ch.1 - 16)	

\* The same processing will be carried out as when All Notes Off is received.

\* The Solo Switch parameter will Off.

## ■System Realtime Message

### ●Timing Clock

Status
F8H

\* This message will be received if the Clock Source parameter is MIDI.

### ●Active Sensing

Status
FEH

\* When Active Sensing is received, the unit will begin monitoring the intervals of all further messages. While monitoring, if the interval between messages exceeds 420 ms, the same processing will be carried out as when All Sounds Off, All Notes Off and Reset All Controllers are received, and message interval monitoring will be halted.

## ■ System Exclusive Message

Status	Data byte	Status
F0H	iiH, ddH, .....eeH	F7H

F0H: System Exclusive Message status  
 ii = ID number: an ID number (manufacturer ID) to indicate the manufacturer whose Exclusive message this is. Roland's manufacturer ID is 41H. ID numbers 7EH and 7FH are extensions of the MIDI standard; Universal Non-realtime Messages (7EH) and Universal Realtime Messages (7FH).  
 dd.....ee = data: 00H - 7FH (0 - 127)  
 F7H: EOX (End Of Exclusive)

Of the System Exclusive messages received by this device, the Universal Non-realtime messages and the Universal Realtime messages and the Data Request (RQ1) messages and the Data Set (DT1) messages will be set automatically.

## ● Universal Non-realtime System Exclusive Messages

### ○ Identity Request Message

Status	Data byte	Status
F0H	7EH, dev, 06H, 01H	F7H

Byte	Explanation
F0H	Exclusive status
7EH	ID number (Universal Non-realtime Message)
dev	Device ID (dev: 00H - 1FH (1 - 32), the initial value is 10H (17).)
06H	Sub ID#1 (General Information)
01H	Sub ID#2 (Identity Request)
F7H	EOX (End Of Exclusive)

\* When this message is received, Identity Reply message (p. 6) will be transmitted.

### ● Data Transmission

This instrument can use exclusive messages to exchange many varieties of internal settings with other devices.

The model ID of the exclusive messages used by this instrument is 00H 4AH.

### ○ Data Request 1 RQ1 (11H)

This message requests the other device to transmit data. The address and size indicate the type and amount of data that is requested.

When a Data Request message is received, if the device is in a state in which it is able to transmit data, and if the address and size are appropriate, the requested data is transmitted as a Data Set 1 (DT1) message. If the conditions are not met, nothing is transmitted.

Status	Data Byte	Status
F0H	41H, dev, 00H, 4AH, 11H, aaH, bbH, ccH, ddH, ssH, ttH, uuH, vvH, sum	F7H

Byte	Remarks
F0H	Exclusive status
41H	ID number (Roland)
dev	device ID (dev: 10H - 1FH, 7FH Initial value is 10H)
00H	model ID #1 (SH-32)
4AH	model ID #2 (SH-32)
11H	command ID (RQ1)
aaH	address MSB
bbH	address
ccH	address
ddH	address LSB
ssH	size MSB
ttH	size
uuH	size
vvH	size LSB
sum	checksum
F7H	EOX (End Of Exclusive)

\* The size of data that can be transmitted at one time is fixed for each type of data. And data requests must be made with a fixed starting address and size. Refer to the address and size given in "Parameter Address Map" (p. 6).

\* For the checksum, refer to (p. 12).

### ○ Data Set 1 DT1 (12H)

Status	Data byte	Status
F0H	41H, dev, 00H, 4AH, 12H, aaH, bbH, ccH, ddH, eeH, ... ffH, sum	F7H

Byte	Explanation
F0H	Exclusive status
41H	ID number (Roland)
dev	Device ID (dev: 10H - 1FH, 7FH Initial value is 10H)
00H	Model ID #1 (SH-32)
4AH	Model ID #2 (SH-32)
12H	Command ID (DT1)
aaH	Address MSB: upper byte of the starting address of the data to be sent
bbH	Address: upper middle byte of the starting address of the data to be sent
ccH	Address: lower middle byte of the starting address of the data to be sent
ddH	Address LSB: lower byte of the starting address of the data to be sent.
eeH	Data: the actual data to be sent. Multiple bytes of data are transmitted in order starting from the address.
:	:
ffH	Data
sum	Checksum
F7H	EOX (End Of Exclusive)

\* The amount of data that can be transmitted at one time depends on the type of data, and data will be transmitted from the specified starting address and size. Refer to the Address and Size given in Section 3, "Parameter address map."

\* Data larger than 256 bytes will be divided into packets of 256 bytes or less, and each packet will be sent at an interval of about 20 ms.

\* For the checksum, refer to (p. 12).

## 2. Data Transmission

### ■ Channel Voice Messages

#### ● Note Off

Status	2nd byte	3rd byte
8nH	kkH	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
kk = note number:	00H - 7FH (0 - 127)	
vv = note off velocity:	40H (64)	

#### ● Note On

Status	2nd byte	3rd byte
9nH	kkH	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
kk = note number:	00H - 7FH (0 - 127)	
vv = note on velocity:	01H - 7FH (1 - 127)	

#### ● Control Change

##### ○ Bank Select (Controller number 0, 32)

Status	2nd byte	3rd byte
BnH	00H	mmH
BnH	20H	llH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
mm, ll = Bank number:	00 00H - 7F 7FH (bank.1 - bank.16384)	

MSB	LSB	
085	000	Performance
086	000	User Rhythm
086	064	Preset Rhythm
087	000	User Patch
087	064	Preset Patch

##### ○ Portamento Time (Controller number 5)

Status	2nd byte	3rd byte
BnH	05H	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv = Portamento Time:	00H - 7FH (0 - 127)	

\* When the Portamento Time parameter is changed, the corresponding value will be transmitted.

## ○Volume (Controller number 7)

Status	2nd byte	3rd byte
BnH	07H	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv = Volume:	00H - 7FH (0 - 127)	

\* When the Level parameter is changed, the corresponding value will be transmitted.

## ○Balance (Controller number 8)

Status	2nd byte	3rd byte
BnH	0AH	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv = Panpot:	00H - 40H - 7FH (OSC2 - Center - OSC1)	

\* When the Oscillator Balance parameter is changed, the corresponding value will be transmitted.

## ○Panpot (Controller number 10)

Status	2nd byte	3rd byte
BnH	0AH	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv = Panpot:	00H - 40H - 7FH (Left - Center - Right)	

\* When the Pan parameter is changed, the corresponding value will be transmitted.

## ○Portamento (Controller number 65)

Status	2nd byte	3rd byte
BnH	41H	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv = Control value:	00H - 7FH (0 - 127) 0 = OFF, 127 = ON	

\* When the Portamento Switch is turned on, the corresponding value will be transmitted.

## ○Resonance (Controller number 71)

Status	2nd byte	3rd byte
BnH	47H	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv = Resonance value (relative change):	00H - 7FH (-64 - 0 - +63)	

\* When the Filter Resonance parameter is changed, the corresponding value will be transmitted.

## ○Release Time (Controller number 72)

Status	2nd byte	3rd byte
BnH	48H	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv = Release Time value (relative change):	00H - 7FH (-64 - 0 - +63)	

\* When the Amp Release Time parameter is changed, the corresponding value will be transmitted.

## ○Attack Time (Controller number 73)

Status	2nd byte	3rd byte
BnH	49H	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv = Attack time value (relative change):	00H - 7FH (-64 - 0 - +63)	

\* When the Amp Attack Time parameter is changed, the corresponding value will be transmitted.

## ○Cutoff (Controller number 74)

Status	2nd byte	3rd byte
BnH	4AH	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv = Cutoff value (relative change):	00H - 7FH (-64 - 0 - +63)	

\* When the Filter Cutoff parameter is changed, the corresponding value will be transmitted.

## ○Decay Time (Controller number 75)

Status	2nd byte	3rd byte
BnH	4BH	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv = Decay Time value (relative change):	00H - 7FH (-64 - 0 - +63)	

\* When the Amp Decay Time parameter is changed, the corresponding value will be transmitted.

## ○Vibrato Rate (Controller number 76)

Status	2nd byte	3rd byte
BnH	4CH	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv = Vibrato Rate value (relative change):	00H - 7FH (-64 - 0 - +63)	

\* When the Pitch Fine parameter of OSC2 is changed, the corresponding value will be transmitted.

## ○Vibrato Depth (Controller number 77)

Status	2nd byte	3rd byte
BnH	4DH	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv = Vibrato Depth Value (relative change):	00H - 7FH (-64 - 0 - +63)	

\* When the Pitch Fine parameter of OSC1 is changed, the corresponding value will be transmitted.

## ○Vibrato Delay (Controller number 78)

Status	2nd byte	3rd byte
BnH	4EH	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv = Vibrato Delay value (relative change):	00H - 7FH (-64 - 0 - +63)	

\* When the PWM Depth parameter of OSC1 is changed, the corresponding value will be transmitted.

## ○General Purpose Controller 5 (Controller number 80)

Status	2nd byte	3rd byte
BnH	50H	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv = Control value:	00H - 40H - 7FH (-64 - 0 - +63)	

\* When the Amp Depth parameter of LFO1 is changed, the corresponding value will be transmitted.

## ○General Purpose Controller 6 (Controller number 81)

Status	2nd byte	3rd byte
BnH	51H	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv = Control value:	00H - 40H - 7FH (-64 - 0 - +63)	

\* When the Filter Envelope Depth parameter is changed, the corresponding value will be transmitted.

## ○General Purpose Controller 7 (Controller number 82)

Status	2nd byte	3rd byte
BnH	52H	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv = Control value:	00H - 7FH (0 - 127)	

\* When the Filter Attack Time parameter is changed, the corresponding value will be transmitted.

## ○General Purpose Controller 8 (Controller number 83)

Status	2nd byte	3rd byte
BnH	53H	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv = Control value:	00H - 7FH (0 - 127)	

\* When the Filter Decay Time parameter is changed, the corresponding value will be transmitted.

## ○Effect 1 (Reverb Send Level) (Controller number 91)

Status	2nd byte	3rd byte
BnH	5BH	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv = Reverb Send Level:	00H - 7FH (0 - 127)	

\* In Performance mode when the Part Reverb Send Level parameter is changed, the corresponding value will be transmitted.

## ○Effect 3 (Chorus Send Level) (Controller number 93)

<u>Status</u>	<u>2nd byte</u>	<u>3rd byte</u>
BnH	5DH	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv = Chorus Send Level:	00H - 7FH (0 - 127)	

\* When the Intensity parameter is changed, the corresponding value will be transmitted.

## ○Effect 4 (Celeste) (Controller number 94)

<u>Status</u>	<u>2nd byte</u>	<u>3rd byte</u>
BnH	5EH	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv =Celeste:	00H - 7FH (0 - 127)	

\* When the Effect Level parameter of Reverb/Delay section is changed, the corresponding value will be transmitted.

## ○Effect 5 (Phaser) (Controller number 95)

<u>Status</u>	<u>2nd byte</u>	<u>3rd byte</u>
BnH	5FH	vvH
n = MIDI channel number:	0H - FH (Ch.1 - 16)	
vv =Phaser:	00H - 7FH (0 - 127)	

\* This message is sent when the Arpeggio Duration parameter is set to "Flt1" or "Flt2."

## ●Program Change

<u>Status</u>	<u>2nd byte</u>
CnH	ppH
n = MIDI channel number:	0H - FH (Ch.1 - 16)
pp = Program number:	00H - 7FH (prog.1 - prog.128)

## ■Channel Mode Messages

### ●MONO (Controller number 126)

<u>Status</u>	<u>2nd byte</u>	<u>3rd byte</u>
BnH	7EH	01H
n = MIDI channel number:	0H - FH (Ch.1 - 16)	

\* When the Solo Switch parameter is turned on, this message will be transmitted.

### ●POLY (Controller number 127)

<u>Status</u>	<u>2nd byte</u>	<u>3rd byte</u>
BnH	7FH	00H
n = MIDI channel number:	0H - FH (Ch.1 - 16)	

\* When the Solo Switch parameter is turned off, this message will be transmitted.

## ■System Exclusive Messages

Universal Non-realtime System Exclusive Message" and Data Set 1 (DT1) are the only System Exclusive messages transmitted by the SH-32.

### ●Universal Non-realtime System Exclusive Message

#### ○Identity Reply Message

Receiving Identity Request Message, the SH-32 send this message.

<u>Status</u>	<u>Data byte</u>	<u>Status</u>
F0H	7EH, dev, 06H, 02H, 41H, 4AH, 01H,	F7H
	00H, 00H, 00H, 00H, 00H, 00H	

<u>Byte</u>	<u>Explanation</u>
FOH	Exclusive status
7EH	ID number (Universal Non-realtime Message)
dev	Device ID (use the same as the device ID of Roland)
06H	Sub ID#1 (General Information)
02H	Sub ID#2 (Identity Reply)
41H	ID number (Roland)
4AH 01H	Device family code
00H 00H	Device family number code
00H 00H 00H 00H	Software revision level
F7H	EOX (End of Exclusive)

## ●Data Transmission

### ○Data Set 1 DT1 (12H)

<u>Status</u>	<u>Data byte</u>	<u>Status</u>
F0H	41H, dev, 00H, 4AH, 12H, aaH, bbH,	F7H
	cCH, ddH, eeH, ... ffH, sum	

<u>Byte</u>	<u>Explanation</u>
F0H	Exclusive status
41H	ID number (Roland)
dev	Device ID (dev: 00H - 1FH, Initial value is 10H)
00H	Model ID #1 (SH-32)
4AH	Model ID #2 (SH-32)
12H	Command ID (DT1)
aaH	Address MSB: upper byte of the starting address of the data to be sent
bbH	Address: upper middle byte of the starting address of the data to be sent
ccH	Address: lower middle byte of the starting address of the data to be sent
ddH	Address LSB: lower byte of the starting address of the data to be sent.
eeH	Data: the actual data to be sent. Multiple bytes of data are transmitted in order starting from the address.
:	:
ffH	Data
sum	Checksum
F7H	EOX (End Of Exclusive)

\* The amount of data that can be transmitted at one time depends on the type of data, and data will be transmitted from the specified starting address and size. Refer to the Address and Size given in Section 3, "Parameter Address Map."

\* Data larger than 256 bytes will be divided into packets of 256 bytes or less, and each packet will be sent at an interval of about 20 ms.

\* For the checksum, refer to (p. 12).

## 3. Parameter Address Map

\* Transmission of "#" marked address is divided to some packets. For example, ABH in hexadecimal notation will be divided to 0AH and 0BH, and is sent/received in this order.

### 1. SH-32 (Model ID = 00H 4AH)

Start Address	Description
00 00 00 00	System
10 00 00 00	Temporary Performance
11 00 00 00	Temporary Patch (Performance Mode Part 1)
11 20 00 00	Temporary Patch (Performance Mode Part 2)
11 40 00 00	Temporary Patch (Performance Mode Part 3)
11 60 00 00	Temporary Patch/Rhythm (Performance Mode Part 4)
14 00 00 00	Temporary Patch/Rhythm (Patch Mode)
15 00 00 00	Temporary Arpeggio Style (Performance Mode)
16 00 00 00	Temporary Rhythm Style (Performance Mode)
17 00 00 00	Temporary Arpeggio/Rhythm Style (Patch Mode)
18 00 00 00	Temporary Chord Form (Performance Mode)
19 00 00 00	Temporary Chord Form (Patch Mode)
20 00 00 00	Performance (01 :1-1)
20 01 00 00	Performance (02 :1-2)
:	:
20 3F 00 00	Performance (64 :8-8)
30 00 00 00	Patch (001 :A11)
30 01 00 00	Patch (002 :A12)
:	:
30 7F 00 00	Patch (128 :B88) * c11 — d88 ... read only
40 00 00 00	Rhythm Set (001 :r1U)
40 10 00 00	Rhythm Set (002 :r1U) * r3P, r4P ... read only
50 00 00 00	Arpeggio Style (001 :11.a)
50 01 00 00	Arpeggio Style (002 :12.a)
:	:
50 3F 00 00	Arpeggio Style (064 :88.a)
50 40 00 00	Rhythm Style (065 :11.r)
50 41 00 00	Rhythm Style (067 :12.r)
:	:
50 7F 00 00	Rhythm Style (128 :88.r)
60 00 00 00	Chord Form (001 :11.c)
60 00 02 00	Chord Form (002 :12.c)
:	:
60 00 7E 00	Chord Form (064 :88.c)

#### ○System

Offset Address	Description
00 00 00 00	System Common

## ○Temporary Patch/Rhythm Set

Offset Address	Description
00 00 00	Temporary Patch
10 00 00	Temporary Rhythm Set

## ○Performance

Offset Address	Description
00 00 00	Performance Common
00 20 00	Performance Part 1
00 21 00	Performance Part 2
00 22 00	Performance Part 3
00 23 00	Performance Part 4/R

## ○Patch

Offset Address	Description
00 00 00	Patch Common
00 02 00	Patch INS-FX
00 04 00	Patch REV/DELAY
00 10 00	Patch Oscillator 1
00 12 00	Patch Oscillator 2

## ○Rhythm Set

Offset Address	Description
00 00 00	Rhythm Set Common
00 02 00	Rhythm Set INS-FX
00 04 00	Rhythm Set REV/DELAY
00 10 00	Rhythm Tone (Key # 21)
00 12 00	Rhythm Tone (Key # 22)
:	
01 3E 00	Rhythm Tone (Key # 108)

## ○Arpeggio Style (Rhythm Style)

Offset Address	Description
00 00 00	Arpeggio Common
00 10 00	Arpeggio Style (Note 1)
00 11 00	Arpeggio Style (Note 2)
:	
00 1F 00	Arpeggio Style (Note 16)

## ○Chord Form

Offset Address	Description
00 00 00	Chord Form

## ○System Common

Offset Address	Description
00 00	0000 000a Sound Mode (0 - 1) PERFORM, PATCH
# 00 01	0000 aaaa Master Tune (0.0 = 440.0 Hz) (24 - 2024) 0000 bbbb 0000 cccc 0000 dddd (-100.0 - 100.0 [cent]) (40 - 88)
00 05	00aa aaaa Master Key Shift (-24 - +24) (dummy)
00 06	0000 000a (dummy)
00 07	000a aaaa Performance Control Channel (0 - 16) 1 - 16, OFF
00 08	0aaa aaaa Performance Bank Select MSB (CC# 0) (0 - 127)
00 09	0aaa aaaa Performance Bank Select LSB (CC# 32) (0 - 127)
00 0A	0aaa aaaa Performance Program Number (PC) (0 - 127)
00 0B	0000 aaaa Patch Receive Channel (0 - 15) 1 - 16
00 0C	0aaa aaaa Patch Bank Select MSB (CC# 0) (0 - 127)
00 0D	0aaa aaaa Patch Bank Select LSB (CC# 32) (0 - 127)
00 0E	0aaa aaaa Patch Program Number (PC) (0 - 127)
00 0F	0000 000a System Clock (0 - 1) Internal, MIDI
00 10	0aaa aaaa Foot Switch (0 - 10) P.UP (PROG), c.UP (CHORD), a.UP (ARP_STYLE), r.UP (RHY_STYLE), tAP (TAP), in.F (INS-FX), rE.d(REV), crd (CHORD-SW), ARP (ARP-SW), Por (PORTA-SW), SoL(SOLO-SW)
00 11	0aaa aaaa (dummy)
00 00 00 12	Total Size

## ○Performance Common

Offset Address	Description
00 00	0aaa aaaa Performance Level (0 - 127)
00 01	00aa aaaa OSC Reserve Part 1 (0 - 32)
00 02	00aa aaaa OSC Reserve Part 2 (0 - 32)
00 03	00aa aaaa OSC Reserve Part 3 (0 - 32)
00 04	00aa aaaa OSC Reserve Part 4 (0 - 32)
# 00 05	0000 aaaa Performance Tempo (200 - 2500) 0000 bbbb 0000 cccc

Offset Address	Description
00 08	0000 000a INS-FX Switch (0 - 1) OFF, ON
00 09	0000 000a REV/DELAY Switch (0 - 1) OFF, ON
00 0A	0000 00aa INS-FX Parameter Source Part (0 - 3) 1 - 4
00 0B	0000 00aa REV/DELAY Parameter Source Part (0 - 3) 1 - 4
00 0C	0000 000a Performance INS > REV Series (0 - 1) SERIES, PARALLEL
00 0D	0000 000a Performance Arpeggiator Switch (0 - 1) OFF, ON
00 0E	0000 00aa Arpeggio Part (0 - 3) 1 - 4
00 0F	0000 000a Arpeggio Part Switch (0 - 1) OFF, ON
00 10	0aaa aaaa Arpeggio Style (0 - 63) 11.a - 88.a
00 11	0000 000a Rhythm Part Switch (0 - 1) OFF, ON
00 12	0aaa aaaa Rhythm Style (64 - 127) 11.r - 88.r
00 13	0aaa aaaa Grid Type (0 - 8) 04_, 08_, 08L, 08H, 08t, 16_, 16L, 16H, 16t (0 - 9)
00 14	0aaa aaaa Motif (0 - 5) UP.L, UP.H, UP._, dn.L, dn.H, dn._, Ud.L, Ud.H, Ud._, rn.L (0 - 11)
00 15	0aaa aaaa Duration (0 - 11) 30, 40, 50, 60, 70, 80, 90
00 16	0000 0aaa Arpeggio Octave Range (61 - 67) -3 - +3
00 17	0000 000a Chord Switch (0 - 1) OFF, ON
00 18	0000 00aa Chord Part (0 - 3) 1 - 4
00 19	00aa aaaa Chord Form Select (0 - 63) 11.r - 88.r
00 00 00 1A	Total Size

## ○Performance Part

Offset Address	Description
00 00	0000 aaaa Receive Channel (0 - 15) 1 - 16
00 01	0000 000a Receive Switch (0 - 1) OFF, ON
00 02	0000 aaaa Layer (Part Stack) Channel (0 - 15) 1 - 16
00 03	0000 000a Layer (Part Stack) Switch (0 - 1) OFF, ON
00 04	0aaa aaaa Patch Bank Select MSB (CC# 0) (0 - 127)
00 05	0aaa aaaa Patch Bank Select LSB (CC# 32) (0 - 127)
00 06	0aaa aaaa Patch Program Number (PC) (0 - 127)
00 07	0aaa aaaa Part Level (CC# 7) (0 - 127)
00 08	0aaa aaaa Part Pan (CC# 10) (0 - 127)
00 09	0aaa aaaa Part Coarse Tune (RPN# 2) L64 - 63R (16 - 112) -48 - +48
00 0A	0aaa aaaa Part Fine Tune (RPN# 1) (14 - 114) -50 - +50
00 0B	0000 000a Mute Switch (0 - 1) OFF, MUTE
00 0C	0000 000a Part INS-FX Switch (0 - 1) OFF, ON
00 0D	0000 000a Part REV/DELAY Switch (0 - 1) OFF, ON
00 0E	0aaa aaaa Part REV/DELAY Send Level (CC# 93) (0 - 127)
00 00 00 0F	Total Size

## ○Patch Common

Offset Address	Description
00 00	0aaa aaaa Patch Level (0 - 127)
00 01	0aaa aaaa Patch Pan (0 - 127) L64 - 63R
00 02	0aaa aaaa Analog Feel (0 - 127)
00 03	0000 000a Solo Switch (0 - 1) SOLO, POLY
00 04	0000 000a Unison Switch (0 - 1) OFF, ON
00 05	0000 00aa Legato Switch (0 - 2) OFF, ON, RETRIGGER (trG)
00 06	0000 00aa Portamento Switch (0 - 2) OFF, LEGATO ONLY, FULLTIME
00 07	0000 000a Portamento Type (0 - 1) RATE, TIME
# 00 08	0aaa aaaa Portamento Time (0 - 127)
00 09	0000 aaaa Patch Tempo (200 - 2500) 0000 bbbb 0000 cccc 20.0 - 250.0 [BPM]
00 0C	0000 000a Patch INS-FX Switch (0 - 1) OFF, ON
00 0D	0000 000a Patch REV/DELAY Switch (0 - 1) OFF, ON
00 0E	0aaa aaaa Patch REV/DELAY Send Level (0 - 127)
00 0F	0000 000a Patch INS > REV Series (0 - 1) SERIES, PARALLEL
00 10	0aaa aaaa Oscillator 1:2 Balance (1 - 127) -63 - +63
00 11	0000 00aa Oscillator Switch (0 - 2) OSCI, OSC2, DUAL
00 12	0000 00aa Oscillator 1x2 Mode (0 - 2) NORMAL, RING, SYNC
00 13	000a aaaa MIDI Pitch Bend Range (0 - 24)
00 14	0aaa aaaa CC#1 LFO1 Pitch Mod Sens (-1 - 127) -63 - +63
00 15	0aaa aaaa CC#1 LFO1 Filter Cutoff Mod Sens (-1 - 127) -63 - +63
00 16	0aaa aaaa CC#1 LFO1 Amp Level Mod Sens (-1 - 127) -63 - +63
00 17	0aaa aaaa CC#1 Filter Cutoff Sens (-1 - 127) -63 - +63
00 18	0aaa aaaa AFT Amp Level Sens (-1 - 127) -63 - +63

# MIDI Implementation

00 19	0aaa aaaa	AFT Filter Cutoff Sens	-63 - +63 (1 - 127) -63 - +63
00 1A	0000 000a	Patch Arpeggiator Switch	(0 - 1) OFF, ON
00 1B	0aaa aaaa	Arpeggio Style	(0 - 63) 11.a - 88.a
00 1C	0aaa aaaa	Grid Type	(0 - 8) 04_, 08_, 08L, 08H, 08t, 16_, 16L, 16H, 16t
00 1D	0aaa aaaa	Motif	(0 - 9) UP.L, UP.H, UP_, dn.L, dn.H, dn_, Ud.L, Ud.H, Ud_, rn.L
00 1E	0aaa aaaa	Duration	(0 - 11) 30, 40, 50, 60, 70, 80, 90, 100, 120, FUL, Ft1, Ft2 (61 - 67)
00 1F	0000 0aaa	Arpeggio Octave Range	-3 - +3
00 20	0000 000a	Chord Switch	(0 - 1) OFF, ON
00 21	00aa aaaa	Chord Form	(0 - 63) 11.c - 88.c
00 22	0aaa aaaa	Pitch Env Attack Time	(0 - 127)
00 23	0aaa aaaa	Pitch Env Decay Time	(0 - 127)
00 24	0000 0aaa	Filter Type	(0 - 4) OFF, LPF, BPF, HPF, PKG
00 25	0000 000a	Slope	(0 - 1) -12, -24 [dB]
00 26	0aaa aaaa	Cutoff Frequency	(0 - 127)
00 27	00aa aaaa	Cutoff Keyfollow	(44 - 84) -200 - +200
00 28	0aaa aaaa	Cutoff Velocity Sens	(1 - 127)
00 29	0aaa aaaa	Resonance	-63 - +63 (0 - 127)
00 2A	0aaa aaaa	Filter Env Depth	(1 - 127)
00 2B	0aaa aaaa	Filter Env Attack Time Velocity Sens	-63 - +63 (1 - 127)
00 2C	0aaa aaaa	Filter Env Attack Time	-63 - +63 (0 - 127)
00 2D	0aaa aaaa	Filter Env Decay Time	(0 - 127)
00 2E	0aaa aaaa	Filter Env Sustain Level	(0 - 127)
00 2F	0aaa aaaa	Filter Env Release Time	(0 - 127)
00 30	0aaa aaaa	Amp Level Velocity Sens	(1 - 127)
00 31	0aaa aaaa	Amp Env Attack Time Velocity Sens	-63 - +63 (1 - 127)
00 32	000a aaaa	Amp Env Time Keyfollow	-63 - +63 (54 - 74) -100 - +100
00 33	0aaa aaaa	Amp Env Attack Time	(0 - 127)
00 34	0aaa aaaa	Amp Env Decay Time	(0 - 127)
00 35	0aaa aaaa	Amp Env Sustain Level	(0 - 127)
00 36	0aaa aaaa	Amp Env Release Time	(0 - 127)
00 37	0000 000a	LF01 Switch	(0 - 1) OFF, ON
00 38	0000 0aaa	LF01 Wave Form	(0 - 6) TRI, SIN, SAW-UP, SQR, TRP, S&H, RND
00 39	0aaa aaaa	LF01 Rate	(0 - 127)
00 3A	0000 000a	LF01 BPM Sync	(0 - 1) OFF, ON
00 3B	0000 0aaa	LF01 Sync Beat/Cycle	(0 - 6) 8, 4, 2, 1, 1/2, 1/3, 1/4
00 3C	0aaa aaaa	LF01 Fade Time	(0 - 127)
00 3D	0000 000a	LF01 Key Sync	(0 - 1) OFF, ON
00 3E	0aaa aaaa	LF01 Oscillator1 Depth	(1 - 127)
00 3F	0aaa aaaa	LF01 Oscillator2 Depth	-63 - +63 (1 - 127)
00 40	0aaa aaaa	LF01 Filter Depth	-63 - +63 (1 - 127)
00 41	0aaa aaaa	LF01 Amp Depth	(1 - 127)
00 42	0aaa aaaa	LF01 Pan Depth	-63 - +63 (1 - 127)
00 43	0000 000a	LF02 Switch	(0 - 1) OFF, ON
00 44	0000 0aaa	LF02 Wave Form	(0 - 6) TRI, SIN, SAW-UP, SQR, TRP, S&H, RND
00 45	0aaa aaaa	LF02 Rate	(0 - 127)
00 46	0000 000a	LF02 BPM Sync	(0 - 1) OFF, ON
00 47	0000 0aaa	LF02 Sync Beat/Cycle	(0 - 6) 8, 4, 2, 1, 1/2, 1/3, 1/4
00 48	0aaa aaaa	LF02 Fade Time	(0 - 127)
00 49	0000 000a	LF02 Key Sync	(0 - 1) OFF, ON
00 4A	0aaa aaaa	LF02 Oscillator1 Depth	(1 - 127)
00 4B	0aaa aaaa	LF02 Oscillator2 Depth	-63 - +63 (1 - 127)
00 4C	0aaa aaaa	LF02 Filter Depth	-63 - +63 (1 - 127)
00 4D	0aaa aaaa	LF02 Amp Depth	(1 - 127)
00 4E	0aaa aaaa	LF02 Pan Depth	-63 - +63 (1 - 127)
00 00 00 4F	Total Size		

## ○Patch INS-FX

Offset	Address	Description	
	00 00	0aaa aaaa	INS-FX Type (0 - 34) EQ, FLt, iSo, od, dt1, dt2, CMP, LMT, Phr, rot, Hch, tch, SPd, FLG, SFL, SP.S, rNg, LoF, Lon, SLi, SL.S, trM, tr.S, APn, AP.S, PS, FPS, dLy, dL.S, LdL, Ld.S, rdL, rEv, Grv
#	00 01	0aaa aaaa	(dummy)
	00 02	0000 aaaa 0000 bbbb 0000 cccc 0000 dddd	INTENSITY (32768 - 32895) 0 - 127
#	00 06	0000 aaaa 0000 bbbb 0000 cccc 0000 dddd	COLOR (32768 - 32895) 0 - 127
#	00 0A	0000 aaaa 0000 bbbb 0000 cccc 0000 dddd	RATE (32768 - 32895) 0 - 127
#	00 0E	0000 aaaa 0000 bbbb	

	0000 cccc	LEVEL	(32768 - 32895)
	0000 dddd		0 - 127
00 00 00 12	Total Size		

## ○Patch REV/DELAY

Offset	Address	Description	
	00 00	0000 aaaa	REV/DELAY Type (0 - 9) r.ro, r.SG, r.HA, dLy, dL.S, LdL, Ld.S, PdL, MdL, Cho
	00 01	0aaa aaaa	(dummy)
#	00 02	0000 aaaa 0000 bbbb 0000 cccc 0000 dddd	E.LEVEL (32768 - 32895) 0 - 127
#	00 06	0000 aaaa 0000 bbbb 0000 cccc 0000 dddd	TIME (32768 - 33768) 0 - 1000
#	00 0A	0000 aaaa 0000 bbbb 0000 cccc 0000 dddd	FBK (32768 - 32866) 0 - 98
#	00 0E	0000 aaaa 0000 bbbb 0000 cccc 0000 dddd	L-R SHIFT/MOD DEPTH (32768 - 32895) 0 - 127
#	00 12	0000 aaaa 0000 bbbb 0000 cccc 0000 dddd	HF DUMP/MOD RATE (32768 - 32893) 0 - 125
00 00 00 16	Total Size		

## ○Patch Oscillator 1 (2)

Offset	Address	Description	
	00 00	0000 00aa	Octave Shift (63 - 65) -1 - +1
	00 01	00aa aaaa	Coarse Tune (40 - 88) -24 - +24
	00 02	0aaa aaaa	Fine Tune (14 - 114) -50 - +50
	00 03	0aaa aaaa	Pitch Env Depth (1 - 127) -63 - +63
	00 04	0000 0aaa	Wave Group (0 - 6) SAW, SQN, PLS, PWM, TRI, SPECT, NOISE
	00 05	0aaa aaaa	Saw Wave Number (0 - 11)
	00 06	0aaa aaaa	Square Wave Number (0 - 9)
	00 07	0aaa aaaa	Pluse Wave Number (0 - 8)
	00 08	0aaa aaaa	Triangle Wave Number (0 - 4)
	00 09	0aaa aaaa	Spectrum Wave Number (0 - 19)
	00 0A	0aaa aaaa	Noise Wave Number (0 - 9)
	00 0B	0aaa aaaa	PWM Depth (0 - 127)
	00 0C	0000 00aa	Sub Oscillator (0 - 2) OFF, OCT, SUBSONIC
00 00 00 0D	Total Size		

## ○Rhythm Set Common

Offset	Address	Description	
#	00 00	0aaa aaaa	Rhythm Set Level (0 - 127)
	00 01	0000 aaaa 0000 bbbb 0000 cccc	Rhythm Set Tempo (200 - 2500) 20.0 - 250.0
	00 04	0000 000a	Rhythm Set INS-FX Switch (0 - 1) OFF, ON
	00 05	0000 000a	Rhythm Set REV/DELAY Switch (0 - 1) OFF, ON
	00 06	0000 000a	Rhythm Set INS > REV Series (0 - 1) SERIES, PARALLEL
	00 07	0000 000a	Arpeggio Switch (0 - 1) OFF, ON
	00 08	0aaa aaaa	Rhythm Style (64 - 127)
	00 09	0aaa aaaa	Grid Type (0 - 8) 04_, 08_, 08L, 08H, 08t, 16_, 16L, 16H, 16t
00 00 00 0A	Total Size		

## ○Rhythm Set INS-FX

Offset	Address	Description	
	00 00	0aaa aaaa	INS-FX Type (0 - 34) EQ, FLt, iSo, od, dt1, dt2, CMP, LMT, Phr, rot, Hch, tch, SPd, FLG, SFL, SP.S, rNg, LoF, Lon, SLi, SL.S, trM, tr.S, APn, AP.S, PS, FPS, dLy, dL.S, LdL, Ld.S, rdL, rEv, Grv
#	00 01	0aaa aaaa	(dummy)
	00 02	0000 aaaa 0000 bbbb 0000 cccc 0000 dddd	INTENSITY (32768 - 32895) 0 - 127
#	00 06	0000 aaaa 0000 bbbb 0000 cccc 0000 dddd	COLOR (32768 - 32895) 0 - 127
#	00 0A	0000 aaaa 0000 bbbb 0000 cccc 0000 dddd	RATE (32768 - 32895) 0 - 127



#	00 0E	0000 aaaa 0000 bbbb 0000 cccc 0000 dddd	LEVEL	(32768 - 32895) 0 - 127
00 00 00 12		Total Size		

## ○Rhythm Set REV/DELAY

Offset Address	Description			
00 00	0000 aaaa	REV/DELAY Type	(0 - 9) r.ro, r.SG, r.HA, dLy, dL.S, LdL, Ld.S, PdL, MdL, Cho	
00 01	0aaa aaaa	(dummy)		
# 00 02	0000 aaaa 0000 bbbb 0000 cccc 0000 dddd	E.LEVEL	(32768 - 32895) 0 - 127	
# 00 06	0000 aaaa 0000 bbbb 0000 cccc 0000 dddd	TIME	(32768 - 33768) 0 - 1000	
# 00 0A	0000 aaaa 0000 bbbb 0000 cccc 0000 dddd	FBK	(32768 - 32866) 0 - 98	
# 00 0E	0000 aaaa 0000 bbbb 0000 cccc 0000 dddd	L-R SHIFT/MOD DEPTH	(32768 - 32895) 0 - 127	
# 00 12	0000 aaaa 0000 bbbb 0000 cccc 0000 dddd	HF DUMP/MOD RATE	(32768 - 32893) 0 - 125	
00 00 00 16		Total Size		

## ○Rhythm Tone

Offset Address	Description			
00 00	0000 000a	Assign Type	(0 - 1) MULTI, SINGLE	
00 01	000a aaaa	Mute Group	(0 - 31) OFF, 1 - 31	
00 02	0aaa aaaa	Rhythm Tone Level	(0 - 127) (40 - 88)	
00 03	00aa aaaa	Coarse Tune	-24 - +24	
00 04	0aaa aaaa	Fine Tune	(14 - 114)	
00 05	0aaa aaaa	Pan	-50 - +50	
00 06	000a aaaa	Pitch Bend Range	(0 - 127) 164 - 63R (0 - 24)	
00 07	0000 000a	Rhythm Tone INS-FX Switch	(0 - 1) OFF, ON	
00 08	0000 000a	Rhythm Tone REV/DELAY Switch	(0 - 1) OFF, ON	
00 09	0aaa aaaa	Rhythm Tone REV/DELAY Send Level	(0 - 127) OFF, ON	
00 0A	0aaa aaaa	Wave Number	(0 - 63) OFF, 1 - 63	
00 0B	0aaa aaaa	Pitch Env Attack Time	(0 - 127)	
00 0C	0aaa aaaa	Pitch Env Decay Time	(0 - 127)	
00 0D	0aaa aaaa	Pitch Env Depth	(1 - 127) -63 - +63	
00 0E	0000 0aaa	Filter Type	(0 - 4) OFF, LPF, BPF, HPP, PKG	
00 0F	0aaa aaaa	Filter Cutoff Frequency	(0 - 127)	
00 10	0aaa aaaa	Filter Cutoff Velocity Sens	(1 - 127)	
00 11	0aaa aaaa	Filter Resonance	(0 - 127)	
00 12	0aaa aaaa	Filter Env Depth	(1 - 127)	
00 13	0aaa aaaa	Filter Env Attack Time Velocity Sens	-63 - +63 (1 - 127)	
00 14	0aaa aaaa	Filter Env Attack Time	(0 - 127)	
00 15	0aaa aaaa	Filter Env Decay Time	(0 - 127)	
00 16	0aaa aaaa	Filter Env Sustain Level	(0 - 127)	
00 17	0aaa aaaa	Filter Env Release Time	(0 - 127)	
00 18	0aaa aaaa	Amp Level Velocity Sens	(1 - 127)	
00 19	0aaa aaaa	Amp Env Attack Time Velocity Sens	-63 - +63 (1 - 127)	
00 1A	0aaa aaaa	Amp Env Attack Time	(0 - 127)	
00 1B	0aaa aaaa	Amp Env Decay Time	(0 - 127)	
00 1C	0aaa aaaa	Amp Env Sustain Level	(0 - 127)	
00 1D	0aaa aaaa	Amp Env Release Time	(0 - 127)	
00 00 00 1E		Total Size		

## ○Arpeggio Common

Offset Address	Description			
# 00 00	0000 aaaa 0000 bbbb	Style Length	(1 - 32)	
00 00 00 02		Total Size		

## ○Arpeggio Style (Rhythm Style)

Offset Address	Description		
# 00 00	0000 aaaa 0000 bbbb	Original Note	(0 - 128)
# 00 02	0000 aaaa 0000 bbbb	Grid 1 Data	(0 - 128) REST, ON (Velocity 001 - 127), TIE
# 00 04	0000 aaaa		

#	00 06	0000 aaaa 0000 bbbb	Grid 2 Data	(0 - 128) REST, ON (Velocity 001 - 127), TIE
#	00 08	0000 aaaa 0000 bbbb	Grid 3 Data	(0 - 128) REST, ON (Velocity 001 - 127), TIE
#	00 0A	0000 aaaa 0000 bbbb	Step4 Data	(0 - 128) REST, ON (Velocity 001 - 127), TIE
#	00 0C	0000 aaaa 0000 bbbb	Grid 5 Data	(0 - 128) REST, ON (Velocity 001 - 127), TIE
#	00 0E	0000 aaaa 0000 bbbb	Grid 6 Data	(0 - 128) REST, ON (Velocity 001 - 127), TIE
#	00 10	0000 aaaa 0000 bbbb	Grid 7 Data	(0 - 128) REST, ON (Velocity 001 - 127), TIE
#	00 12	0000 aaaa 0000 bbbb	Grid 8 Data	(0 - 128) REST, ON (Velocity 001 - 127), TIE
#	00 14	0000 aaaa 0000 bbbb	Grid 9 Data	(0 - 128) REST, ON (Velocity 001 - 127), TIE
#	00 16	0000 aaaa 0000 bbbb	Grid 10 Data	(0 - 128) REST, ON (Velocity 001 - 127), TIE
#	00 18	0000 aaaa 0000 bbbb	Grid 11 Data	(0 - 128) REST, ON (Velocity 001 - 127), TIE
#	00 1A	0000 aaaa 0000 bbbb	Grid 12 Data	(0 - 128) REST, ON (Velocity 001 - 127), TIE
#	00 1C	0000 aaaa 0000 bbbb	Grid 13 Data	(0 - 128) REST, ON (Velocity 001 - 127), TIE
#	00 1E	0000 aaaa 0000 bbbb	Grid 14 Data	(0 - 128) REST, ON (Velocity 001 - 127), TIE
#	00 20	0000 aaaa 0000 bbbb	Grid 15 Data	(0 - 128) REST, ON (Velocity 001 - 127), TIE
#	00 22	0000 aaaa 0000 bbbb	Grid 16 Data	(0 - 128) REST, ON (Velocity 001 - 127), TIE
#	00 24	0000 aaaa 0000 bbbb	Grid 17 Data	(0 - 128) REST, ON (Velocity 001 - 127), TIE
#	00 26	0000 aaaa 0000 bbbb	Grid 18 Data	(0 - 128) REST, ON (Velocity 001 - 127), TIE
#	00 28	0000 aaaa 0000 bbbb	Grid 19 Data	(0 - 128) REST, ON (Velocity 001 - 127), TIE
#	00 2A	0000 aaaa 0000 bbbb	Grid 20 Data	(0 - 128) REST, ON (Velocity 001 - 127), TIE
#	00 2C	0000 aaaa 0000 bbbb	Grid 21 Data	(0 - 128) REST, ON (Velocity 001 - 127), TIE
#	00 2E	0000 aaaa 0000 bbbb	Grid 22 Data	(0 - 128) REST, ON (Velocity 001 - 127), TIE
#	00 30	0000 aaaa 0000 bbbb	Grid 23 Data	(0 - 128) REST, ON (Velocity 001 - 127), TIE
#	00 32	0000 aaaa 0000 bbbb	Grid 24 Data	(0 - 128) REST, ON (Velocity 001 - 127), TIE
#	00 34	0000 aaaa 0000 bbbb	Grid 25 Data	(0 - 128) REST, ON (Velocity 001 - 127), TIE
#	00 36	0000 aaaa 0000 bbbb	Grid 26 Data	(0 - 128) REST, ON (Velocity 001 - 127), TIE
#	00 38	0000 aaaa 0000 bbbb	Grid 27 Data	(0 - 128) REST, ON (Velocity 001 - 127), TIE
#	00 3A	0000 aaaa 0000 bbbb	Grid 28 Data	(0 - 128) REST, ON (Velocity 001 - 127), TIE
#	00 3C	0000 aaaa 0000 bbbb	Grid 29 Data	(0 - 128) REST, ON (Velocity 001 - 127), TIE
#	00 3E	0000 aaaa 0000 bbbb	Grid 30 Data	(0 - 128) REST, ON (Velocity 001 - 127), TIE
#	00 40	0000 aaaa 0000 bbbb	Grid 31 Data	(0 - 128) REST, ON (Velocity 001 - 127), TIE
#	00 42	0000 aaaa 0000 bbbb	Grid 32 Data	(0 - 128) REST, ON (Velocity 001 - 127), TIE
00 00 00 42		Total Size		

## ○Chord Pattern

Offset Address	Description		
00 00	0000 000a	Chord Note 0 (C-1)	(0 - 1) OFF, ON
00 01	0000 000a	Chord Note 1 (C#-1)	(0 - 1) OFF, ON
00 02	0000 000a	Chord Note 2 (D-1)	(0 - 1) OFF, ON
00 03	0000 000a	Chord Note 3 (Eb-1)	(0 - 1) OFF, ON
00 04	0000 000a	Chord Note 4 (E-1)	(0 - 1) OFF, ON
00 05	0000 000a	Chord Note 5 (F-1)	(0 - 1) OFF, ON
00 06	0000 000a	Chord Note 6 (F#-1)	(0 - 1) OFF, ON
00 07	0000 000a	Chord Note 7 (G-1)	(0 - 1) OFF, ON
00 08	0000 000a	Chord Note 8 (G#-1)	(0 - 1) OFF, ON
00 09	0000 000a	Chord Note 9 (A-1)	(0 - 1) OFF, ON
00 0A	0000 000a	Chord Note 10 (Bb-1)	(0 - 1) OFF, ON
00 0B	0000 000a	Chord Note 11 (B-1)	(0 - 1) OFF, ON
00 0C	0000 000a	Chord Note 12 (C0)	(0 - 1) OFF, ON
00 0D	0000 000a	Chord Note 13 (C#0)	(0 - 1) OFF, ON
00 0E	0000 000a	Chord Note 14 (D0)	(0 - 1) OFF, ON
00 0F	0000 000a	Chord Note 15 (Eb0)	(0 - 1) OFF, ON
00 10	0000 000a	Chord Note 16 (E0)	(0 - 1) OFF, ON
00 11	0000 000a	Chord Note 17 (F0)	(0 - 1) OFF, ON

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00 12	0000 000a	Chord Note 18 (F#0)	OFF, ON (0 - 1)	00 57	0000 000a	Chord Note 87 (Eb6)	OFF, ON (0 - 1)
00 13	0000 000a	Chord Note 19 (G0)	OFF, ON (0 - 1)	00 58	0000 000a	Chord Note 88 (E6)	OFF, ON (0 - 1)
00 14	0000 000a	Chord Note 20 (G#0)	OFF, ON (0 - 1)	00 59	0000 000a	Chord Note 89 (F6)	OFF, ON (0 - 1)
00 15	0000 000a	Chord Note 21 (A0)	OFF, ON (0 - 1)	00 5A	0000 000a	Chord Note 90 (F#6)	OFF, ON (0 - 1)
00 16	0000 000a	Chord Note 22 (Bb0)	OFF, ON (0 - 1)	00 5B	0000 000a	Chord Note 91 (G6)	OFF, ON (0 - 1)
00 17	0000 000a	Chord Note 23 (B0)	OFF, ON (0 - 1)	00 5C	0000 000a	Chord Note 92 (G#6)	OFF, ON (0 - 1)
00 18	0000 000a	Chord Note 24 (C1)	OFF, ON (0 - 1)	00 5D	0000 000a	Chord Note 93 (A6)	OFF, ON (0 - 1)
00 19	0000 000a	Chord Note 25 (C#1)	OFF, ON (0 - 1)	00 5E	0000 000a	Chord Note 94 (Bb6)	OFF, ON (0 - 1)
00 1A	0000 000a	Chord Note 26 (D1)	OFF, ON (0 - 1)	00 5F	0000 000a	Chord Note 95 (B6)	OFF, ON (0 - 1)
00 1B	0000 000a	Chord Note 27 (Eb1)	OFF, ON (0 - 1)	00 60	0000 000a	Chord Note 96 (C7)	OFF, ON (0 - 1)
00 1C	0000 000a	Chord Note 28 (E1)	OFF, ON (0 - 1)	00 61	0000 000a	Chord Note 97 (C#7)	OFF, ON (0 - 1)
00 1D	0000 000a	Chord Note 29 (F1)	OFF, ON (0 - 1)	00 62	0000 000a	Chord Note 98 (D7)	OFF, ON (0 - 1)
00 1E	0000 000a	Chord Note 30 (F#1)	OFF, ON (0 - 1)	00 63	0000 000a	Chord Note 99 (Eb7)	OFF, ON (0 - 1)
00 1F	0000 000a	Chord Note 31 (G1)	OFF, ON (0 - 1)	00 64	0000 000a	Chord Note 100 (E7)	OFF, ON (0 - 1)
00 20	0000 000a	Chord Note 32 (G#1)	OFF, ON (0 - 1)	00 65	0000 000a	Chord Note 101 (F7)	OFF, ON (0 - 1)
00 21	0000 000a	Chord Note 33 (A1)	OFF, ON (0 - 1)	00 66	0000 000a	Chord Note 102 (F#7)	OFF, ON (0 - 1)
00 22	0000 000a	Chord Note 34 (Bb1)	OFF, ON (0 - 1)	00 67	0000 000a	Chord Note 103 (G7)	OFF, ON (0 - 1)
00 23	0000 000a	Chord Note 35 (B1)	OFF, ON (0 - 1)	00 68	0000 000a	Chord Note 104 (G#7)	OFF, ON (0 - 1)
00 24	0000 000a	Chord Note 36 (C2)	OFF, ON (0 - 1)	00 69	0000 000a	Chord Note 105 (A7)	OFF, ON (0 - 1)
00 25	0000 000a	Chord Note 37 (C#2)	OFF, ON (0 - 1)	00 6A	0000 000a	Chord Note 106 (Bb7)	OFF, ON (0 - 1)
00 26	0000 000a	Chord Note 38 (D2)	OFF, ON (0 - 1)	00 6B	0000 000a	Chord Note 107 (B7)	OFF, ON (0 - 1)
00 27	0000 000a	Chord Note 39 (Eb2)	OFF, ON (0 - 1)	00 6C	0000 000a	Chord Note 108 (C8)	OFF, ON (0 - 1)
00 28	0000 000a	Chord Note 40 (E2)	OFF, ON (0 - 1)	00 6D	0000 000a	Chord Note 109 (C#8)	OFF, ON (0 - 1)
00 29	0000 000a	Chord Note 41 (F2)	OFF, ON (0 - 1)	00 6E	0000 000a	Chord Note 110 (D8)	OFF, ON (0 - 1)
00 2A	0000 000a	Chord Note 42 (F#2)	OFF, ON (0 - 1)	00 6F	0000 000a	Chord Note 111 (Eb8)	OFF, ON (0 - 1)
00 2B	0000 000a	Chord Note 43 (G2)	OFF, ON (0 - 1)	00 70	0000 000a	Chord Note 112 (E8)	OFF, ON (0 - 1)
00 2C	0000 000a	Chord Note 44 (G#2)	OFF, ON (0 - 1)	00 71	0000 000a	Chord Note 113 (F8)	OFF, ON (0 - 1)
00 2D	0000 000a	Chord Note 45 (A2)	OFF, ON (0 - 1)	00 72	0000 000a	Chord Note 114 (F#8)	OFF, ON (0 - 1)
00 2E	0000 000a	Chord Note 46 (Bb2)	OFF, ON (0 - 1)	00 73	0000 000a	Chord Note 115 (G8)	OFF, ON (0 - 1)
00 2F	0000 000a	Chord Note 47 (B2)	OFF, ON (0 - 1)	00 74	0000 000a	Chord Note 116 (G#8)	OFF, ON (0 - 1)
00 30	0000 000a	Chord Note 48 (C3)	OFF, ON (0 - 1)	00 75	0000 000a	Chord Note 117 (A8)	OFF, ON (0 - 1)
00 31	0000 000a	Chord Note 49 (C#3)	OFF, ON (0 - 1)	00 76	0000 000a	Chord Note 118 (Bb8)	OFF, ON (0 - 1)
00 32	0000 000a	Chord Note 50 (D3)	OFF, ON (0 - 1)	00 77	0000 000a	Chord Note 119 (B8)	OFF, ON (0 - 1)
00 33	0000 000a	Chord Note 51 (Eb3)	OFF, ON (0 - 1)	00 78	0000 000a	Chord Note 120 (C9)	OFF, ON (0 - 1)
00 34	0000 000a	Chord Note 52 (E3)	OFF, ON (0 - 1)	00 79	0000 000a	Chord Note 121 (C#9)	OFF, ON (0 - 1)
00 35	0000 000a	Chord Note 53 (F3)	OFF, ON (0 - 1)	00 7A	0000 000a	Chord Note 122 (D9)	OFF, ON (0 - 1)
00 36	0000 000a	Chord Note 54 (F#3)	OFF, ON (0 - 1)	00 7B	0000 000a	Chord Note 123 (Eb9)	OFF, ON (0 - 1)
00 37	0000 000a	Chord Note 55 (G3)	OFF, ON (0 - 1)	00 7C	0000 000a	Chord Note 124 (E9)	OFF, ON (0 - 1)
00 38	0000 000a	Chord Note 56 (G#3)	OFF, ON (0 - 1)	00 7D	0000 000a	Chord Note 125 (F9)	OFF, ON (0 - 1)
00 39	0000 000a	Chord Note 57 (A3)	OFF, ON (0 - 1)	00 7E	0000 000a	Chord Note 126 (F#9)	OFF, ON (0 - 1)
00 3A	0000 000a	Chord Note 58 (Bb3)	OFF, ON (0 - 1)	00 7F	0000 000a	Chord Note 127 (G9)	OFF, ON (0 - 1)
00 3B	0000 000a	Chord Note 59 (B3)	OFF, ON (0 - 1)				
00 3C	0000 000a	Chord Note 60 (C4)	OFF, ON (0 - 1)				
00 3D	0000 000a	Chord Note 61 (C#4)	OFF, ON (0 - 1)				
00 3E	0000 000a	Chord Note 62 (D4)	OFF, ON (0 - 1)				
00 3F	0000 000a	Chord Note 63 (Eb4)	OFF, ON (0 - 1)				
00 40	0000 000a	Chord Note 64 (E4)	OFF, ON (0 - 1)				
00 41	0000 000a	Chord Note 65 (F4)	OFF, ON (0 - 1)				
00 42	0000 000a	Chord Note 66 (F#4)	OFF, ON (0 - 1)				
00 43	0000 000a	Chord Note 67 (G4)	OFF, ON (0 - 1)				
00 44	0000 000a	Chord Note 68 (G#4)	OFF, ON (0 - 1)				
00 45	0000 000a	Chord Note 69 (A4)	OFF, ON (0 - 1)				
00 46	0000 000a	Chord Note 70 (Bb4)	OFF, ON (0 - 1)				
00 47	0000 000a	Chord Note 71 (B4)	OFF, ON (0 - 1)				
00 48	0000 000a	Chord Note 72 (C5)	OFF, ON (0 - 1)				
00 49	0000 000a	Chord Note 73 (C#5)	OFF, ON (0 - 1)				
00 4A	0000 000a	Chord Note 74 (D5)	OFF, ON (0 - 1)				
00 4B	0000 000a	Chord Note 75 (Eb5)	OFF, ON (0 - 1)				
00 4C	0000 000a	Chord Note 76 (E5)	OFF, ON (0 - 1)				
00 4D	0000 000a	Chord Note 77 (F5)	OFF, ON (0 - 1)				
00 4E	0000 000a	Chord Note 78 (F#5)	OFF, ON (0 - 1)				
00 4F	0000 000a	Chord Note 79 (G5)	OFF, ON (0 - 1)				
00 50	0000 000a	Chord Note 80 (G#5)	OFF, ON (0 - 1)				
00 51	0000 000a	Chord Note 81 (A5)	OFF, ON (0 - 1)				
00 52	0000 000a	Chord Note 82 (Bb5)	OFF, ON (0 - 1)				
00 53	0000 000a	Chord Note 83 (B5)	OFF, ON (0 - 1)				
00 54	0000 000a	Chord Note 84 (C6)	OFF, ON (0 - 1)				
00 55	0000 000a	Chord Note 85 (C#6)	OFF, ON (0 - 1)				
00 56	0000 000a	Chord Note 86 (D6)	OFF, ON (0 - 1)				
				00 00 01 00	Total Size		

## 4. Supplementary Material

### ●Decimal and Hexadecimal Table

(An "H" is appended to the end of numbers in hexadecimal notation.)

In MIDI documentation, data values and addresses/sizes of Exclusive messages, etc. are expressed as hexadecimal values for each 7 bits.

The following table shows how these correspond to decimal numbers.

D	H	D	H	D	H	D	H
0	00H	32	20H	64	40H	96	60H
1	01H	33	21H	65	41H	97	61H
2	02H	34	22H	66	42H	98	62H
3	03H	35	23H	67	43H	99	63H
4	04H	36	24H	68	44H	100	64H
5	05H	37	25H	69	45H	101	65H
6	06H	38	26H	70	46H	102	66H
7	07H	39	27H	71	47H	103	67H
8	08H	40	28H	72	48H	104	68H
9	09H	41	29H	73	49H	105	69H
10	0AH	42	2AH	74	4AH	106	6AH
11	0BH	43	2BH	75	4BH	107	6BH
12	0CH	44	2CH	76	4CH	108	6CH
13	0DH	45	2DH	77	4DH	109	6DH
14	0EH	46	2EH	78	4EH	110	6EH
15	0FH	47	2FH	79	4FH	111	6FH
16	10H	48	30H	80	50H	112	70H
17	11H	49	31H	81	51H	113	71H
18	12H	50	32H	82	52H	114	72H
19	13H	51	33H	83	53H	115	73H
20	14H	52	34H	84	54H	116	74H
21	15H	53	35H	85	55H	117	75H
22	16H	54	36H	86	56H	118	76H
23	17H	55	37H	87	57H	119	77H
24	18H	56	38H	88	58H	120	78H
25	19H	57	39H	89	59H	121	79H
26	1AH	58	3AH	90	5AH	122	7AH
27	1BH	59	3BH	91	5BH	123	7BH
28	1CH	60	3CH	92	5CH	124	7CH
29	1DH	61	3DH	93	5DH	125	7DH
30	1EH	62	3EH	94	5EH	126	7EH
31	1FH	63	3FH	95	5FH	127	7FH

D: decimal

H: hexadecimal

- \* Decimal values such as MIDI channel, bank select, and program change are listed as one greater than the values given in the above table.
- \* A 7-bit byte can express data in the range of 128 steps. For data where greater precision is required, we must use two or more bytes. For example, two hexadecimal numbers aa bbH expressing two 7-bit bytes would indicate a value of  $aa \times 128 + bb$ .
- \* In the case of values which have a +/- sign, 00H = -64, 40H = +/-0, and 7FH = +63, so that the decimal expression would be 64 less than the value given in the above chart. In the case of two types, 00 00H = -8192, 40 00H = +/-0, and 7F 7FH = +8191. For example, if aa bbH were expressed as decimal, this would be  $aa \text{ bbH} - 40 \text{ 00H} = aa \times 128 + bb - 64 \times 128$ .
- \* Data marked "Use nibbled data" is expressed in hexadecimal in 4-bit units. A value expressed as a 2-byte nibble 0a 0bH has the value of  $a \times 16 + b$ .

#### <Example1> What is the decimal expression of 5AH?

From the preceding table, 5AH = 90

#### <Example2> What is the decimal expression of the value 12 34H given as hexadecimal for each 7 bits?

From the preceding table, since 12H = 18 and 34H = 52

$$18 \times 128 + 52 = 2356$$

#### <Example3> What is the decimal expression of the nibbled value 0A 03 09 0D?

From the preceding table, since 0AH = 10, 03H = 3, 09H = 9, 0DH = 13

$$((10 \times 16 + 3) \times 16 + 9) \times 16 + 13 = 41885$$

#### <Example4> What is the nibbled expression of the decimal value 1258?

$$\begin{array}{r} 16 \overline{) 1258} \\ 16 \overline{) \underline{78} \dots 10} \\ 16 \overline{) \underline{4} \dots 14} \\ \underline{0 \dots 4} \end{array}$$

Since from the preceding table, 0 = 00H, 4 = 04H, 14 = 0EH, 10 = 0AH, the result is: 00 04 0E 0AH.

### ●Examples of Actual MIDI Messages

#### <Example1> 92 3E 5F

9n is the Note-on status, and n is the MIDI channel number. Since 2H = 2, 3EH = 62, and 5FH = 95, this is a Note-on message with MIDI CH = 3, note number 62 (note name is D4), and velocity 95.

#### <Example2> CE 49

CnH is the Program Change status, and n is the MIDI channel number. Since EH = 14 and 49H = 73, this is a Program Change message with MIDI CH = 15, program number 74 (Flute in GS).

#### <Example3> EA 00 28

EnH is the Pitch Bend Change status, and n is the MIDI channel number. The 2nd byte (00H = 0) is the LSB and the 3rd byte (28H = 40) is the MSB, but Pitch Bend Value is a signed number in which 40 00H (=  $64 \times 12 + 80 = 8192$ ) is 0, so this Pitch Bend Value is 28 00H - 40 00H =  $40 \times 12 + 80 - (64 \times 12 + 80) = 5120 - 8192 = -3072$

If the Pitch Bend Sensitivity is set to 2 semitones, -8192 (00 00H) will cause the pitch to change -200 cents, so in this case  $-200 \times (-3072) \div (-8192) = -75$  cents of Pitch Bend is being applied to MIDI channel 11.

#### <Example4> B3 64 00 65 00 06 0C 26 00 64 7F 65 7F

BnH is the Control Change status, and n is the MIDI channel number. For Control Changes, the 2nd byte is the control number, and the 3rd byte is the value. In a case in which two or more messages consecutive messages have the same status, MIDI has a provision called "running status" which allows the status byte of the second and following messages to be omitted. Thus, the above messages have the following meaning.

- |            |   |     |
|------------|---|-----|
| B3 64 00   | MIDI ch.4, lower byte of RPN parameter number:  | 00H |
| (B3) 65 00 | (MIDI ch.4) upper byte of RPN parameter number: | 00H |
| (B3) 06 0C | (MIDI ch.4) upper byte of parameter value:      | 0CH |
| (B3) 26 00 | (MIDI ch.4) lower byte of parameter value:      | 00H |
| (B3) 64 7F | (MIDI ch.4) lower byte of RPN parameter number: | 7FH |
| (B3) 65 7F | (MIDI ch.4) upper byte of RPN parameter number: | 7FH |

In other words, the above messages specify a value of 0C 00H for RPN parameter number 00 00H on MIDI channel 4, and then set the RPN parameter number to 7F 7FH.

RPN parameter number 00 00H is Pitch Bend Sensitivity, and the MSB of the value indicates semitone units, so a value of 0CH = 12 sets the maximum pitch bend range to +/-12 semitones (1 octave). (On GS sound generators the LSB of Pitch Bend Sensitivity is ignored, but the LSB should be transmitted anyway (with a value of 0) so that operation will be correct on any device.)

Once the parameter number has been specified for RPN or NRPN, all Data Entry messages transmitted on that same channel will be valid, so after the desired value has been transmitted, it is a good idea to set the parameter number to 7F 7FH to prevent accidents. This is the reason for the (B3) 64 7F (B3) 65 7F at the end.

It is not desirable for performance data (such as Standard MIDI File data) to contain many events with running status as given in <Example 4>. This is because if playback is halted during the song and then rewound or fast-forwarded, the sequencer may not be able to transmit the correct status, and the sound generator will then misinterpret the data. Take care to give each event its own status.

It is also necessary that the RPN or NRPN parameter number setting and the value setting be done in the proper order. On some sequencers, events occurring in the same (or consecutive) clock may be transmitted in an order different than the order in which they were received. For this reason it is a good idea to slightly skew the time of each event (about 1 tick for TPQN = 96, and about 5 ticks for TPQN = 480).

\* TPQN: Ticks Per Quarter Note

## ● Example of an Exclusive Message and Calculating a Checksum

Roland Exclusive messages (RQ1, DT1) are transmitted with a checksum at the end (before F7) to make sure that the message was correctly received. The value of the checksum is determined by the address and data (or size) of the transmitted Exclusive message.

### ○ How to Calculate the Checksum (hexadecimal numbers are indicated by "H")

The checksum is a value derived by adding the address, size, and checksum itself and inverting the lower 7 bits.

Here's an example of how the checksum is calculated. We will assume that in the Exclusive message we are transmitting, the address is aa bb cc ddH and the data or size is ee ffH.

$$\begin{aligned} aa + bb + cc + dd + ee + ff &= \text{sum} \\ \text{sum} \div 128 &= \text{quotient} \dots \text{remainder} \\ 128 - \text{remainder} &= \text{checksum} \end{aligned}$$

### <Example1> Setting FILTER TYPE of Temporary Patch Data to BPF (DT1)

According to the "Parameter Address Map" (p. 6), the start address of Temporary Patch is 14 00 00 00H, the offset address of Patch Common 00 00 00H, and the offset address of FILTER TYPE is 00 24H. Therefore the address of FILTER TYPE of Temporary Patch is;

$$\begin{array}{r} 14\ 00\ 00\ 00\text{H} \\ \quad 00\ 00\ 00\text{H} \\ +) \quad 00\ 24\text{H} \\ \hline 14\ 00\ 00\ 24\text{H} \end{array}$$

BPF has the value of 02H.

So the system exclusive message should be sent is;

F0	41	10	00 4A	12	14 00 00 24	02	??	F7
(1)	(2)	(3)	(4)	(5)	address	data	checksum	(6)

(1) Exclusive Status	(2) ID (Roland)	(3) Device ID (17)
(4) Model ID (SH-32)	(5) Command ID (DT1)	(6) End of Exclusive

Then calculate the checksum.

$$\begin{aligned} 14\text{H} + 00\text{H} + 00\text{H} + 24\text{H} + 02\text{H} &= 20 + 0 + 0 + 36 + 2 = 58 \text{ (sum)} \\ 58 \text{ (sum)} \div 128 &= 0 \text{ (quotient)} \dots 58 \text{ (remainder)} \\ \text{checksum} &= 128 - 58 \text{ (remainder)} = 70 = 46\text{H} \end{aligned}$$

This means that F0 41 10 00 4A 12 14 00 00 24 02 46 F7 is the message should be sent.

### <Example2> Getting the data (RQ1) of Patch "A11"

According to the "Parameter Address Map" (p. 6), the start address of Patch "A11" is 30 08 00 00H.

The offset address of Rhythm is also assigned as follows;

00 00 00	Patch Common
00 02 00	Patch INS-FX
00 04 00	Patch REV/DELAY
00 10 00	Patch Oscillator (Oscillator 1)
00 12 00	Patch Oscillator (Oscillator 2)

As the data size of Patch Oscillator is 00 00 00 0DH, summation of the size, the offset address of Patch Oscillator (Oscillator 2) will be;

$$\begin{array}{r} 00\ 12\ 00\text{H} \\ +) 00\ 00\ 00\ 0D\text{H} \\ \hline 00\ 00\ 12\ 0D\text{H} \end{array}$$

As the size of Patch is 00 00 12 0DH, the system exclusive message should be sent is;

F0	41	10	00 4A	11	30 08 00 00	00 00 12 0D	??	F7
(1)	(2)	(3)	(4)	(5)	address	data	checksum	(6)

(1) Exclusive Status	(2) ID (Roland)	(3) Device ID (17)
(4) Model ID (SH-32)	(5) Command ID (RQ1)	(6) End of Exclusive

Then calculate the checksum.

$$\begin{aligned} 30\text{H} + 08\text{H} + 00\text{H} + 00\text{H} + 00\text{H} + 00\text{H} + 12\text{H} + 0D\text{H} &= 48 + 8 + 0 + 0 + 0 + 0 + 18 + 13 = 87 \text{ (sum)} \\ 87 \text{ (sum)} \div 128 &= 0 \text{ (quotient)} \dots 87 \text{ (remainder)} \\ \text{checksum} &= 128 - 87 \text{ (remainder)} = 41 = 29\text{H} \end{aligned}$$

This means that F0 41 10 00 4A 11 30 08 00 00 00 00 12 0D 29 F7 is the message should be sent.

### <Example3> Getting data (RQ1) at once;

Temporary Performance data,  
Temporary Patch data of whole part in Performance mode,  
Temporary Rhythm data of whole part in Performance mode.

According to the "Parameter Address Map" (p. 6), the start address of the above all parameters is assigned as following:

10 00 00 00H	Temporary Performance
11 00 00 00H	Temporary Patch/Rhythm (Performance Mode Part 1)
:	
11 60 00 00H	Temporary Patch/Rhythm (Performance Mode Part 4)

The offset address of Patch is also assigned as follows:

00 00 00	Temporary Patch
10 00 00	Temporary Rhythm

The offset address of Rhythm Set is also assigned as follows:

00 00 00	Rhythm Common
00 02 00	Rhythm INS-FX
00 04 00	Rhythm REV/DELAY
00 10 00	Rhythm Wave (Key # 21)
00 12 00	Rhythm Wave (Key # 22)
:	
01 3E 00	Rhythm Wave (Key # 108)

As the data size of Rhythm Wave is 00 00 00 1EH, summation of the size, the start address of Part 4 at Temporary Patch/Rhythm in Performance mode, the offset address of Temporary Rhythm and the offset address of Rhythm Wave (Key # 108) will be;

$$\begin{array}{r} 11\ 60\ 00\ 00\text{H} \\ \quad 10\ 00\ 00\text{H} \\ \quad 01\ 3E\ 00\text{H} \\ +) \quad 00\ 00\ 00\ 1E\text{H} \\ \hline 11\ 71\ 3E\ 1E\text{H} \end{array}$$

And the size that have to be got should be;

$$\begin{array}{r} 11\ 71\ 3E\ 1E\text{H} \\ -) \quad 10\ 00\ 00\ 00\text{H} \\ \hline 01\ 71\ 3E\ 1E\text{H} \end{array}$$

Therefore the system exclusive message should be sent is;

F0	41	10	00 4A	11	10 00 00 00	01 71 3E 1E	22	F7
(1)	(2)	(3)	(4)	(5)	address	data	checksum	(6)

(1) Exclusive Status	(2) ID (Roland)	(3) Device ID (17)
(4) Model ID (SH-32)	(5) Command ID (RQ1)	(6) End of Exclusive

