GENERAL MIDI GS

E-28

INTELLIGENT KEYBOARD

MIDI implementation

Roland

E-28 INTELLIGENT KEYBOARD

MIDI IMPLEMENTATION **Version 1.0** **Date: June 1996**

ARRANGER SECTION

1 Receive data (Arranger Section)

- Channel Voice Messages -

■ Note off

Status	Second	Third
8nH	kkH	vvH
9nH	kkH	00H

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
kk=Note number : 00H - 7FH (0 - 127)
vv=Velocity : 00H - 7FH (0 - 127)

*Ignored when "Midi Rx Channel = OFF" and the Note number is outside the "Limits".
*Velocity is ignored..

■ Note on

Status	Second	Third
9nH	kkH	vvH

n= MIDI channel number : 0H - FH (ch.1 - ch.16)
kk= Note number : 00H - 7FH (0 - 127)
vv= Velocity : 01H - 7FH (1 - 127)

*Ignored when "Midi Rx Channel = OFF" and the Note number is outside the "Limits".

■ Polyphonic key pressure

Status	Second	Third
AnH	kkH	vvH

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
kk=Note number : 00H - 7FH (0 - 127)
vv=Value : 00H - 7FH (0 - 127)

*Ignored when "Midi Rx Channel = OFF".
*Effect to the parameter set on "PAf controller function".
The default setting has no effect.

■ Control change

*Ignored when "Midi Rx Channel = OFF".
*The values set by Control change messages won't reset by receiving new Program change messages.

Bank select

Status	Second	Third
BnH	00H	mmH
BnH	20H	l l H

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
mm, l l=Bank number : 00H,00H - 7FH,7FH (bank1 - bank16384)
Default Value = 00 00H (bank.1)

"Rx.Bank Select" is set to ON by "GS RESET". (Power-on default value is ON.)
*The LSB 7-bits are ignored (always regards as llH=00H).
However, when sending Bank Select messages, you have to send both of the MSB(mm) and LSB(ll) together.
*"Bank select" is suspended until receiving "Program change".
To select a Tone of another bank, you have to send Bank select(mm,ll) before sending the Program change.
*The "Variation number" of GS Format is defined as the decimal expression of the MSB value (Control change number 00H) of the Bank select.

Modulation

Status	Second	Third
BnH	01H	vvH

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
vv=Modulation depth : 00H - 7FH (0 - 127)

*Ignored when "Modulation Midi Rx Filter = OFF".
*Effect to the parameter set on "MOD controller function".
The default setting is pitch modulation depth.

Portamento time

Status	Second	Third
BnH	05H	vvH

n=MIDI channel number : 0H - FH (ch.1- ch.16)
vv=Portamento time : 00H - 7FH (0 - 127)
Default Value = 00H (0)

*The Portamento time value changes the rate of pitch change when Portamento is ON or when using portamento control messages.
Value 0 is the fastest.

Data entry

Status	Second	Third
BnH	06H	mmH
BnH	26H	l l H

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
mm,ll=Value of the parameter specified with RPN and/or NRPN

Volume

Status	Second	Third
BnH	07H	vvH

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
vv=Volume : 00H - 7FH (0 - 127)

*Volume messages control the volume level of the specified channel (part).
Use Volume messages to control volume balance of each part.
*Ignored when "Volume Midi Rx Filter = OFF".

Panpot

Status	Second	Third
BnH	0AH	vvH

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
vv=Panpot : 00H - 40H 7FH (Left - Center - Right)

*127 steps from Left to Center to Right.
*Within the Drum Part, the panpot provides overall control of a stereophonic image.
*Ignored when "Panpot Midi Rx Filter" = OFF".

Expression

Status	Second	Third
BnH	0BH	vvH

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
vv=Expression : 00H - 7FH (0 - 127)

*Expression and Volume messages are cumulative, and the result will control the overall volume.
Use Expression messages for expression pedal, or creating expressive effects, such as crescendo, decrescendo, while playing.
*Ignored when "Expression Midi Rx Filter = OFF".

Hold1

Status	Second	Third
BnH	40H	vvH

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
vv=Control Value : 00H - 7FH (0 - 127) 0-63=OFF,64-127=ON

*Ignored when "Sustain Midi Rx.Filter = OFF".

Portamento

Status	Second	Third
BnH	41H	vvH

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
vv=Control Value : 00H - 7FH (0 - 127) 0-63=OFF 64-127=ON

Sostenuto

Status	Second	Third
BnH	42H	vvH

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
vv=Control Value : 00H - 7FH (0 - 127) 0-63=OFF 64-127=ON

Soft

Status	Second	Third
BnH	43H	vvH

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
vv=Control Value : 00H - 7FH (0 - 127)

Portamento Control

Status	Second	Third
BnH	54H	kkH

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
kk=source note number for pitch reference: 00H - 7FH (0 - 127)

*When a Note On message is receivec after a Portamento Control message, the voice's pitch will glide from the pitch specified by the source note number of the Portamento Control message at the rate set by the portamento time controller (regardless portamento on/off.)
If there is a currently sounding voice whose note number is coincident with the source note number, the voice's pitch will glide to the new Note On's pitch according to the portamento time without re-triggering (played in legato). Then no new voice should be assigned.

Example 1.

On MIDI	Description	Result
90 3C 40	Note on C4	C4 on
B0 54 3C	Portamento Control from C4	no change (C4 voice still sounding)
90 40 40	Note on E4	glide from C4 to E4
80 3C 40	Note off C4	no change
80 40 40	Note off E4	E4 off

Example 2.

On MIDI	Description	Result
B0 54 3C	Portamento Control from C4	no change
90 40 40	Note on E4	E4 is played with glide from C4 to E4
80 40 40	Note off E4	E4 off

Effect1 depth(Reverb send level)

Status	Second	Third
BnH	5BH	vvH

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
vv=Reverb send level : 00H - 7FH (0 - 127)

*Effect1 depth messages control the Send Level of the specified channel (part) to the internal Reverb unit.
*Ignored when "Reverb Depth Rx Filter = OFF".

Effect3 depth(Chorus send level)

Status	Second	Third
BnH	5DH	vvH

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
vv=Chorus send level : 00H - 7FH (0 - 127)

*Effect3 depth messages control the Send Level of the specified channel (part) to the internal Chorus unit.
*Ignored when "Chorus Depth Midi Rx Filter = OFF".

NRPN MSB/LSB

Status	Second	Third
BnH	63H	mmH
BnH	62H	llH

n =MIDI channel number :0H - FH (ch.1 - ch.16)
mm =MSB of the NRPN
ll =LSB of the NRPN

*Recognized when "Rx.NRPN = ON". "Rx.NRPN" is set ON by "GS RESET".
*The values set by NRPN won't reset by receiving new Program Change messages or Reset All Controllers.

NRPN
An NRPN (Non Registered Parameter Number) is an expanded control change message.
Each function of an NRPN is described by the individual manufacturer.
To use NRPN, set NRPN number (MSB/LSB) before sending data. Then send data by Data entry message(Control Change # 6/38).
And then, it is recommended to send RPN null (RPN number = 7FH/7FH) to prevent the data from being unexpectedly change. For more explanation, refer to Chapter 4. Useful Information, Example of actual MIDI messages <EXAMPLE 4>.

You can change the following parameters by using NRPN.

NRPN MSB	NRPN LSB	Data entry MSB	Description
01H	08H	mmH	Vibrato rate relative change on specified channel mm: 0EH-40H-72H (-50 - 0 - +50)
01H	09H	mmH	Vibrato depth relative change on specified channel mm: 0EH-40H-72H (-50 - 0 - +50)
01H	0AH	mmH	Vibrato delay relative change on specified channel mm: 0EH-40H-72H (-50 - 0 - +50)
01H	20H	mmH	TVF cutoff frequency relative change on specified channel mm: 0EH-40H-72H (-50 - 0 - +50)
01H	21H	mmH	TVF resonance relative change on specified channel mm: 0EH-40H-72H (-50 - 0 - +50)
01H	63H	mmH	TVF&TVA Env. Attack time relative change on specified channel mm: 0EH-40H-72H (-50 - 0 - +50)
01H	64H	mmH	TVF&TVA Env. Decay time relative change on specified channel mm: 0EH-40H-72H (-50 - 0 - +50)
01H	66H	mmH	TVF&TVA Env. Release time relative change on specified channel mm: 0EH-40H-72H (-50 - 0 - +50)

18H	r r H	mmH	Pitch coarse of drum instrument relative change on specified drum instrument rr: key number of drum instrument mm: 00H-40H-7FH (-64 - 0 - +63 semitone)
1AH	r r H	mmH	TVA level of drum instrument absolute change on specified drum instrument rr: key number of drum instrument mm: 00H-7FH (zero - maximum)
1CH	r r H	mmH	Panpot of drum instrument absolute change on specified drum instrument rr: key number of drum instrument mm: 00H,01H-40H-7FH (Random, Left-Center-Right)
1DH	r r H	mmH	Reverb send level of drum instrument absolute change on specified drum instrument rr: key number of drum instrument mm: 00H-7FH (zero - maximum)
1EH	r r H	mmH	Chorus send level of drum instrument absolute change on specified drum instrument rr: key number of drum instrument mm: 00H-7FH (zero - maximum)

*Data entry LSB is ignored.
*The relative change means that the parameter value(e.g.-50 - 0 - +50) will be added to the preset value.
*The absolute change means that the parameter value will be replaced by the received value.
*Ignored when "NRPN Midi Rx Filter = OFF".

RPN MSB/LSB

Status	Second	Third
BnH	65H	mmH
BnH	64H	l l H

n =MIDI channel number :0H -FH (ch.1 - ch.16)
mm =MSB of the RPN
l l =MSB of the RPN

*The values set by an RPN won't be reset by receiving new Program Change messages or Reset All Controllers.

RPN
An RPN (Registered Parameter Number) is an expanded control change message.
Each function of an RPN is described by the MIDI Standard.
To use RPN, set RPN number (MSB/LSB) before sending data. Then send data by Data entry message(Control Change # 6/38). And then, it is recommended to send RPN null (RPN number = 7FH/7FH) to prevent the data from being unexpectedly change. For more explanation, refer to Chapter 4. Useful Information, Example of actual MIDI messages <EXAMPLE 4>.

You can change the following parameters by using RPN.

RPN MSB	RPN LSB	Data entry MSB	Data entry LSB	Description
00H	00H	mmH	----	Pitch bend sensitivity mm: 00H-18H (0 - 24 semitone) Default value=02H (two semitones) l l: ignored (value=00H) (Up to 2 octaves)
00H	01H	mmH	l l H	Master fine tuning mm, l l: 00 00H-40 00H-7F 7FH (-8192x100/8192 - 0 - +8191x100/8192 cents)
00H	02H	mmH	----	Master coarse tuning mm: 28H-40H-58H (-24 - 0 - +24 semitones) l l: ignored (value=00H)
7FH	7FH	----	----	RPN null Return to disable condition. The parameter already set retains its value. mm,l l: ignored.

■ **Program change**

Status	Second
CnH	ppH

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
pp=Program number : 00H - 7FH (prog.1 - prog.128)

*The Tone of the voices already ON before receiving a program change message isn't affected.
The Tone will be changed by a new Not-on message after the program change is received.
*Ignored when "Program change Midi Rx Filter = OFF".
*In the drum part, Program change messages are ignored when the Bank is set at 129 - 16384 (ie. the value of the control change number 0 is not 00H).

■ **Channel pressure**

Status	Second
DnH	vvH

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
vv=Value : 00H - 7FH (0 - 127)

*Effect to the parameter set on "MOD controller function".
The default setting has no effect.

■ **Pitch bend change**

Status	Second	Third
EnH	l l H	mmH

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
mm, l l=Value : 00 00H - 40 00H - 7F 7FH (-8192 - 0 - +8191)

*Effect to the parameter set on "MOD controller function".
The default setting is pitch bend.
*Ignored when "Pitch Bender Midi Rx Filter = OFF"

Channel Mode Messages

■ **All sounds off**

Status	Second	Third
BnH	78H	00H

n=MIDI channel number : 0H - FH (ch.1 - ch.16)

*When "All sounds off" is received, all sounds on a specified channel turn off immediately.
However, the state of channel messages does not change. You must not use "All sound off" message for "Note off".

■ **Reset all controllers**

Status	Second	Third
BnH	79H	00H

n=MIDI channel number : 0H - FH (ch.1 - ch.16)

*When "reset all controllers" is received, the controller value of specified channel return to the default at values as follows.

Controller	Default Value
Pitch bend change	0(Center)
Polyphonic key pressure	0(off)
Channel pressure	0(off)
Modulation	0(off)
Expression	127(maximum)
Hold1	0(off)
Portamento	0(off)
Sostenuto	0(off)
Soft	0(off)
RPN	disabled. Theparameter already set retains its old value
NRPN	disabled. Theparameter already set retains its old value

■ **All notes off**

Status	Second	Third
BnH	7BH	00H

n=MIDI channel number : 0H - FH (ch.1 - ch.16)

*When "All notes off" is received, all notes are turned off in the specified channel.
However, sound continues while hold1 and/or sostenuto is on.

■ **OMNI OFF**

Status	Second	Third
BnH	7CH	00H

n=MIDI channel number : 0H - FH (ch.1 - ch.16)

*OMNI OFF is only recognized as "all notes off". Mode doesn't change.

■ **OMNI ON**

Status	Second	Third
BnH	7DH	00H

n=MIDI channel number : 0H - FH (ch.1 - ch.16)

*OMNI ON is only recognized as "all notes off". Mode doesn't change (OMNI OFF remains).

■ **MONO**

Status	Second	Third
BnH	7EH	mmH

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
mm=number of mono : 00H - 10H (0 - 16)

**MONO is recognized as "all sounds off". The specified channel turns to Mode4 (M=1), even if mm is not equal to 1 (mm is ignored).

■ **POLY**

Status	Second	Third
BnH	7FH	00H

n=MIDI channel number : 0H - FH (ch.1 - ch.16)

*POLY is recognized as "all sounds off". The specified channel turns to Mode3.

System Real Time Message

■ **Active sensing**

Status
FEH

*Having received an "active sensing" message, e-28 expects to receive additional active sensing messages at 300ms intervals.
If the interval is greater than 420ms, e-28 executes "All sounds off", "All notes off" and "Reset all controllers" and returns to normal operation. (Monitoring of active sensing messages will terminate.)

■ **Sequencer start**

Status
FAH
When "Sequencer start" is received the internal recorder and/or the internal arranger start.

■ **Sequencer stop**

Status
FCH
When "Sequencer stop" is received the internal recorder and/or the internal arranger stop.

■ **Timing clock**

Status
F8H
When "Timing clock" is received the internal recorder or the internal arranger are syncronized with an external clock .

System Exclusive Message

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

F0H : System exclusive
ii=ID number : The ID number identifies the manufacturer of a MIDI device that triggers an exclusive message. Value 7EH and 7FH are reserved to use as universal messages which are used for extension of the MIDI Standard.
41H : Roland's Manufacturer-ID.
7EH : Universal Non-Realtime Message
7FH : Universal Realtime Message
dd,...,ee=data: 00H-7FH (0-127)
F7H: EOX (End of Exclusive/System common)

System Exclusive Messages of Mode Change

System Exclusive Messages of Mode Change are the messages used to initialize the internal parameters of the device to General MIDI mode or GS default mode. "GS reset" and "Exit GS mode" use a form of Roland Exclusive Message. "Turn General MIDI System On" and "Turn General MIDI System Off" use a form of Universal Non-real Time Message.

GS reset

Status	Data Byte	Status
F0H	41H, 10H, 42H, 12H, 40H, 00H, 7FH, 00H, 41H	F7H

Byte	Description	
F0H	Exclusive status	
41H	ID number	(Roland)
10H	Device ID	(dev => 10H)
42H	Model ID	(GS)
12H	Command ID	(DT1)
40H	Address MSB	
00H	:	
7FH	Address LSB	
00H	Data	(GS reset)
41H	Checksum	
F7H	EOX	(End of exclusive)

*Upon receiving this message, all the internal parameters are set to the default settings of the GS Format. (Rx.NRPN SW will be turned ON by this message.)
*It takes about 100 ms to execute this message.

Exit GS mode

Status	Data Byte	Status
F0H	41H, 10H, 42H, 12H, 40H, 00H, 7FH, 7FH, 42H	F7H

Byte	Description	
F0H	Exclusive status	
41H	ID number	(Roland)
10H	Device ID	(dev => 10H)
42H	Model ID	(GS)
12H	Command ID	(DT1)
40H	Address MSB	
00H	:	
7FH	Address LSB	
7FH	Data	(Exit GS mode)
42H	Checksum	
F7H	EOX	(End of exclusive)

*Upon receiving this message, the unit changes from GS to e-28 default mode.
*It takes about 100 ms to execute this message.

Turn General MIDI System On

Status	Data Byte	Status
F0H	7EH, 7FH, 09H, 01H	F7H

Byte	Description	
F0H	Exclusive status	
7EH	ID number	(Universal non-real time message)
7FH	ID of target device	(Broadcast)
09H	sub-ID#1	(General MIDI message)
01H	sub-ID#2	(General MIDI On)
F7H	EOX	(End of exclusive)

*Upon receiving this message, all the internal parameters are set to the default settings of General MIDI System Level 1.
*It takes about 100 ms to execute this message.

Turn General MIDI System Off

Status	Data Byte	Status
F0H	7EH, 7FH, 09H, 02H	F7H

Byte	Description	
F0H	Exclusive status	
7EH	ID number	(Universal non-real time message)
7FH	ID of target device	(Broadcast)
09H	sub-ID#1	(General MIDI message)
02H	sub-ID#2	(General MIDI Off)
F7H	EOX	(End of exclusive)

*Upon receiving this message, the unit changes from General MIDI mode to e-28 default mode.
*It takes about 100 ms to execute this message.

■ Data Transfer

e-28 can transmit and receive the various parameters using System Exclusive messages of the following data format.
GS Common Exclusive messages use Model ID = 42H and Device ID = 17(10H).

■ Request data 1 RQ1

This message is sent out to request the remote device to send back the required data. It contains data for the address and size that specify designation and length, respectively.
On receiving a proper RQ1 message for the device, the device will transmit a "Data set 1 (DT1)" message, which contains the requested data. Otherwise, the device will not send anything.

Status	Data Byte	Status
F0H	41H, 10H, 42H, 11H, aaH, bbH, ccH, ssH, ttH, uuH, sum	F7H

Byte	Description	
F0H	Exclusive status	
41H	Manufacturer's ID	(Roland)
10H	Device ID	(dev => 10H)
42H	Model ID	(GS)
11H	Command ID	(RQ1)
aaH	Address MSB	
bbH	:	
ccH	Address LSB	
ssH	Size MSB	
ttH	:	
uuH	Size LSB	
sum	Checksum	
F7H	EOX	(End of exclusive)

*e-28 only recognizes the RQ1 messages whose address and size match the Parameter Address Map (Section 3).
*The error checking process uses a Checksum. Refer to Section 4 to calculate a Checksum.

■ Data set 1 DT1

This message corresponds to the actual data transfer process.
On receiving a DT1 message, the device writes the data to internal memory according to the address.

Status	Data Byte	Status
F0H	41H, 10H, 42H, 12H, aaH, bbH, ccH, ddH, ... eeH, sum	F7H

Byte	Description	
F0H	Exclusive status	
41H	Manufacturer's ID	(Roland)
10H	Device ID	(dev => 10H)
42H	Model ID	(GS)
12H	Command ID	(DT1)
aaH	Address MSB	
bbH	:	
ccH	Address LSB	
ddH	Data	
:	:	
eeH	Data	
sum	Checksum	
F7H	EOX	(End of exclusive)

*e-28 only recognizes the DT1 messages whose address and size match the Parameter Address Map (Section 3).
*To send large DT1 messages at a time, insert 40ms - intervals at least in between each packet.
*The error checking process uses a Checksum. Refer to Section 4 to calculate a Checksum.

2 Transmit data (Arranger Section)

- Channel Voice Messages -

■ Note off

Status	Second	Third
9nH	kkH	00H

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
kk=Note number : 00H - 7FH (0 - 127)
vv=Velocity : 00H - (0)

■ Note on

Status	Second	Third
9nH	kkH	vvH

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
kk=Note number : 00H - 7FH (0 - 127)
vv=Velocity : 01H - 7FH (1 - 127)

■ Control change

* The e-28 does not send this message if "Midi Tx Channel" = Off

Bank select

Status	Second	Third
BnH	00H	mmH
BnH	20H	llH

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
mm, ll =Bank number : 00H,00H - 7FH,7FH (bank1 - bank16384)

Modulation

Status	Second	Third
BnH	01H	vvH

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
vv=Modulation depth : 00H - 7FH (0 - 127)

Portamento time

Status	Second	Third
BnH	05H	vvH

n=MIDI channel number : 00H - 0FH (ch.1 - ch.16)
vv=Portamento Time : 00H - 7FH (0 - 127) Default 00H (0)

* The portamento Time value change the rate of pitch change when portamento is ON or when using Portamento Control Messages. Value 0 is the fastest.

Hold1

Status	Second	Third
BnH	40H	vvH

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
vv=Control Value : 00H - 7FH (0 - 127) 0-63=OFF, 64-127=ON

Portamento Control

Status	Second	Third
BnH	54H	kkH

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
kk=source note number for pitch reference: 00H - 7FH (0 - 127)

*When a Note On message is received after a Portamento Control message, the voice's pitch will glide from the pitch specified by the source note number of the Portamento Control message at the rate set by the portamento time controller (regardless portamento on/off.) If there is a currently sounding voice whose note number is coincident with the source note number, the voice's pitch will glide to the new Note On's pitch according to the portamento time without re-triggering (played in legato). Then no new voice should be assigned.

Example 1.

On MIDI	Description	Result
90 3C 40	Note on C4	C4 on
B0 54 3C	Portamento Control from C4	no change (C4 voice still sounding)
90 40 40	Note on E4	glide from C4 to E4
80 3C 40	Note off C4	no change
80 40 40	Note off E4	E4 off

Example 2.

On MIDI	Description	Result
B0 54 3C	Portamento Control from C4	no change
90 40 40	Note on E4	E4 is played with glide from C4 to E4
80 40 40	Note off E4	E4 off

Effect1 depth (Reverb send level)

Status	Second	Third
BnH	5BH	vvH

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
vv=Reverb send level: 00H - 7FH (0 - 127)

*Effect1 depth messages control the Send Level of the specified channel (part) to the internal Reverb unit.

Effect3 depth (Chorus send level)

Status	Second	Third
BnH	5DH	vvH

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
vv=Chorus send level: 00H - 7FH (0 - 127)

*Effect3 depth messages control the Send Level of the specified channel (part) to the internal Chorus unit.

■ **Program change**

Status	Second
CnH	ppH

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
pp=Program number : 00H - 7FH (prog.1 - prog.128)

■ **Pitch bend change**

Status	Second	Third
EnH	l l H	mmH

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
mm, l l=Value : 00 00H - 40 00H - 7F 7FH (-8192 - 0 - +8191)

System Realtime Message

Active sensing

Status
FEH

*Transmits at about 300ms intervals.

Sequencer start

Status
FAH

"Sequencer start" is transmitted if START/STOP button is pressed and the internal recorder/arranger is in STOP mode.

Sequencer stop

Status
FCH

"Sequencer stop" is transmitted if START/STOP button is pressed and the internal recorder/arranger is in START mode.

Timing clock

Status
F8H
"Timing clock" is always transmitted.

System Exclusive Message

■ **Data Transfer**

e-28 transmits "Data set 1 (DT1)" message when receiving a proper "Request Data 1(RQ1)" message. Refer to section 1(System Exclusive Message)

■ **Data set 1** **DT1 (12H)**

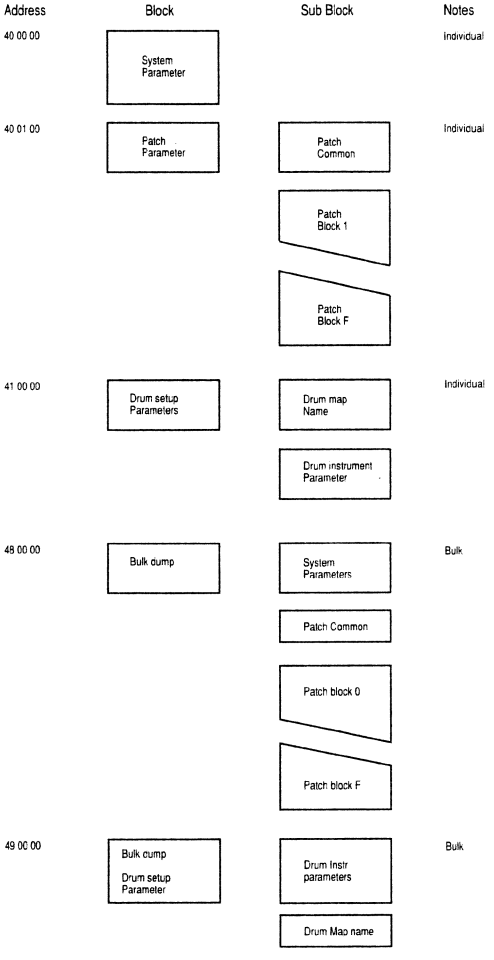
Status	Data Byte	Status
F0H	41H, 10H, (42H), 12H, aaH, bbH, ccH, ddH, ... eeH, sum	F7H

Byte	Description	
F0H	Exclusive status	
41H	Manufacturer's ID	(Roland)
10H	Device ID	(dev => 10H)
42H	Model ID	(GS)
12H	Command ID	(DT1)
aaH	Address MSB	
bbH	Address	
ccH	Address LSB	
ddH	Data	
:	:	
eeH	Data	
sum	Checksum	
F7H	EOX	(End of exclusive)

*e-28 only send the DT1 messages whose address and size match the Parameter Address Map (Section 3).
*If the data to send is a large data (more than 128 bytes), then the data will be sent out in separate packets.
*Refer to Section 4 to calculate a Checksum.

3.1 Parameter address map (Model ID=42H)

This map indicates address, size, Data (range), Parameter, Description, and Default Value of parameters which can be transferred using "Request data 1 (RQ1)" and "Data set 1 (DT1)".
All the numbers of address, size, Data, and Default Value are indicated in 7-bit Hexadecimal-form.



There are two types of GS Exclusive message. One is an individual parameter comunication, the other is a bulk dump communication.

Individual parameter

You can use individual parameter communication to send or request an individual parameter value.
One packet of System Exclusive messages "F0 ..... F7" can only have one parameter (which may contain several bytes).
You cannot use any address having "#" for the top address in a System Exclusive message.

[SYSTEM PARAMETERS]

Address(H)	*SIZE(H)*	*Data(H)*	*Parameter*	*Description*	*Default value (H)*
40 00 00 40 00 01# 40 00 02# 40 00 03#	00 00 04	0018 - 07E8	MASTER TUNE	-100.0 - +100.0 [cent] Use nibblized data.	00 04 00 00
40 00 04	00 00 01	00, 7F	MASTER VOLUME	0 - 127	7F
40 00 05	00 00 01	28, 58	MASTER KEY Shift	-24 / +24 semitones	40
40 00 06	00 00 01	01, 7F	MASTER PAN		40
40 00 7F	00 00 01	00, 7F	MODE SET (Rx Only)	00 = GS Reset 127 = Exit GS	

[PATCH PARAMETERS]

e-28 has 16 parts. The parameters of each part are called PATCH PARAMETERS. To send or request a PATCH PARAMETER, use the part number (which is usually same as the MIDI channel number) .

*x...BLOCK NUMBER (0 - F),

Part 1	(default MIDIch = 1)	x=1	Rx only 1
Part 2	(default MIDIch = 2)	x=2	Acc Bass
Part 3	(default MIDIch = 3)	x=3	Rx only 2
Part 4	(default MIDIch = 4)	x=4	Upper 1
Part 5	(default MIDIch = 5)	x=5	Acc 1
Part 6	(default MIDIch = 6)	x=6	Acc 2
Part 7	(default MIDIch = 7)	x=7	Acc 3
Part 8	(default MIDIch = 8)	x=8	Man Bass
Part 9	(default MIDIch = 9)	x=9	Rx only 3
Part 10	(default MIDIch =10)	x=0	Acc Drums
Part 11	(default MIDIch =11)	x=A	Lower
Part 12	(default MIDIch =12)	x=B	Rx only 4
Part 13	(default MIDIch =13)	x=C	Upper 2
Part 16	(default MIDIch =16)	x=F	Man Drums

Address(H)	*SIZE(H)*	*Data(H)*	*Parameter*	*Description*	*Default value (H)*
40 01 00 40 01 :# 40 01 0F#	00 00 10	20 - 7F	PATCH NAME	16 ASCII Characters	
40 01 10	00 00 10	00 - 18	VOICE RESERVE	Part 0	00
40 01 11#				Part 1	00
40 01 12#				Part 2	02
40 01 13#				Part 3	00
40 01 14#				Part 4	08
40 01 15#				Part 5	02
40 01 16#				Part 6	02
40 01 17#				Part 7	02
40 01 18#				Part 8	00
40 01 19#				Part 9	00
40 01 1A#				Part 11	06
40 01 1B#				Part 12	00
40 01 1C#				Part 13	00
40 01 1D#				Part 14	00
40 01 1E#				Part 15	00
40 01 1F#				Part 16	02

The sum total of voices in the voice reserve function must be equal or less than the number of the maximum poliphony. (24)

40 01 30	00 00 01	00 - 07	REVERB MACRO	00: Room 1 01: Room 2 02: Room 3 03: Hall 1 04: Hall 2 05: Plate 06: Delay 07: Panning Delay	04
40 01 31	00 00 01	00 - 7F	REVERB CHARACTER		04
40 01 32	00 00 01	00 - 7F	REVERB PRE-LPF		00
40 01 33	00 00 01	00 - 7F	REVERB LEVEL		40
40 01 34	00 00 01	00 - 7F	REVERB TIME		40
40 01 35	00 00 01	00 - 7F	REVERB DELAY FEEDBACK		00
40 01 36	00 00 01	00 - 7F	REVERB SEND LEVEL TO CHORUS		00

REVERB MACRO is a parameter used to select the preset type of the effect. When set to another REVERB MACRO, all other reverb parameters will reset to the values set for each type of REVERB MACRO.

40 01 38	00 00 01	00 - 07	CHORUS MACRO	00: Chorus 1 01: Chorus 2 02: Chorus 3 03: Chorus 4 04: Feedback Chorus 05: Flanger 06: Short Delay 07: Short Delay(FB)	02
40 01 39	00 00 01	00 - 7F	CHORUS PRE-LPF		00
40 01 3A	00 00 01	00 - 7F	CHORUS LEVEL		40
40 01 3B	00 00 01	00 - 7F	CHORUS FEEDBACK		08
40 01 3C	00 00 01	00 - 7F	CHORUS DELAY		50
40 01 3D	00 00 01	00 - 7F	CHORUS RATE		03
40 01 3E	00 00 01	00 - 7F	CHORUS DEPTH		13
40 01 3F	00 00 01	00 - 7F	CHORUS SEND LEVEL TO REVERB		00

CHORUS MACRO is a parameter used to select the preset type of effect. When set to another CHORUS MACRO, then all other chorus parameters will reset to the values set for each type of CHORUS MACRO.

40 1x 00	00 00 02	00 - 7F	TONE NUMBER	CC#00 VALUE	see table 3
40 1x 01#		00 - 7F		P.C. VALUE	see table 3
40 1x 02	00 00 01	00 - 10	Rx. CHANNEL	1 - 16,OFF	see table 1
40 1x 03	00 00 01	00 - 01	Rx. PITCH BEND	OFF / ON	01
40 1x 04	00 00 01	00 - 01	Rx. Caf	OFF / ON	01
40 1x 05	00 00 01	00 - 01	Rx. PROGRAM CHANGE	OFF / ON	01
40 1x 06	00 00 01	00 - 01	Rx. Control Change	OFF / ON	01
40 1x 07	00 00 01	00 - 01	Rx. Paf	OFF / ON	01
40 1x 08	00 00 01	00 - 01	Rx. Note messages	OFF / ON	01
40 1x 09	00 00 01	00 - 01	Rx. RPN	OFF / ON	01
40 1x 0A	00 00 01	00 - 01	Rx. NRPN	OFF / ON	00(01*)

* Rx. NRPN is set to ON by "GS RESET".

40 1x 0B	00 00 01	00 - 01	Rx. MODULATION	OFF / ON	01
40 1x 0C	00 00 01	00 - 01	Rx. VOLUME	OFF / ON	01
40 1x 0D	00 00 01	00 - 01	Rx. PANPOT	OFF / ON	01
40 1x 0E	00 00 01	00 - 01	Rx. EXPRESSION	OFF / ON	01
40 1x 0F	00 00 01	00 - 01	Rx. HOLD1	OFF / ON	01
40 1x 10	00 00 01	00 - 01	Rx. PORTAMENTO	OFF / ON	01
40 1x 11	00 00 01	00 - 01	Rx. SOSTENUTO	OFF / ON	01
40 1x 12	00 00 01	00 - 01	Rx. SOFT	OFF / ON	01
40 1x 13	00 00 01	00 - 01	MONO/POLY MODE	Mono / Poly (=Bn 7E 01 / Bn 7F 00)	01
40 1x 14	00 00 01	00 - 01	ASSIGN MODE	0 = single 1 = limited-multi 2 = full multi	see table 2

ASSIGN MODE is a parameter used to select the voice assign mode "multiple NOTE-ON" occur (the same note- number on the same channel at the same time).

Part	#	Part Name	Assign Mode
Part	1	Rx only 1	SINGLE
Part	2	Acc Bass	SINGLE
Part	3	Rx only 2	SINGLE
Part	4	Upper 1	LIMITED MULTI
Part	5	Acc 1	SINGLE
Part	6	Acc 2	SINGLE
Part	7	Acc 3	SINGLE
Part	8	Man Bass	SINGLE
Part	9	Rx only 3	SINGLE
Part	10	Acc Drums	SINGLE
Part	11	Lower	LIMITED MULTI
Part	12	Rx only 4	SINGLE
Part	13	Upper 2	SINGLE
Part	16	Man Drums	SINGLE

40 1x 15	00 00 01	00 - 02	USE FOR RHYTHM PART	0 = OFF 00 at x<> 0 1 = MAP1 01 at x=0 2 = MAP2	

USE FOR RHYTHM PART is a parameter to be define the part to be used as an ordinary part (0), as a drum part using DRUM MAP1 (1), or a drum part using the DRUM MAP 2 (2). The default is MAP1(1) for Part 10 (MIDI Ch-10, x=0) , and all other parts are set to ordinary parts (OFF (0)).

40 1x 16	00 00 01	28 - 58	PITCH KEY SHIFT	-24 - +24 [semitone]	40
40 1x 17	00 00 02	08 - F8	PITCH OFFSET FINE	-12.0 - +12.0 [Hz]	08 00
40 1x 18#				Use nibblized data.	
40 1x 19	00 00 01	00 - 7F	PART LEVEL	0 - 127 (=Bn 07 vv)	64
40 1x 1A	00 00 01	00 - 7F	VELOCITY SENSE DEPTH	0 - 127	40
40 1x 1B	00 00 01	00 - 7F	VELOCITY SENSE OFFSET	0 - 127	40
40 1x 1C	00 00 01	00 - 7F	PART PANPOT	Random, -63(LEFT) - +63(RIGHT) (=Bn 0A vv, except random)	40
40 1x 1D	00 00 01	00 - 7F	KEY RANGE LOW	C1 - G-9	00
40 1x 1E	00 00 01	00 - 7F	KEY RANGE HIGH	C1 - G-9	7F
40 1x 1F	00 00 01	00 - 5F	CC1 CONTROLLER NUM	0 - 95	10
40 1x 20	00 00 01	00 - 5F	CC2 CONTROLLER NUM	0 - 95	11
40 1x 21	00 00 01	00 - 7F	CHORUS SEND LEVEL	0 - 127 (=Bn 5D vv)	00
40 1x 22	00 00 01	00 - 7F	REVERB SEND LEVEL	0 - 127 (=Bn 5B vv)	28
40 1x 23	00 00 01	00 - 01	Rx. Bank Select	OFF/ON	01

Rx. Bank Select is set to ON by power-on reset or by "GS RESET".

40 1x 30	00 00 01	0E - 72	TONE MODIFY 1 Vibrato rate	-50 - +50 (=Bn 63 01 62 08 06 vv)	40
40 1x 31	00 00 01	0E - 72	TONE MODIFY 2 Vibrato depth	-50 - +50 (=Bn 63 01 62 09 06 vv)	40
40 1x 32	00 00 01	0E - 72	TONE MODIFY 3 TVF cutoff freq.	-50 - +50 (=Bn 63 01 62 20 06 vv)	40
40 1x 33	00 00 01	0E - 72	TONE MODIFY 4 TVF resonance	-50 - +50 (=Bn 63 01 62 21 06 vv)	40
40 1x 34	00 00 01	0E - 72	TONE MODIFY 5 TVF&TVA Env.attack	-50 - +50 (=Bn 63 01 62 63 06 vv)	40
40 1x 35	00 00 01	0E - 72	TONE MODIFY 6 TVF&TVA Env.decay	-50 - +50 (=Bn 63 01 62 64 06 vv)	40
40 1x 36	00 00 01	0E - 72	TONE MODIFY 7 TVF&TVA Env.release	-50 - +50 (=Bn 63 01 62 66 06 vv)	40
40 1x 37	00 00 01	0E - 72	TONE MODIFY 8 Vibrato delay	-50 - +50 (=Bn 63 01 62 0A 06 vv)	40
40 1x 40	00 00 0C	00 - 7F	SCALE TUNING C	-64 - +63 [cent]	40
40 1x 41#		00 - 7F	SCALE TUNING C#	-64 - +63 [cent]	40
40 1x 42#		00 - 7F	SCALE TUNING D	-64 - +63 [cent]	40
40 1x 43#		00 - 7F	SCALE TUNING D#	-64 - +63 [cent]	40
40 1x 44#		00 - 7F	SCALE TUNING E	-64 - +63 [cent]	40
40 1x 45#		00 - 7F	SCALE TUNING F	-64 - +63 [cent]	40
40 1x 46#		00 - 7F	SCALE TUNING F#	-64 - +63 [cent]	40
40 1x 47#		00 - 7F	SCALE TUNING G	-64 - +63 [cent]	40
40 1x 48#		00 - 7F	SCALE TUNING G#	-64 - +63 [cent]	40
40 1x 49#		00 - 7F	SCALE TUNING A	-64 - +63 [cent]	40
40 1x 4A#		00 - 7F	SCALE TUNING A#	-64 - +63 [cent]	40
40 1x 4B#		00 - 7F	SCALE TUNING B	-64 - +63 [cent]	40
40 2x 00	00 00 01	28 - 58	MOD PITCH CONTROL	-24 - +24 [semitone]	40
40 2x 01	00 00 01	00 - 7F	MOD TVF CUTOFF CONTROL	-9600 - +9600 [cent]	40
40 2x 02	00 00 01	00 - 7F	MOD AMPLITUDE CONTROL	-100.0 - +100.0 [%]	40
40 2x 03	00 00 01	00 - 7F	MOD LFO1 RATE CONTROL	-10.0 - +10.0 [Hz]	40
40 2x 04	00 00 01	00 - 7F	MOD LFO1 PITCH DEPTH	0 - 600 [cent]	0A
40 2x 05	00 00 01	00 - 7F	MOD LFO1 TVF DEPTH	0 - 2400 [cent]	00
40 2x 06	00 00 01	00 - 7F	MOD LFO1 TVA DEPTH	0 - 100.0 [%]	00
40 2x 07	00 00 01	00 - 7F	MOD LFO2 RATE CONTROL	-10.0 - +10.0 [Hz]	40
40 2x 08	00 00 01	00 - 7F	MOD LFO2 PITCH DEPTH	0 - 600 [cent]	00
40 2x 09	00 00 01	00 - 7F	MOD LFO2 TVF DEPTH	0 - 2400 [cent]	00
40 2x 0A	00 00 01	00 - 7F	MOD LFO2 TVA DEPTH	0 - 100.0 [%]	00
40 2x 10	00 00 01	40 - 58	BEND PITCH CONTROL	0 - 24 [semitone]	42
40 2x 11	00 00 01	00 - 7F	BEND TVF CUTOFF CONTROL	-9600 - +9600 [cent]	40
40 2x 12	00 00 01	00 - 7F	BEND AMPLITUDE CONTROL	-100.0 - +100.0 [%]	40
40 2x 13	00 00 01	00 - 7F	BEND LFO1 RATE CONTROL	-10.0 - +10.0 [Hz]	40
40 2x 14	00 00 01	00 - 7F	BEND LFO1 PITCH DEPTH	0 - 600 [cent]	00
40 2x 15	00 00 01	00 - 7F	BEND LFO1 TVF DEPTH	0 - 2400 [cent]	00
40 2x 16	00 00 01	00 - 7F	BEND LFO1 TVA DEPTH	0 - 100.0 [%]	00
40 2x 17	00 00 01	00 - 7F	BEND LFO2 RATE CONTROL	-10.0 - +10.0 [Hz]	40
40 2x 18	00 00 01	00 - 7F	BEND LFO2 PITCH DEPTH	0 - 600 [cent]	00
40 2x 19	00 00 01	00 - 7F	BEND LFO2 TVF DEPTH	0 - 2400 [cent]	00
40 2x 1A	00 00 01	00 - 7F	BEND LFO2 TVA DEPTH	0 - 100.0 [%]	00
40 2x 20	00 00 01	28 - 58	CAf PITCH CONTROL	-24 - +24 [semitone]	40
40 2x 21	00 00 01	00 - 7F	CAf TVF CUTOFF CONTROL	-9600 - +9600 [cent]	40
40 2x 22	00 00 01	00 - 7F	CAf AMPLITUDE CONTROL	-100.0 - +100.0 [%]	40
40 2x 23	00 00 01	00 - 7F	CAf LFO1 RATE CONTROL	-10.0 - +10.0 [Hz]	40
40 2x 24	00 00 01	00 - 7F	CAf LFO1 PITCH DEPTH	0 - 600 [cent]	00
40 2x 25	00 00 01	00 - 7F	CAf LFO1 TVF DEPTH	0 - 2400 [cent]	00
40 2x 26	00 00 01	00 - 7F	CAf LFO1 TVA DEPTH	0 - 100.0 [%]	00
40 2x 27	00 00 01	00 - 7F	CAf LFO2 RATE CONTROL	-10.0 - +10.0 [Hz]	40
40 2x 28	00 00 01	00 - 7F	CAf LFO2 PITCH DEPTH	0 - 600 [cent]	00
40 2x 29	00 00 01	00 - 7F	CAf LFO2 TVF DEPTH	0 - 2400 [cent]	00
40 2x 2A	00 00 01	00 - 7F	CAf LFO2 TVA DEPTH	0 - 100.0 [%]	00
40 2x 30	00 00 01	28 - 58	PAf PITCH CONTROL	-24 - +24 [semitone]	40
40 2x 31	00 00 01	00 - 7F	PAf TVF CUTOFF CONTROL	-9600 - +9600 [cent]	40
40 2x 32	00 00 01	00 - 7F	PAf AMPLITUDE CONTROL	-100.0 - +100.0 [%]	40
40 2x 33	00 00 01	00 - 7F	PAf LFO1 RATE CONTROL	-10.0 - +10.0 [Hz]	40
40 2x 34	00 00 01	00 - 7F	PAf LFO1 PITCH DEPTH	0 - 600 [cent]	00
40 2x 35	00 00 01	00 - 7F	PAf LFO1 TVF DEPTH	0 - 2400 [cent]	00

40 2x 36	00 00 01	00 - 7F	PAf LFO1 TVA DEPTH	0 - 100.0 [%]	00
40 2x 37	00 00 01	00 - 7F	PAf LFO2 RATE CONTROL	-10.0 - +10.0 [Hz]	40
40 2x 38	00 00 01	00 - 7F	PAf LFO2 PITCH DEPTH	0 - 600 [cent]	00
40 2x 39	00 00 01	00 - 7F	PAf LFO2 TVF DEPTH	0 - 2400 [cent]	00
40 2x 3A	00 00 01	00 - 7F	PAf LFO2 TVA DEPTH	0 - 100.0 [%]	00
40 2x 40	00 00 01	28 - 58	CC1 PITCH CONTROL	-24 - +24 [semitone]	40
40 2x 41	00 00 01	00 - 7F	CC1 TVF CUTOFF CONTROL	-9600 - +9600 [cent]	40
40 2x 42	00 00 01	00 - 7F	CC1 AMPLITUDE CONTROL	-100.0 - +100.0 [%]	40
40 2x 43	00 00 01	00 - 7F	CC1 LFO1 RATE CONTROL	-10.0 - +10.0 [Hz]	40
40 2x 44	00 00 01	00 - 7F	CC1 LFO1 PITCH DEPTH	0 - 600 [cent]	00
40 2x 45	00 00 01	00 - 7F	CC1 LFO1 TVF DEPTH	0 - 2400 [cent]	00
40 2x 46	00 00 01	00 - 7F	CC1 LFO1 TVA DEPTH	0 - 100.0 [%]	00
40 2x 47	00 00 01	00 - 7F	CC1 LFO2 RATE CONTROL	-10.0 - +10.0 [Hz]	40
40 2x 48	00 00 01	00 - 7F	CC1 LFO2 PITCH DEPTH	0 - 600 [cent]	00
40 2x 49	00 00 01	00 - 7F	CC1 LFO2 TVF DEPTH	0 - 2400 [cent]	00
40 2x 4A	00 00 01	00 - 7F	CC1 LFO2 TVA DEPTH	0 - 100.0 [%]	00
40 2x 50	00 00 01	28 - 58	CC2 PITCH CONTROL	-24 - +24 [semitone]	40
40 2x 51	00 00 01	00 - 7F	CC2 TVF CUTOFF CONTROL	-9600 - +9600 [cent]	40
40 2x 52	00 00 01	00 - 7F	CC2 AMPLITUDE CONTROL	-100.0 - +100.0 [%]	40
40 2x 53	00 00 01	00 - 7F	CC2 LFO1 RATE CONTROL	-10.0 - +10.0 [Hz]	40
40 2x 54	00 00 01	00 - 7F	CC2 LFO1 PITCH DEPTH	0 - 600 [cent]	00
40 2x 55	00 00 01	00 - 7F	CC2 LFO1 TVF DEPTH	0 - 2400 [cent]	00
40 2x 56	00 00 01	00 - 7F	CC2 LFO1 TVA DEPTH	0 - 100.0 [%]	00
40 2x 57	00 00 01	00 - 7F	CC2 LFO2 RATE CONTROL	-10.0 - +10.0 [Hz]	40
40 2x 58	00 00 01	00 - 7F	CC2 LFO2 PITCH DEPTH	0 - 600 [cent]	00
40 2x 59	00 00 01	00 - 7F	CC2 LFO2 TVF DEPTH	0 - 2400 [cent]	00
40 2x 5A	00 00 01	00 - 7F	CC2 LFO2 TVA DEPTH	0 - 100.0 [%]	00

DRUM SETUP PARAMETERS

*m:Map number (0 = MAP1, 1 = MAP2)
*rr:drum part note number (00H - 7FH)

Address(H)	*SIZE(H)*	*Data(H)*	*Parameter*	*Description*
41 m0 00 : # 41 m0 0B#	00 00 0C	20 - 7F	DRUM MAP NAME	ASCII Character
41 m1 rr	00 00 01	00 - 7F	PLAY NOTE NUMBER	Pitch coarse
41 m2 rr	00 00 01	00 - 7F	LEVEL	TVA level (=Bn 63 1A 62 rr 06 vv)
41 m3 rr	00 00 01	00 - 7F	ASSIGN GROUP NUMBER	Non, 1 - 127
41 m4 rr	00 00 01	00 - 7F	PANPOT	Random, -63(LEFT) - +63(RIGHT) (=Bn 63 1C 62 rr 06 vv)
41 m5 rr	00 00 01	00 - 7F	REVERB SEND LEVEL	0.0 - 1.0 Multiplicand of the part reverb depth (=Bn 63 1D 62 rr 06 vv)
41 m6 rr	00 00 01	00 - 7F	CHORUS SEND LEVEL	0.0 - 1.0 Multiplicand of the part chorus depth (=Bn 63 1E 62 rr 06 vv)
41 m7 rr	00 00 01	00 - 01	Rx. NOTE OFF	OFF / ON
41 m8 rr	00 00 01	00 - 01	Rx. NOTE ON	OFF / ON

When you change Drum Sets, all values of the DRUM SETUP PARAMETERS will be initialized.

Bulk Dump

You can send or request bulk data which contains a large amount of parameter data by using Bulk Dump communication.
It is used for storing bulk data in a sequencer or a computer. To send or request bulk data, use the Address and Size indicated in the following map.
You cannot use any address having "#" for the top address in a System Exclusive message except the following case.
Messages which include large data (more than 128 bytes) are sent out in separate packets, then, the top address of the following messages may be the address marked "#".
To send several packets of large DT1 messages at a time, insert intervals of at least 40ms in between those packets.

All Parameters (System Parameters and all Patch Parameters)

Address(H)	*SIZE(H)*	*Description*	*Number of packets*
48 00 00 : # 48 1D 0F#	00 1D 10	ALL	30 packets

System Parameters

Address(H)	*SIZE(H)*	*Description*	*Number of packets*
48 00 00 : # 48 00 0F#	00 00 10	SYSTEM PARAMETERS	1 packet

Patch Parameters

Address(H)	*SIZE(H)*	*Description*	*Number of packets*
48 00 10 : # 48 01 0F#	00 01 00	PATCH COMMON	1 packet
48 01 10 : # 48 02 6F#	00 01 60	BLOCK 0	2 packets
48 02 70 : # 48 04 4F#	00 01 60	BLOCK 1	2 packets
48 04 50 : # 48 06 2F#	00 01 60	BLOCK 2	2 packets
48 06 30 : # 48 08 0F#	00 01 60	BLOCK 3	2 packets
48 08 10 : # 48 09 6F#	00 01 60	BLOCK 4	2 packets
48 09 70 : # 48 0B 4F#	00 01 60	BLOCK 5	2 packets
48 0B 50 : # 48 0D 2F#	00 01 60	BLOCK 6	2 packets
48 0D 30 : # 48 0F 0F#	00 01 60	BLOCK 7	2 packets
48 0F 10 : # 48 10 6F#	00 01 60	BLOCK 8	2 packets
48 10 70 : # 48 12 4F#	00 01 60	BLOCK 9	2 packets
48 12 50 : # 48 14 2F#	00 01 60	BLOCK A	2 packets
48 14 30 : # 48 16 0F#	00 01 60	BLOCK B	2 packets
48 16 10 : # 48 17 6F#	00 01 60	BLOCK C	2 packets
48 17 70 : # 48 19 4F#	00 01 60	BLOCK D	2 packets
48 19 50 : # 48 1B 2F#	00 01 60	BLOCK E	2 packets
48 1B 30 : # 48 1D 0F#	00 01 60	BLOCK F	2 packets

DRUM SETUP PARAMETERS

*m: map number (0 = MAP1, 1 = MAP2)

Address(H)	*SIZE(H)*	*Description*	*Number of packets*
49 m0 00 : 49 m1 7F	00 02 00	PLAY NOTE NUMBER	2 packets
49 m2 00 : 49 m3 7F	00 02 00	LEVEL	2 packets
49 m4 00 : 49 m5 7F	00 02 00	ASSIGN GROUP NUMBER	2 packets
49 m6 00 : 49 m7 7F	00 02 00	PANPOT	2 packets

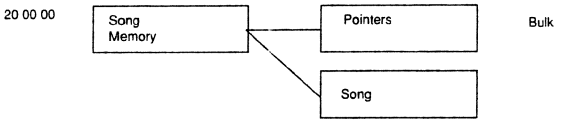
49 m8 00 : 49 m9 7F	00 02 00	REVERB SEND LEVEL	2 packets
49 mA 00 : 49 mB 7F	00 02 00	CHORUS SEND LEVEL	2 packets
49 mC 00 : 49 mD 7F	00 02 00	Rx. NOTE ON/OFF	2 packets
49 mE 00 : 49 mE 17	00 00 18	DRUM MAP NAME	1 packet

3.2 Parameter address map (Model ID=78H)

This map indicates address, size, Data (range), Parameter and Description of parameters which can be transferred using "Request data 1 (RQ1)" and "Data set 1 (DT1)".
All the numbers of address, size and Data are indicated in 7-bit Hexadecimal-form.

■ Address Block map

An outlined address map of the Exclusive Communication is shown below;



■ Song Memory (RQ1)

Address(H)	Size(H)	Description	Number of packets
20 00 00	00 30 00	Song Memory	54 packets Use nibblized data.

■ Song Memory (DT1)

Address(H)	Size(H)	Description	Number of packet
50 00 00	00 05 0C	Song Pointers	6 packets
20 00 00	00 30 00	Song Memory	48 packets Use nibblized data.

TONE PROGRAM CHANGE

A 'GM/GS' tone is selected by the message : BnH 00H mmH BnH 20H iiH CnH ppH

n=MIDI channel number : 0H-FH(0-15) 0=ch.1 15=ch.16

mmH	iiH	ppH	Sound Name	CC00	CC32	PC
* piano						
00H	00H	00H	Piano 1	00	00	01
08H	00H	00H	Piano 1w	08	00	01
10H	00H	00H	Piano 1d	16	00	01
*						
00H	00H	01H	Piano 2	00	00	02
08H	00H	01H	Piano 2w	08	00	02
*						
00H	00H	02H	Piano 3	00	00	03
08H	00H	02H	Piano 3w	08	00	03
*						
00H	00H	03H	Honky-tonk	00	00	04
08H	00H	03H	Honky-tonk w	08	00	04
*						
00H	00H	04H	E.Piano 1	00	00	05
08H	00H	04H	Detuned EP 1	08	00	05
10H	00H	04H	E.Piano 1 v	16	00	05
18H	00H	04H	60's E.Piano	24	00	05
*						
00H	00H	05H	E.Piano 2	00	00	06
08H	00H	05H	Detuned EP 2	08	00	06
10H	00H	05H	E.Piano 2v	16	00	06
*						
00H	00H	06H	Harpsichord	00	00	07
08H	00H	06H	Coupled Hps.	08	00	07
10H	00H	06H	Harpsi.w	16	00	07
18H	00H	06H	Harpsi.o	24	00	07
*						
00H	00H	07H	Clav.	00	00	08
*						
* chromatic percussion						
00H	00H	08H	Celesta	00	00	09
*						
00H	00H	09H	Glockenspiel	00	00	10
*						
00H	00H	0AH	Music Box	00	00	11
*						
00H	00H	0BH	Vibraphone	00	00	12
08H	00H	0BH	Vib.w	08	00	12
*						
00H	00H	0CH	Marimba	00	00	13
08H	00H	0CH	Marimba w	08	00	13
*						
00H	00H	0DH	Xylophone	00	00	14
*						
00H	00H	0EH	Tubular-bell	00	00	15
08H	00H	0EH	Church Bell	08	00	15
09H	00H	0EH	Carillon	09	00	15
*						
00H	00H	0FH	Santur	00	00	16
*						
* organ						
00H	00H	10H	Organ 1	00	00	17
08H	00H	10H	Detuned Or.1	08	00	17
10H	00H	10H	60's Organ 1	16	00	17
20H	00H	10H	Organ 4	32	00	17
*						
00H	00H	11H	Organ 2	00	00	18
08H	00H	11H	Detuned Or.2	08	00	18
20H	00H	11H	Organ 5	32	00	18
*						
00H	00H	12H	Organ 3	00	00	19
*						
00H	00H	13H	Church Org.1	00	00	20
08H	00H	13H	Church Org.2	08	00	20
10H	00H	13H	Church Org.3	16	00	20
*						
00H	00H	14H	Reed Organ	00	00	21
*						
00H	00H	15H	Accordion Fr	00	00	22
08H	00H	15H	Accordion It	08	00	22
*						
00H	00H	16H	Harmonica	00	00	23
*						
00H	00H	17H	Bandoneon	00	00	24
*						
* guitar						
00H	00H	18H	Nylon-str.Gt	00	00	25
08H	00H	18H	Ukulele	08	00	25
10H	00H	18H	Nylon Gt.o	16	00	25
20H	00H	18H	Nylon Gt.2	32	00	25
*						
00H	00H	19H	Steel-str.Gt	00	00	26
08H	00H	19H	12-str.Gt	08	00	26
10H	00H	19H	Mandolin	16	00	26
*						
00H	00H	1AH	Jazz Gt.	00	00	27
08H	00H	1AH	Hawaiian Gt.	08	00	27
*						
00H	00H	1BH	Clean Gt.	00	00	28
08H	00H	1BH	Chorus Gt.	08	00	28
*						
00H	00H	1CH	Muted Gt.	00	00	29
08H	00H	1CH	Funk Gt.	08	00	29
10H	00H	1CH	Funk Gt.2	16	00	29
*						
00H	00H	1DH	Overdrive Gt.	00	00	30
*						
00H	00H	1EH	DistortionGt.	00	00	31
08H	00H	1EH	Feedback Gt.	08	00	31
*						
00H	00H	1FH	Gt.Harmonics	00	00	32
08H	00H	1FH	Gt. Feedback	08	00	32
*						
* bass						
00H	00H	20H	Acoustic Bs.	00	00	33
*						
00H	00H	21H	Fingered Bs.	00	00	34
*						

00H	00H	22H	Picked Bs.	00	00	35
*						
00H	00H	23H	Fretless Bs.	00	00	36
*						
00H	00H	24H	Slap Bass 1	00	00	37
*						
00H	00H	25H	Slap Bass 2	00	00	38
*						
00H	00H	26H	Synth Bass 1	00	00	39
01H	00H	26H	SynthBass101	01	00	39
08H	00H	26H	Synth Bass 3	08	00	39
*						
00H	00H	27H	Synth Bass 2	00	00	40
08H	00H	27H	Synth Bass 4	08	00	40
10H	00H	27H	Rubber Bass	16	00	40
*						
* strings & orchestral instruments						
00H	00H	28H	Violin	00	00	41
08H	00H	28H	Slow Violin	08	00	41
*						
00H	00H	29H	Viola	00	00	42
*						
00H	00H	2AH	Cello	00	00	43
*						
00H	00H	2BH	Contrabass	00	00	44
*						
00H	00H	2CH	Tremolo Str	00	00	45
*						
00H	00H	2DH	PizzicatoStr	00	00	46
*						
00H	00H	2EH	Harp	00	00	47
*						
00H	00H	2FH	Timpani	00	00	48
*						
* ensemble						
00H	00H	30H	Strings	00	00	49
08H	00H	30H	Orchestra	08	00	49
*						
00H	00H	31H	Slow Strings	00	00	50
*						
00H	00H	32H	Syn.Strings1	00	00	51
08H	00H	32H	Syn.Strings3	08	00	51
*						
00H	00H	33H	Syn.Strings2	00	00	52
*						
00H	00H	34H	Choir Aahs	00	00	53
20H	00H	34H	Choir Aahs 2	32	00	53
*						
00H	00H	35H	Voice Oohs	00	00	54
*						
00H	00H	36H	SynVox	00	00	55
*						
00H	00H	37H	OrchestraHit	00	00	56
*						
* brass						
00H	00H	38H	Trumpet	00	00	57
*						
00H	00H	39H	Trombone	00	00	58
01H	00H	39H	Trombone 2	01	00	58
*						
00H	00H	3AH	Tuba	00	00	59
*						
00H	00H	3BH	MutedTrumpet	00	00	60
*						
00H	00H	3CH	French Horn	00	00	61
01H	00H	3CH	French Horn2	01	00	61
*						
00H	00H	3DH	Brass 1	00	00	62
08H	00H	3DH	Brass 2	08	00	62
*						
00H	00H	3EH	Synth Brass1	00	00	63
08H	00H	3EH	Synth Brass3	08	00	63
10H	00H	3EH	AnalogBrass1	16	00	63
*						
00H	00H	3FH	Synth Brass2	00	00	64
08H	00H	3FH	Synth Brass4	08	00	64
10H	00H	3FH	AnalogBrass2	16	00	64
*						
* reed						
00H	00H	40H	Soprano Sax	00	00	65
*						
00H	00H	41H	Alto Sax	00	00	66
*						
00H	00H	42H	Tenor Sax	00	00	67
*						
00H	00H	43H	Baritone Sax	00	00	68
*						
00H	00H	44H	Oboe	00	00	69
*						
00H	00H	45H	English Horn	00	00	70
*						
00H	00H	46H	Bassoon	00	00	71
*						
00H	00H	47H	Clarinet	00	00	72
*						
* pipe						
0H	00H	48H	Piccolo	00	00	73
*						
00H	00H	49H	Flute	00	00	74
*						
00H	00H	4AH	Recorder	00	00	75
*						
00H	00H	4BH	Pan Flute	00	00	76
*						
00H	00H	4CH	Bottle Blow	00	00	77
*						
00H	00H	4DH	Shakuhachi	00	00	78
*						
00H	00H	4EH	Whistle	00	00	79
*						
00H	00H	4FH	Ocarina	00	00	80
*						
* synth lead						
00H	00H	50H	Square Wave	00	00	81
01H	00H	50H	Square	01	00	81
08H	00H	50H	Sine Wave	08	00	81
*						
00H	00H	51H	Saw Wave	00	00	82
01H	00H	51H	Saw	01	00	82
08H	00H	51H	Doctor Solo	08	00	82
*						
00H	00H	52H	Syn.Calliope	00	00	83
*						
00H	00H	53H	Chiffer Lead	00	00	84
*						
00H	00H	54H	Charang	00	00	85
*						
00H	00H	55H	Solo Vox	00	00	86
*						
00H	00H	56H	5th Saw Wave	00	00	87
*						
00H	00H	57H	Bass & Lead	00	00	88
*						
* synth pad						
00H	00H	58H	Fantasia	00	00	89
*						
00H	00H	59H	Warm Pad	00	00	90
*						
00H	00H	5AH	Polysynth	00	00	91
*						
00H	00H	5BH	Space Voice	00	00	92
*						
00H	00H	5CH	Bowed Glass	00	00	93
*						
00H	00H	5DH	Metal Pad	00	00	94
*						
00H	00H	5EH	Halo Pad	00	00	95
*						
00H	00H	5FH	Sweep Pad	00	00	96
*						
* synth sfx						
00H	00H	60H	Ice Rain	00	00	97
*						
00H	00H	61H	Soundtrack	00	00	98
*						
00H	00H	62H	Crystal	00	00	99
01H	00H	62H	Syn Mallet	01	00	99
*						
00H	00H	63H	Atmosphere	00	00	100
*						
00H	00H	64H	Brightness	00	00	101
*						
00H	00H	65H	Goblin	00	00	102
*						
00H	00H	66H	Echo Drops	00	00	103
01H	00H	66H	Echo Bell	01	00	103
02H	00H	66H	Echo Pan	02	00	103
*						
00H	00H	67H	Star Theme	00	00	104
*						

* ethnic misc						
00H	00H	68H	Sitar	00	00	105
01H	00H	68H	Sitar 2	01	00	105
*						
00H	00H	69H	Banjo	00	00	106
*						
00H	00H	6AH	Shamisen	00	00	107
*						
00H	00H	6BH	Koto	00	00	108
08H	00H	6BH	Taisho Koto	08	00	108
*						
00H	00H	6CH	Kalimba	00	00	109
*						
00H	00H	6DH	Bag Pipe	00	00	110
*						
00H	00H	6EH	Fiddle	00	00	111
*						
00H	00H	6FH	Shanai	00	00	112
*						
* percussive						
00H	00H	70H	Tinkle Bell	00	00	113
*						
00H	00H	71H	Agogo	00	00	114
*						
00H	00H	72H	Steel Drums	00	00	115
*						
00H	00H	73H	Woodblock	00	00	116
08H	00H	73H	Castanets	08	00	116
*						
00H	00H	74H	Taiko	00	00	117
08H	00H	74H	Concert BD	08	00	117
*						
00H	00H	75H	Melo. Tom 1	00	00	118
08H	00H	75H	Melo. Tom 2	08	00	118
*						
00H	00H	76H	Synth Drum	00	00	119
08H	00H	76H	808 Tom	08	00	119
09H	00H	76H	Elec Perc	09	00	119
*						
00H	00H	77H	Reverse Cym.	00	00	120
*						
* sfx						
00H	00H	78H	Gt.FretNoise	00	00	121
01H	00H	78H	Gt.Cut Noise	01	00	121
02H	00H	78H	String Slap	02	00	121
*						
00H	00H	79H	Breath Noise	00	00	122
01H	00H	79H	Fl.Key Click	01	00	122
*						
00H	00H	7AH	Seashore	00	00	123
01H	00H	7AH	Rain	01	00	123
02H	00H	7AH	Thunder	02	00	123
03H	00H	7AH	Wind	03	00	123
04H	00H	7AH	Stream	04	00	123
05H	00H	7AH	Bubble	05	00	123
*						
00H	00H	7BH	Bird	00	00	124
01H	00H	7BH	Dog	01	00	124
02H	00H	7BH	Horse-Gallop	02	00	124
03H	00H	7BH	Bird 2	03	00	124
*						
00H	00H	7CH	Telephone 1	00	00	125
01H	00H	7CH	Telephone 2	01	00	125
02H	00H	7CH	DoorCreaking	02	00	125
03H	00H	7CH	Door	03	00	125
04H	00H	7CH	Scratch	04	00	123
*						
00H	00H	7DH	Helicopter	00	00	126
01H	00H	7DH	Car-Engine	01	00	126
02H	00H	7DH	Car-Stop	02	00	126
03H	00H	7DH	Car-Pass	03	00	126
04H	00H	7DH	Car-Crash	04	00	126
05H	00H	7DH	Siren	05	00	126
06H	00H	7DH	Train	06	00	126
07H	00H	7DH	Jetplane	07	00	126
08H	00H	7DH	Starship	08	00	126
09H	00H	7DH	Burst Noise	09	00	126
*						
00H	00H	7EH	Applause	00	00	127
02H	00H	7EH	Screaming	02	00	127
03H	00H	7EH	Punch	03	00	127
04H	00H	7EH	Heart Beat	04	00	127
05H	00H	7EH	Footsteps	05	00	127
*						
00H	00H	7FH	Gun Shot	00	00	128
01H	00H	7FH	Machine Gun	01	00	128
02H	00H	7FH	Lasergun	02	00	128
03H	00H	7FH	Explosion	03	000	128
*						

■ Drum set program change

A Drum set is selected by the message :BnH 00H mmH BnH 20H iiH CnH ppHn=MIDI channel number :0H-FH(0-15) 0=ch.1 15=ch.16

mmH	iiH	ppH	Set name	CC00	CC32	PC
00H	00H	00H	Standard Set	00	00	01
00H	00H	08H	Room set	00	00	09
00H	00H	10H	Power set	00	00	17
00H	00H	18H	Elec set	00	00	25
00H	00H	19H	808 Set	00	00	26
00H	00H	20H	Jazz Set	00	00	33
00H	00H	28H	Brush Set	00	00	41
00H	00H	30H	Orch. Set	00	00	49
00H	00H	38H	Sfx	00	00	57

■ Style program change

A Style is selected by the message :BnH 00H mmH BnH 20H iiH CnH ppH
n=MIDI channel number : 0H-FH(0-15) 0=ch.1 15=ch.16

mmH	iiH	Description	CC00	CC32
01H	15H	11 ROCK	1	21
01H	16H	12 BALROCK	1	22
21H	06H	13 RAP	33	6
02H	17H	14 HOUSE	2	23
02H	18H	15 DANCE 1	2	24
02H	19H	16 DANCE 2	2	25
03H	0CH	17 FUNK	3	12
1CH	08H	18 CONTEMP	28	8
06H	17H	21 8 BEAT 1	6	23
06H	18H	22 8 BEAT 2	6	24
06H	19H	23 8 BEAT 3	6	25
06H	1AH	24 8 BEAT 4	6	26
07H	19H	25 16 BEAT 1	7	25
07H	1AH	26 16 BEAT 2	7	26
07H	1BH	27 16 BEAT 3	7	27
07H	1CH	28 16 BEAT 4	7	28
09H	05H	31 BOOGIE	9	5
0AH	11H	32 ROCK'N 1	10	17
0AH	08H	33 ROCK'N 2	10	8
05H	08H	34 SLROCK 1	5	8
05H	06H	35 SLROCK 2	5	6
0AH	12H	36 TWIST	10	18
04H	0FH	37 BALLAD 1	4	15
04H	04H	38 BALLAD 2	4	4
0DH	01H	41 SL SWING 1	13	1
0DH	02H	42 SL SWING 2	13	2
0CH	0AH	43 SWING	12	10
0DH	08H	44 BIGBAND	13	8
2CH	09H	45 R&B	44	9
0FH	03H	46 SHUFFLE	15	3
0BH	01H	47 DIXIE	11	1
0BH	02H	48 CHARLEST	11	2
16H	03H	51 BOSSA	22	3
16H	04H	52 LATIN	22	4
18H	02H	53 CHA CHA	24	2
3BH	02H	54 MERENGUE	59	2
27H	0BH	55 POPROCK	39	11
17H	02H	56 RHUMBA	23	2
27H	05H	57 BEGUINE	39	5
1AH	02H	58 TANGO	26	2
1BH	04H	61 SAMBA 1	27	4
1BH	08H	62 SAMBA 2	27	8
19H	04H	63 SALSA	25	4
26H	05H	64 MAMBO 1	38	5
26H	01H	65 MAMBO 2	38	1
08H	03H	66 REGGAE	8	3
1CH	09H	67 FUSION	28	9
15H	01H	68 BAROQUE	21	1
12H	02H	71 SL WALTZ	18	2
11H	06H	72 JZ WALTZ	17	6
11H	05H	73 WALTZ	17	5
14H	02H	74 MARCH	20	2
22H	03H	75 FOXTROT	34	3
13H	03H	76 POLKA	19	3
14H	08H	77 D MARSCH	20	8
27H	0AH	78 SCHLAGER	39	10

2CH	03H	81	BLUES	44	3
10H	02H	82	COUNTRY	16	2
3CH	00H	83	SEVILLA	60	0
3CH	01H	84	SP RHUMBA	60	1
11H	0EH	85	MUSETTE	17	14
11H	0FH	86	FR WALTZ	17	15
10H	06H	87	S COUNTRY	16	6
0AH	0FH	88	S BOOGIE	10	15

■ **Values of ppH**

ppH	Description		PC
00H	Original Basic		01
01H	Original Advanced		02
08H	Variation Basic		09
09H	Variation Advanced		10
40H	Intro Basic		65
41H	Intro Advanced		66
48H	Ending Basic		73
49H	Ending Advanced		74
58H	Fill in to Original Basic		89
59H	Fill in to Original Advanced		90
60H	Fill in to Variation Basic		97
61H	Fill in to Variation Advanced		98
70H	Break Mute		113
50H	Fill in to Variation	<	81
51H	Fill in to Original	<	82
52H	Intro	< E- series compatibility	83
53H	Ending	<	84
54H	Break Mute	<	85

4 Useful Information

Decimal and Hexadecimal
It is common to use 7-bit Hexadecimal numbers in MIDI communication. The following is a conversion table between decimal numbers and 7-bit Hexadecimal numbers.

Decimal	Hexa-decimal	Decimal	Hexa-decimal	Decimal	Hexa-decimal	Decimal	Hexa-decimal
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

*To indicate a decimal number for the MIDI channel, Bank number, and Program number, add one to the values in the table.
*The resolution of 7-bit Hexadecimal numbers is 128. Use several bytes for values which require more resolution.
i.e. The number "ad bbH" in 7-bit Hexadecimal is "ad x 128 + bb" in Decimal form.
*A signed number (with a sign +/-) is indicated as 00H = -64, 40H = 0, 7FH = +63.
So the signed number "aaH" in 7-bit Hexadecimal is "ad - 64" (ad is the decimal number of aaH).
In case of two bytes, it is regarded as 00 00H = -8192, 40 00H = 0, 7F 7FH = +8191.
So the signed number "ad bbH" in 7-bit Hexadecimal is "ad bbH - 40 00H = ad x 128 + bb - 64 x 128", where, ad and bb is
the decimal number of aaH and bbH respectively.
*The data indicated as "nibbled" is a 4-bit Hexadecimal number.
i.e. "0a 0bH" is "a x 16 + b".

<Example 1> Convert "5AH" in Hexadecimal to a Decimal number.
(By using the table)5AH = 90

<Example 2> Convert "12 34H" in 7-bit Hexadecimal to a Decimal number.
(By using the table) 12H = 18, 34H = 52
So,18 x 128 + 52 = 2356

<Example 3> Convert "0A 03 09 0D" in nibblized form to a Decimal number.
(By using the table)0AH = 10, 03H = 3, 09H = 9, 0DH = 13
So,((10 x 16 + 3) x 16 + 9) x 16 + 13 = 41885

Example of actual MIDI messages

<Example 1> 92 3E 5F
"9n" is a status of a Note On message, and "n" is a MIDI channel number.
The second byte is the Note number, and the third is Velocity.
2H = 2, 3EH = 62, 5FH = 95
So, this is a Note On message of MIDI channel=3, Note number=62(D4) and Velocity=95.

<Example 2> CE 49
"Cn" is a status of a Program change message, and "n" is a MIDI channel number.
The second byte is a Program number.
EH = 14, 49H = 73
So, this is a Program change message of MIDI channel=15, Program number= 74 (Flute in GS).

<Example 3> EA 00 28
"EnH" is a status of a Pitch bend change message, and "n" is a MIDI channel number.
The second byte (00H) is an LSB and the third (28H) is an MSB of a Pitch bend value (%signed).

The Pitch bend value is:
28 00H - 40 00H = 40 x 128 + 0 - (64 x 128 + 0) = 5120 - 8192 = -3072
So, this is a Pitch bend change message of MIDI channel=11, Pitch bend value = -3072

If the Pitch bend sensitivity is set to 2 semitones, and the Pitch bend value -8192 (00 00H) is defined as -200 cents,
The actual pitch bend value of this message is :
200 x (-3072) / (-8192) = -75 cent

<Example 4> B3 64 00 65 00 06 0C 26 00 64 7F 65 7F
"Bn" is a status of a Control change message, and "n" is a MIDI channel number.
The second byte is a Control number and the third is the value.
This packet uses the running status rule, that is, when you send a series of messages with the same status, you can omit the following status bytes.
This message contains :

B3	64 00	MIDI CH = 4	LSB	of RPN parameter number	: 00H
(B3)	65 00	MIDI CH = 4	MSB	of RPN parameter number	: 00H
(B3)	06 0C	MIDI CH = 4	MSB	of Data entry	: 0CH
(B3)	26 00	MIDI CH = 4	LSB	of Data entry	: 00H
(B3)	64 7F	MIDI CH = 4	LSB	of RPN parameter number	: 7FH
(B3)	65 7F	MIDI CH = 4	MSB	of RPN parameter number	: 7FH

This message string means 'send data "0C 00H" to RPN parameter number"00 00H", after that, set RPN parameter number to "7F 7F".

RPN parameter number "00 00H" is Pitch bend sensitivity and the unit of the MSB value is a semitone, so 0CH = 12 is a value to set the Pitch bend sensitivity = 12 semitones (one octave).
GS devices ignore the LSB value of Pitch bend sensitivity. However, you had better send both MSB and LSB(=00H) to maintain data compatibility.

Once an RPN or NRPN number is set, all the Data entry messages sent after are effective.
Sometimes this rule may cause a problem if the MIDI data is played by a recorder and it is operated in fast forward or backward mode. It is recommended, therefore, to set the RPN or NRPN number to 7F 7FH after sending the Data entry messages.

*To use running-status for several MIDI event like <example 4> in a song data (e.g. Standard MIDI File data) is not recommended.
There may be a recorder which can not handle such data correctly when it is operated in fast forward or backward. Putting the status byte for every event is the reliable way.
*The parameter number and the value of RPN or NRPN must be sent in correct order. As some recorders may send those recorded data in different order if an event is too close to another, it is recommended to place each event in a different tick. (1-CLK for TPQN=92, or 5-CLK for TPQN=480 is recommended).

The send order may be different as each recorder if the events are in the same clock in sequence data.

Checksum of Roland System Exclusive messages

Roland System Exclusive messages (RQ1 and DT1) have a Checksum at the end of the data (just before EOX) to be able to check for communication errors.
The Checksum is determined by values of address and data (or size) included in the message.

<How to calculate Checksums> ("H" indicates Hexadecimal.)

The error checking process employs a sum-ckeck error detection. It provides binary bit figures whose lower 7 bits are zero when values for an address, data (or size) and the Checksum are summed.

One practical equation to determine Checksum is:
If the address is "ad bb ccH" and the data(or the size) is "dd ee ffH"
ad + bb + cc + dd + ee + ff = sum
sum / 128 = quotient / remainder
128 - remainder = checksum

<Example 1> Set "REVERB MACRO" to "ROOM 3"

According to the Parameter Address Map, the Address of REVERB MACRO is 40 01 30H, and the Value correspond to ROOM 3 is 02H.
So, the message should be :

F0 41 10 42 12 40 01 30 02 ?? F7	(1)Exclusive Status(4)	Model ID (GS)
	(2)ID (Roland)	(5)Command ID (DT1)
(1)(2)(3)(4)(5) address data checksum (6)	(3)Device ID (16)	(6)End of Exclusive

The Checksum is:
40H + 01H + 30H + 02H = 64 + 1 + 48 + 2 = 115(sum)
115(sum) / 128 = 0(quotient) 115(remainder)
checksum = 128 - 115(remainder) = 13 = 0DH

Therefore, the message to send is : F0 41 10 42 12 40 01 30 02 0D F7

<Example 2> To request LEVEL of NOTE NUMBER 75(D#5; Claves) in DRUM MAP 1

NOTE NUMBER 75(D#5) is 4BH in Hexadecimal.
The Address of "LEVEL of NOTE NUMBER 75(D#5; Claves) in DRUM MAP 1" is 41 02 4BH, and the size is 00 00 01H. So, the message should be :

F0 41 10 42 11 41 02 4B 00 00 01 ?? F7	(1)Exclusive Status	(4)Model ID (GS)
	(2)ID (Roland)	(5)Command ID (RQ1)
(1)(2)(3)(4)(5) address size checksum (6)	(3)Device ID (16)	(6)End of Exclusive

The Checksum is :
41H + 02H + 4BH + 00H + 00H + 01H = 65 + 2 + 75 + 0 + 0 + 1 = 143(sum)
143(sum) / 128 = 1(quotient) 15(remainder)
checksum = 128 - 15(remainder) = 113 = 71H

Therefore, the message to send is : F0 41 10 42 11 41 02 4B 00 00 01 71 F7

<Example 3> Set "MASTER TUNE" to +23.4 cents by System Exclusive
The Address of "MASTER TUNE" is 40 00 00H, and the Size is 00 00 04H.
The Value should be nibblized data whose resolution is 0.1 cents, and which is a signed value
(00 04 00 00H (= 1024) = %0).
+23.4[cents] = 234 + 1024 = 1258 =(hexadecimal)=> 04 EAH =(nibblized)=> 00 04 0E 0AH
So, the message should be :

F0 41 10 42 12 41 00 00 00 04 0E 0A ?? F7	(1)Exclusive Status	(4)Model ID (GS)
	(2)ID (Roland)	(5)Command ID (DT1)
(1)(2)(3)(4)(5) address data checksum (6)	(3)Device ID (16)	(6)End of Exclusive

The Checksum is :
41H + 00H + 00H + 00H + 04H + 0EH + 0AH = 65 + 0 + 0 + 0 + 4 + 14 + 10 = 93(sum)
93(sum) / 128 = 0(quotient) 93(remainder)
checksum = 128 - 93(remainder) = 35 = 23H

Therefore, the message to send is : F0 41 10 42 12 41 00 00 00 04 0E 0A 23 F7

MIDI IMPLEMENTATION CHART

[INTELLIGENT KEYBOARD] (Arranger Section)
Model E-28

Date: June 1996
Version: 1.0

FUNCTION		TRANSMITTED	RECOGNIZED	REMARKS
Basic	Default	2-4-5-6-7-8-10-11-13-16	1-2-3-4-5-6-7-8-9-10-11-12-13-14-16	1 = Rx 1 2 = Acc Bass 3 = Rx 2 4 = Upper1 5 = Acc 1 6 = Acc 2 7 = Acc 3 8 = Manual Bass 9 = Rx3 10 = Acc Drums/Stl PC 11 = Lower 12 = Rx 4 13 = Upper 2 14 = Note to Arranger 16 = Man Drum
Channel	Changed	X	1-16, OFF	
Mode	Default Messages Altered	Mode 3 Mode 3, 4 (M=1) **********	Mode 3 Mode 3, 4 (M=1) *2	
Note Number:	True voice	0-127 **********	0-127 *1 0-127	
Velocity	Note ON Note OFF	O X	O *1 X	
After Touch	Key's Ch's	X X	O *1 O *1	
Pitch Bender		O	O *1	
Control Change	0,32 1 5 6,38 7 10 11 64 65 66 67 84 91 93 98,99 100,101 120 121	O O O X X O *3 O *3 O X X X O O O X X X X	O (MSB only) *1 O *1 O *1 O *1 O *1 O *1 O *1 O *1 O *1 O *1 O *1 O *1 O (Reverb) *1 O (Chorus) *1 O *1 O *1 O O	Bank select Modulation Portamento time Data entry Volume Panpot Expression Hold 1 Portamento Sostenuto Soft Portamento control Effect 1 depth Effect 3 depth NRPN LSB, MSB RPN LSB, MSB All sound off Reset all controllers
Program Change:		O **********	O *1 0-127	 Prog. 1-128
System Exclusive		O	O	
System Common	:Song Pos :Song Sel :Tune	X X X	X X X	
System Real Time	:Clock :Commands	O O	O O	
Aux Messages	:Local On/Off :All Notes Off :Active Sense :Reset	X X O X	X O (123-125) O X	
Notes		* 1 O or X is selectable * 2 Recognize as M=1 even if M%1 * 3 Transmitted if recorded into Recorder		

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

O: YES
X: NO

SOUND MODULE AND KEYBOARD SECTION, STANDARD MIDI FILE PLAYER

1 Receive data (Sound Module and Keyboard Section)

- Channel Voice Messages -

■ Note off

Status	Second	Third
8nH	kkH	vvH
9nH	kkH	00H

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
kk=Note number : 00H - 7FH (0 - 127)
vv=Velocity : 00H - 7FH (0 - 127)

*Ignored when "Midi Rx.channel = OFF".
*In the drum part, recognized when "Rx.Note off = ON" for each instrument.
*Velocity is ignored.

■ Note on

Status	Second	Third
9nH	kkH	vvH

n= MIDI channel number : 0H - FH (ch.1 - ch.16)
kk= Note number : 00H - 7FH (0 - 127)
vv= Velocity : 01H - 7FH (1 - 127)

*Ignored when "Rx.Note message = OFF".
*In the drum part, ignored when "Rx.Note on = OFF" for each instrument.

■ Polyphonic key pressure

Status	Second	Third
AnH	kkH	vvH

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
kk=Note number : 00H - 7FH (0 - 127)
vv=Value : 00H - 7FH (0 - 127)

*Ignored when "Rx.Polyphonic key pressure = OFF".
*Effect to the parameter set on "PAf controller function".
The default setting has no effect.

■ Control change

*Ignored all control change messages other than channel mode messages when "Rx.Control change = OFF".
*The values set by Control change messages won't reset by receiving new Program change messages.

Bank select

Status	Second	Third
BnH	00H	mmH
BnH	20H	llH

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
mm, ll=Bank number : 00H,00H - 7FH,7FH (bank1 - bank16384)
Default Value = 00 00H (bank.1)

*Ignored when "Rx.Bank Select = OFF".
"Rx.Bank Select" is set to ON by "GS RESET". (Power-on default value is ON.)
*The LSB 7-bits are ignored (always regards as llH=00H).
However, when sending Bank Select messages, you have to send both of the MSB(mm) and LSB(ll) together.
*"Bank select" is suspended until receiving "Program change".

To select a Tone of another bank, you have to send Bank select(mm,ll) before sending the Program change.
*The "Variation number" of GS Format is defined as the decimal expression of the MSB value (Control change number 00H) of the Bank select.

Modulation

Status	Second	Third
BnH	01H	vvH

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
vv=Modulation depth : 00H - 7FH (0 - 127)

*Ignored when "Rx.Modulation = OFF".
*Effect to the parameter set on "MOD controller function".
The default setting is pitch modulation depth.

Portamento time

Status	Second	Third
BnH	05H	vvH

n=MIDI channel number : 0H - FH (ch.1- ch.16)
vv=Portamento time : 00H - 7FH (0 - 127)
Default Value = 00H (0)

*The Portamento time value changes the rate of pitch change when Portamento is ON or when using portamento control messages.
Value 0 is the fastest.

Data entry

Status	Second	Third
BnH	06H	mmH
BnH	26H	llH

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
mm,ll=Value of the parameter specified with RPN and/or NRPN

Volume

Status	Second	Third
BnH	07H	vvH

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
vv=Volume : 00H - 7FH (0 - 127)

*Volume messages control the volume level of the specified channel (part).
Use Volume messages to control volume balance of each part.
*Ignored when "Rx.Volume = OFF".

Panpot

Status	Second	Third
BnH	0AH	vvH

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
vv=Panpot : 00H - 40H 7FH (Left - Center - Right)

*127 steps from Left to Center to Right.
*Within the Drum Part, the panpot provides overall control of a stereophonic image.
*Ignored when "Rx.Panpot = OFF".

Expression

Status	Second	Third
BnH	0BH	vvH

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
vv=Expression : 00H - 7FH (0 - 127)

*Expression and Volume messages are cumulative, and the result will control the overall volume.
Use Expression messages for expression pedal, or creating expressive effects, such as crescendo, decrescendo, while playing.
*Ignored when "Rx.Expression = OFF".

Hold1

Status	Second	Third
BnH	40H	vvH

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
vv=Control Value : 00H - 7FH (0 - 127) 0-63=OFF, 64-127=ON

*Ignored when "Rx.Hold1 = OFF".

Portamento

Status	Second	Third
BnH	41H	vvH

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
vv=Control Value : 00H - 7FH (0 - 127) 0-63=OFF, 64-127=ON

*Ignored when "Rx.Portamento = OFF".

Sostenuto

Status	Second	Third
BnH	42H	vvH

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
vv=Control Value : 00H - 7FH (0 - 127) 0-63=OFF, 64-127=ON

*Ignored when "Rx.Sostenuto = OFF".

Soft

Status	Second	Third
BnH	43H	vvH

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
vv=Control Value : 00H - 7FH (0 - 127)

*Ignored when "Rx.Soft = OFF".

Portamento Control

Status	Second	Third
BnH	54H	kkH

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
kk=source note number for pitch reference: 00H - 7FH (0 - 127)

*When a Note On message is received after a Portamento Control message, the voice's pitch will glide from the pitch specified by the source note number of the Portamento Control message at the rate set by the portamento time controller (regardless portamento on/off.)
If there is a currently sounding voice whose note number is coincident with the source note number, the voice's pitch will glide to the new Note On's pitch according to the portamento time without re-triggering (played in legato). Then no new voice should be assigned.

Example 1.

On MIDI	Description	Result
90 3C 40	Note on C4	C4 on
B0 54 3C	Portamento Control from C4	no change (C4 voice still sounding)
90 40 40	Note on E4	glide from C4 to E4
80 3C 40	Note off C4	no change
80 40 40	Note off E4	E4 off

Example 2.

On MIDI	Description	Result
B0 54 3C	Portamento Control from C4	no change
90 40 40	Note on E4	E4 is played with glide from C4 to E4
80 40 40	Note off E4	E4 off

Effect1 depth(Reverb send level)

Status	Second	Third
BnH	5BH	vvH

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
vv=Reverb send level : 00H - 7FH (0 - 127)

*Effect1 depth messages control the Send Level of the specified channel (part) to the internal Reverb unit.

Effect3 depth(Chorus send level)

Status	Second	Third
BnH	5DH	vvH

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
vv=Chorus send level : 00H - 7FH (0 - 127)

*Effect3 depth messages control the Send Level of the specified channel (part) to the internal Chorus unit.

NRPN MSB/LSB

Status	Second	Third
BnH	63H	mmH
BnH	62H	llH

n =MIDI channel number :0H - FH (ch.1 - ch.16)
mm =MSB of the NRPN
ll =LSB of the NRPN

*Recognized when "Rx.NRPN = ON". "Rx.NRPN" is set ON by "GS RESET".
*The values set by NRPN won't reset by receiving new Program Change messages or Reset All Controllers.

NRPN

An NRPN (Non Registered Parameter Number) is an expanded control change message.
Each function of an NRPN is described by the individual manufacturer.
To use NRPN, set NRPN number (MSB/LSB) before sending data. Then send data by Data entry message (Control Change # 6/38).
And then, it is recommended to send RPN null (RPN number = 7FH/7FH) to prevent the data from being unexpectedly change. For more explanation, refer to Chapter 4. Useful Information, Example of actual MIDI messages <EXAMPLE 4>.

You can change the following parameters by using NRPN.

NRPN MSB	NRPN LSB	Data entry MSB	Description
01H	08H	mmH	Vibrato rate relative change on specified channel mm: 0EH-40H-72H (-50 - 0 - +50)
01H	09H	mmH	Vibrato depth relative change on specified channel mm: 0EH-40H-72H (-50 - 0 - +50)
01H	0AH	mmH	Vibrato delay relative change on specified channel mm: 0EH-40H-72H (-50 - 0 - +50)
01H	20H	mmH	TVF cutoff frequency relative change on specified channel mm: 0EH-40H-72H (-50 - 0 - +50)
01H	21H	mmH	TVF resonance relative change on specified channel mm: 0EH-40H-72H (-50 - 0 - +50)
01H	63H	mmH	TVF&TVA Env. Attack time relative change on specified channel mm: 0EH-40H-72H (-50 - 0 - +50)

01H	64H	mmH	TVF&TVA Env. Decay time relative change on specified channel mm: 0EH-40H-72H (-50 - 0 - +50)
01H	66H	mmH	TVF&TVA Env. Release time relative change on specified channel mm: 0EH-40H-72H (-50 - 0 - +50)
18H	r r H	mmH	Pitch coarse of drum instrument relative change on specified drum instrument rr: key number of drum instrument mm: 00H-40H-7FH (-64 - 0 - +63 semitone)
1AH	r r H	mmH	TVA level of drum instrument absolute change on specified drum instrument rr: key number of drum instrument mm: 00H-7FH (zero - maximum)
1CH	r r H	mmH	Panpot of drum instrument absolute change on specified drum instrument rr: key number of drum instrument mm: 00H,01H-40H-7FH (Random, Left-Center-Right)
1DH	r r H	mmH	Reverb send level of drum instrument absolute change on specified drum instrument rr: key number of drum instrument mm: 00H-7FH (zero - maximum)
1EH	r r H	mmH	Chorus send level of drum instrument absolute change on specified drum instrument rr: key number of drum instrument mm: 00H-7FH (zero - maximum)

*Data entry LSB is ignored.
*The relative change means that the parameter value(e.g.-50 - 0 - +50) will be added to the preset value.
*The absolute change means that the parameter value will be replaced by the received value.

RPN MSB/LSB

Status	Second	Third
BnH	65H	mmH
BnH	64H	l l H

n =MIDI channel number :0H -FH (ch.1 - ch.16)
mm =MSB of the RPN
l l =MSB of the RPN

*Ignored when "Rx.RPN = OFF".
*The values set by an RPN won't be reset by receiving new Program Change messages or Reset All Controllers.

RPN
An RPN (Registered Parameter Number) is an expanded control change message.
Each function of an RPN is described by the MIDI Standard.
To use RPN, set RPN number (MSB/LSB) before sending data. Then send data by Data entry message(Control Change # 6/38). And then, it is recommended to send RPN null (RPN number = 7FH/7FH) to prevent the data from being unexpectedly change. For more explanation, refer to Chapter 4. Useful Information, Example of actual MIDI messages <EXAMPLE 4>.

You can change the following parameters by using RPN.

RPN MSB	RPN LSB	Data entry MSB	Data entry LSB	Description
00H	00H	mmH	----	Pitch bend sensitivity mm: 00H-18H (0 - 24 semitone) Default value=02H (two semitones) l l: ignored (value=00H) (Up to 2 octaves)
00H	01H	mmH	l l H	Master fine tuning mm, l l: 00 00H-40 00H-7F 7FH (-8192x100/8192 - 0 - +8191x100/8192 cents)
00H	02H	mmH	----	Master coarse tuning mm: 28H-40H-58H (-24 - 0 - +24 semitones) l l: ignored (value=00H)
7FH	7FH	----	----	RPN null Return to disable condition. The parameter already set retains its value. mm,l l: ignored.

■ **Program change**

Status	Second
CnH	ppH

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
pp=Program number : 00H - 7FH (prog.1 - prog.128)

*The Tone of the voices already ON before receiving a program change message isn't affected.
The Tone will be changed by a new Not-on message after the program change is received.
*Ignored when "Rx.Program change = OFF".
*In the drum part, Program change messages are ignored when the Bank is set at 129 - 16384 (ie. the value of the control change number 0 is not 00H).

■ **Channel pressure**

Status	Second
DnH	vvH

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
vv=Value : 00H - 7FH (0 - 127)

*Effect to the parameter set on "MOD controller function".
The default setting has no effect.
*Ignored when "Rx.Channel pressure = OFF".

■ **Pitch bend change**

Status	Second	Third
EnH	l l H	mmH

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
mm, l l=Value : 00 00H - 40 00H - 7F 7FH (-8192 - 0 - +8191)

*Effect to the parameter set on "MOD controller function".
The default setting is pitch bend.
*Ignored when "Rx.Pitch bend change = OFF"

Channel Mode Messages

■ **All sounds off**

Status	Second	Third
BnH	78H	00H

n=MIDI channel number : 0H - FH (ch.1 - ch.16)

*When "All sounds off" is received, all sounds on a specified channel turn off immediately.
However, the state of channel messages does not change. You must not use "All sound off" message for "Note off".

■ **Reset all controllers**

Status	Second	Third
BnH	79H	00H

n=MIDI channel number : 0H - FH (ch.1 - ch.16)

*When "reset all controllers" is received, the controller value of specified channel returns to the default at values as follows.

Controller	Default Value
Pitch bend change	0(Center)
Polyphonic key pressure	0(off)
Channel pressure	0(off)
Modulation	0(off)
Expression	127(maximum)
Hold1	0(off)
Portamento	0(off)
Sostenuto	0(off)
Soft	0(off)
RPN	disabled. The parameter already set retains its old value.
NRPN	disabled. The parameter already set retains its old value.

■ **All notes off**

Status	Second	Third
BnH	7BH	00H

n=MIDI channel number : 0H - FH (ch.1 - ch.16)

*When "All notes off" is received, all notes are turned off in the specified channel.
However, sound continues while hold1 and/or sostenuto is on.

■ **OMNI OFF**

Status	Second	Third
BnH	7CH	00H

n=MIDI channel number : 0H - FH (ch.1 - ch.16)

*OMNI OFF is only recognized as "all notes off". Mode doesn't change.

■ **OMNI ON**

Status	Second	Third
BnH	7DH	00H

n=MIDI channel number : 0H - FH (ch.1 - ch.16)

*OMNI ON is only recognized as "all notes off". Mode doesn't change (OMNI OFF remains).

■ **MONO**

Status	Second	Third
BnH	7EH	mmH

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
mm=number of mono : 00H - 10H (0 - 16)

**MONO is recognized as "all sounds off". The specified channel turns to Mode4 (M=1), even if mm is not equal to 1 (mm is ignored).

■ **POLY**

Status	Second	Third
BnH	7FH	00H

n=MIDI channel number : 0H - FH (ch.1 - ch.16)

*POLY is recognized as "all sounds off". The specified channel turns to Mode3.

System Real Time Message

■ **Active sensing**

Status
FEH

*Having received an "active sensing" message, GS expects to receive additional active sensing messages at 300ms intervals.
If the interval is greater than 420ms, GS executes "All sounds off", "All notes off" and "Reset all controllers" and returns to normal operation.
(Monitoring of active sensing messages will terminate.)

System Exclusive Message

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

F0H : System exclusive
ii=ID number : The ID number identifies the manufacturer of a MIDI device that triggers an exclusive message. Value 7EH and 7FH are reserved to use as universal messages which are used for extension of the MIDI Standard.
41H : Roland's Manufacturer-ID.
7EH : Universal Non-Realtime Message
7FH :Universal Realtime Message
dd,...,ee=data: 00H-7FH (0-127)
F7H: EOX (End of Exclusive/System common)

■ **System Exclusive Messages of Mode Change**

System Exclusive Messages of Mode Change are the messages used to initialize the internal parameters of the device to General MIDI mode or GS default mode .
"GS reset" and "Exit GS mode" use a form of Roland Exclusive Message. "Turn General MIDI System On" and "Turn General MIDI System Off" use a form of Universal Non-real Time Message.

■ **GS reset**

Status	Data Byte	Status
F0H	41H, 10H, 42H, 12H, 40H, 00H, 7FH, 00H, 41H	F7H

Byte	Description	
F0H	Exclusive status	
41H	ID number	(Roland)
10H	Device ID	(dev => 10H)
42H	Model ID	(GS)
12H	Command ID	(DT1)
40H	Address MSB	
00H	:	
7FH	Address LSB	
00H	Data	(GS reset)
41H	Checksum	
F7H	EOX	(End of exclusive)

*Upon receiving this message, all the internal parameters are set to the default settings of the GS Format. (Rx.NRPN SW will be turned ON by this message.)
*It takes about 100 ms to execute this message.

■ **Exit GS mode**

Status	Data Byte	Status
F0H	41H, 10H, 42H, 12H, 40H, 00H, 7FH, 7FH, 42H	F7H

Byte	Description	
F0H	Exclusive status	
41H	ID number	(Roland)
10H	Device ID	(dev => 10H)
42H	Model ID	(GS)
12H	Command ID	(DT1)
40H	Address MSB	
00H	:	
7FH	Address LSB	
7FH	Data	(Exit GS mode)
42H	Checksum	
F7H	EOX	(End of exclusive)

*Upon receiving this message, the unit changes from GS to e-28 default mode.
*It takes about 100 ms to execute this message.

■ **Turn General MIDI System On**

Status	Data Byte		Status
F0H	7EH, 7FH, 09H, 01H		F7H

Byte	Description	
F0H	Exclusive status	
7EH	ID number	(Universal non-real time message)
7FH	ID of target device	(Broadcast)
09H	sub-ID#1	(General MIDI message)
01H	sub-ID#2	(General MIDI On)
F7H	EOX	(End of exclusive)

*Upon receiving this message, all the internal parameters are set to the default settings of General MIDI System Level 1.
*It takes about 100 ms to execute this message.

■ **Turn General MIDI System Off**

Status	Data Byte		Status
F0H	7EH, 7FH, 09H, 02H		F7H

Byte	Description	
F0H	Exclusive status	
7EH	ID number	(Universal non-real time message)
7FH	ID of target device	(Broadcast)
09H	sub-ID#1	(General MIDI message)
02H	sub-ID#2	(General MIDI Off)
F7H	EOX	(End of exclusive)

*Upon receiving this message, the unit changes from General MIDI mode to e-28 default mode.
*It takes about 100 ms to execute this message.

■ **Data Transfer**

e-28 can transmit and receive the various parameters using System Exclusive messages of the following data format.

GS Common Exclusive messages use Model ID = 42H and Device ID = 17(10H).

e-28 have a unique Exclusive communication function which has it's own Model IDs in addition to the GS Common Exclusive messages.

■ **Request data 1 RQ1**

This message is sent out to request the remote device to send back the required data.
It contains data for the address and size that specify designation and length, respectively.
On receiving a proper RQ1 message for the device, the device will transmit a "Data set 1 (DT1)" message, which contains the
requested data. Otherwise, the device will not send anything.

Status	Data Byte	Status
F0H	41H, 10H, 42H, 11H, aaH, bbH, ccH, ssH, ttH, uuH, sum	F7H

Byte	Description	
F0H	Exclusive status	
41H	Manufacturer's ID	(Roland)
10H	Device ID	(dev => 10H)
42H	Model ID	(GS)
11H	Command ID	(RQ1)
aaH	Address MSB	
bbH	:	
ccH	Address LSB	
ssH	Size MSB	
ttH	:	
uuH	Size LSB	
sum	Checksum	
F7H	EOX	(End of exclusive)

*e-28 only recognize the RQ1 messages whose address and size match the Parameter Address Map (Section 3).
*The error checking process uses a Checksum. Refer to Section 4 to calculate a Checksum.

■ **Data set 1 DT1**

This message corresponds to the actual data transfer process.
On receiving a DT1 message, the device writes the data to internal memory according to the address.

Status	Data Byte	Status
F0H	41H, 10H, 42H, 12H, aaH, bbH, ccH, ddH, ... eeH, sum	F7H

Byte	Description	
F0H	Exclusive status	
41H	Manufacturer's ID	(Roland)
10H	Device ID	(dev => 10H)
42H	Model ID	(GS)
12H	Command ID	(DT1)
aaH	Address MSB	
bbH	:	
ccH	Address LSB	
ddH	Data	
:	:	
eeH	Data	
sum	Checksum	
F7H	EOX	(End of exclusive)

*e-28 only recognize the DT1 messages whose address and size match the Parameter Address Map (Section 3).
*To send large DT1 messages at a time, insert 40ms - intervals at least in between each packet.
*The error checking process uses a Checksum. Refer to Section 4 to calculate a Checksum.

2 Transmit Data (Sound Module & Keyboard Section)

- Channel Voice Message -

■ **Note off**

Status	Second	Third
9nH	kkH	00H

n=MIDI channel number :	0H - FH	(ch.1 - ch.16)
kk=Note number :	00H - 7FH	(0 - 127)
vv=Velocity :	00H	(0)

■ **Note on**

Status	Second	Third
9nH	kkH	vvH

n=MIDI channel number :	0H - FH	(ch.1 - ch.16)
kk=Note number :	00H - 7FH	(0 - 127)
vv=Velocity :	01H - 7FH	(1 - 127)

■ **Control change**

Bank select

Status	Second	Third
BnH	00H	mmH
BnH	20H	llH

n=MIDI channel number :	0H - FH	(ch.1 - ch.16)
mm, ll =Bank number :	00H,00H - 7FH,7FH	(bank1 - bank16384)

Modulation

Status	Second	Third
BnH	01H	vvH

n=MIDI channel number :	0H - FH	(ch.1 - ch.16)
vv=Modulation depth :	00H - 7FH	(0 - 127)

Hold1

Status	Second	Third
BnH	40H	vvH

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
vv=Control Value : 00H - 7FH (0 - 127) 0-63=OFF, 64-127=ON

■ Effect3 depth (Chorus send level)

Status	Second	Third
BnH	5DH	vvH

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
vv=Chorus send level: 00H - 7FH (0 - 127)

*Effect3 depth messages control the Send Level of the specified channel (part) to the internal Chorus unit.

■ Program change

Status	Second
CnH	ppH

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
pp=Program number : 00H - 7FH (prog.1 - prog.128)

■ Pitch bend change

Status	Second	Third
EnH	l l H	mmH

n=MIDI channel number : 0H - FH (ch.1 - ch.16)
mm, l l=Value : 00 00H - 40 00H - 7F 7FH (-8192 - 0 - +8191)

System Realtime Message

Active sensing

Status
FEH

*Transmits at about 300ms intervals.

System Exclusive Message

■ Data Transfer
e-28 transmits "Data set 1 (DT1)" message when receiving a proper "Request Data 1(RQ1)" message. Refer to section 1(System Exclusive Message)

■ Data set 1 DT1 (12H)

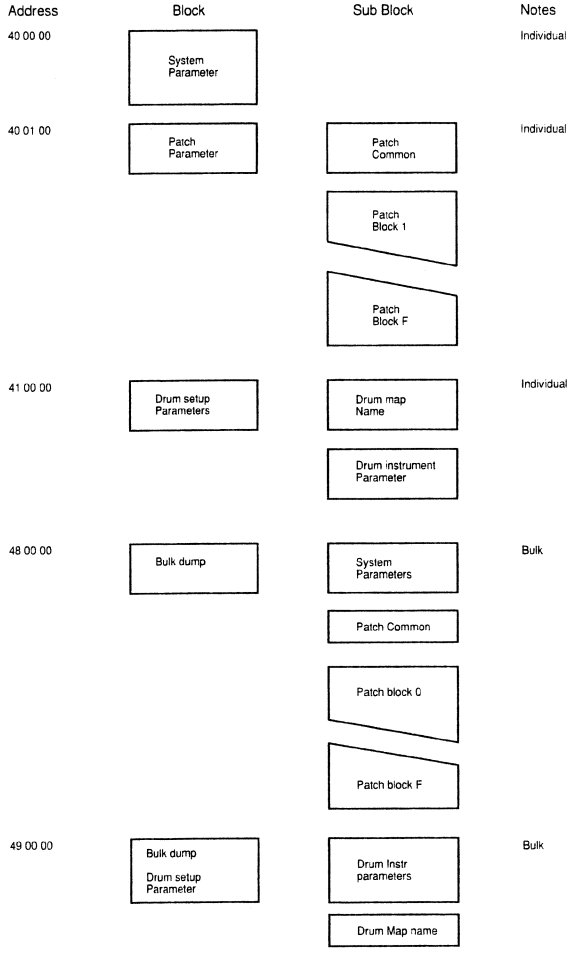
Status	Data Byte	Status
F0H	41H, 10H, 42H, 12H, aaH, bbH, ccH, ddH, ... eeH, sum	F7H

Byte	Description	
F0H	Exclusive status	
41H	Manufacturer's ID	(Roland)
10H	Device ID	(dev => 10H
42H	Model ID	(GS)
12H	Command ID	(DT1)
aaH	Address MSB	
bbH	Address	
ccH	Address LSB	
ddH	Data	
:	:	
eeH	Data	
sum	Checksum	
F7H	EOX	(End of exclusive)

*e-28 only send the DT1 messages whose address and size match the Parameter Address Map (Section 3).
*If the data to send is a large data (more than 128 bytes), then the data will be sent out in separate packets.
*Refer to Section 4 to calculate a Checksum.

3 Parameter address map (Model ID = 42H)

This map indicates address, size, Data (range), Parameter, Description, and Default Value of parameters which can be transferred using "Request data 1 (RQ1)" and "Data set 1 (DT1)".
All the numbers of address, size, Data, and Default Value are indicated in 7-bit Hexadecimal-form.



There are two types of GS Exclusive message. One is an individual parameter communication, the other is a bulk dump communication.

Individual parameter

You can use individual parameter communication to send or request an individual parameter value.
One packet of System Exclusive messages "F0 ..... F7" can only have one parameter (which may contain several bytes).
You cannot use any address having "#" for the top address in a System Exclusive message.

[SYSTEM PARAMETERS]

Address(H)	*SIZE(H)*	*Data(H)*	*Parameter*	*Description*	*Default value (H)*
40 00 00 40 00 01# 40 00 02# 40 00 03#	00 00 04	0018 - 07E8	MASTER TUNE	-100.0 - +100.0 [cent] Use nibblized data.	00 04 00 00
40 00 04	00 00 01	00 - 7F	MASTER VOLUME	0 - 127	7F
40 00 05	00 00 01	28-58	MASTER KEY SHIFT	- 24 - +24 semitones	40
40 00 06	00 00 01	01 - 7F	MASTER PAN		40
40 00 7F	00 00 01	00, 7F	MODE SET (Rx Only)	00 = GS Reset 127 = Exit GS	

Refer to "System Exclusive Messages of Mode Change" Page ...

[PATCH PARAMETERS]

e-28 has 16 parts. The parameters of each part are called PATCH PARAMETERS. To send or request a PATCH PARAMETER, use not the part number (which is usually same as the MIDI channel number) but the BLOCK NUMBER in the message.

*x...BLOCK NUMBER (0 - F),

Part 1 (default MIDIch = 1)	x=1
Part 2 (default MIDIch = 2)	x=2
:	:
Part 9 (default MIDIch = 9)	x=9
Part10 (default MIDIch =10)	x=0
Part11 (default MIDIch =11)	x=A
Part12 (default MIDIch =12)	x=B
:	:
Part16 (default MIDIch =16)	x=F

*n...MIDI channel number (0 - F) of the BLOCK.

Address(H)	*SIZE(H)*	*Data(H)*	*Parameter*	*Description*	*Default value (H)*
40 01 00 40 01 :# 40 01 0F#	00 00 10	20-7F	PATCH NAME	16 ASCII Characters	
40 01 10	00 00 10	00 - 18	VOICE RESERVE	PART 10 (Drum Part)	02
40 01 11#				PART 1	06
40 01 12#				PART 2	02
40 01 13#				PART 3	02
40 01 14#				PART 4	02
40 01 15#				PART 5	02
40 01 16#				PART 6	02
40 01 17#				PART 7	02
40 01 18#				PART 8	02
40 01 19#				PART 9	02
40 01 1A#				PART 11	00
40 01 :#				:	
40 01 1F#				PART 16	00

The sum total of voices in the voice reserve function must be equal or less than the number of the maximum polyphony. The number of the maximum polyphony of e-28 is 24.

40 01 30	00 00 01	00 - 07	REVERB MACRO	00:Room 1 01: Room 2 02: Room 3 03: Hall 1 04: Hall 2 05: Plate 06: Delay 07: Panning Delay	04
40 01 31	00 00 01	00 - 07	REVERB CHARACTER		04
40 01 32	00 00 01	00 - 07	REVERB PRE-LPF		00
40 01 33	00 00 01	00 - 7F	REVERB LEVEL		40
40 01 34	00 00 01	00 - 7F	REVERB TIME		40
40 01 35	00 00 01	00 - 7F	REVERB DELAY FEEDBACK		00
40 01 36	00 00 01	00 - 7F	REVERB SEND LEVEL TO CHORUS		00

REVERB MACRO is a parameter used to select the preset type of the effect. When set to another REVERB MACRO, all other reverb parameters will reset to the values set for each type of REVERB MACRO.

40 01 38	00 00 01	00 - 07	CHORUS MACRO	00: Chorus 1 01: Chorus 2 02: Chorus 3 03: Chorus 4 04: Feedback Chorus 05: Flanger 06. Short Delay 07. Short Delay(FB)	02
40 01 39	00 00 01	00 - 07	CHORUS PRE-LPF		00
40 01 3A	00 00 01	00 - 7F	CHORUS LEVEL		40
40 01 3B	00 00 01	00 - 7F	CHORUS FEEDBACK		08
40 01 3C	00 00 01	00 - 7F	CHORUS DELAY		50
40 01 3D	00 00 01	00 - 7F	CHORUS RATE		03
40 01 3E	00 00 01	00 - 7F	CHORUS DEPTH		13
40 01 3F	00 00 01	00 - 7F	CHORUS SEND LEVEL TO REVERB		00

CHORUS MACRO is a parameter used to select the preset type of effect. When set to another CHORUS MACRO, then all other chorus parameters will reset to the values set for each type of CHORUS MACRO.

40 1x 00	00 00 02	00 - 7F	TONE NUMBER	CC#00 VALUE	00
40 1x 01#		00 - 7F	P.C. VALUE		00
40 1x 02	00 00 01	00 - 10	Rx. CHANNEL	1 - 16,OFF	same as the Part#
40 1x 03	00 00 01	00 - 01	Rx. PITCH BEND	OFF / ON	01
40 1x 04	00 00 01	00 - 01	Rx. CH PRESSURE(CAf)	OFF / ON	01
40 1x 05	00 00 01	00 - 01	Rx. PROGRAM CHANGE	OFF / ON	01
40 1x 06	00 00 01	00 - 01	Rx. CONTROL CHANGE	OFF / ON	01
40 1x 07	00 00 01	00 - 01	Rx. POLY PRESSURE(PAf)	OFF / ON	01
40 1x 08	00 00 01	00 - 01	Rx. NOTE MESSAGE	OFF / ON	01
40 1x 09	00 00 01	00 - 01	Rx. RPN	OFF / ON	01
40 1x 0A	00 00 01	00 - 01	Rx. NRPN	OFF / ON	00(01*)

* Rx. NRPN is set to ON by "GS RESET" .

40 1x 0B	00 00 01	00 - 01	Rx. MODULATION	OFF / ON	01
40 1x 0C	00 00 01	00 - 01	Rx. VOLUME	OFF / ON	01
40 1x 0D	00 00 01	00 - 01	Rx. PANPOT	OFF / ON	01
40 1x 0E	00 00 01	00 - 01	Rx. EXPRESSION	OFF / ON	01
40 1x 0F	00 00 01	00 - 01	Rx. HOLD1	OFF / ON	01
40 1x 10	00 00 01	00 - 01	Rx. PORTAMENTO	OFF / ON	01
40 1x 11	00 00 01	00 - 01	Rx. SOSTENUTO	OFF / ON	01
40 1x 12	00 00 01	00 - 01	Rx. SOFT	OFF / ON	01
40 1x 13	00 00 01	00 - 01	MONO/POLY MODE	Mono / Poly (=Bn 7E 01 / Bn 7F 00)	01
40 1x 14	00 00 01	00 - 02	ASSIGN MODE	0 = SINGLE 1 =LIMITED-MULTI 2 = FULL-MULTI	00 at x=0 01 at x%0

ASSIGN MODE is a parameter used to select the voice assign manner when "multiple Note Ons" occur (the same note number on the same channel at the same time).
The best assign modes (SINGLE(0) for Drum part and LIMITED-MULTI(1) for the other parts) are selected automatically, so you don't need reset this parameter.

40 1x 15	00 00 01	00 - 02	USE FOR RHYTHM PART	0 = OFF 1 = MAP1 2 = MAP2	00 at x%0 01 at x=0

USE FOR RHYTHM PART is a parameter to define the part to be used as an ordinary part (0), as a drum part using DRUM MAP1(1),
or a drum part using DRUM MAP2(2). The default is MAP1(1) for Part10 (MIDI CH-10,x=0), and all other parts are set to ordinary parts(OFF(0)).

40 1x 16	00 00 01	28 - 58	PITCH KEY SHIFT	-24 - +24 [semitone]	40
40 1x 17 40 1x 18#	00 00 02	08 - F8	PITCH OFFSET FINE	-12.0 - +12.0 [Hz]08 Use nibblized data.	00
40 1x 19	00 00 01	00 - 7F	PART LEVEL	0 - 127 (=Bn 07 vv)	64
40 1x 1A	00 00 01	00 - 7F	VELOCITY SENSE DEPTH	0 - 127	40
40 1x 1B	00 00 01	00 - 7F	VELOCITY SENSE OFFSET	0 - 127	40
40 1x 1C	00 00 01	00 - 7F	PART PANPOT	Random, -63(LEFT) - +63(RIGHT) (=Bn 0A vv, except random)	40
40 1x 1D	00 00 01	00 - 7F	KEY RANGE LOW	C-1 - G9	00
40 1x 1E	00 00 01	00 - 7F	KEY RANGE HIGH	C-1 - G9	7F
40 1x 1F	00 00 01	00 - 5F	CC1 CONTROLLER NUMBER	0 - 95	10
40 1x 20	00 00 01	00 - 5F	CC2 CONTROLLER NUMBER	0 - 95	11
40 1x 21	00 00 01	00 - 7F	CHORUS SEND LEVEL	0 - 127 (=Bn 5D vv)	00
40 1x 22	00 00 01	00 - 7F	REVERB SEND LEVEL	0 - 127 (=Bn 5B vv)	28
40 1x 23	00 00 01	00 - 01	Rx. Bank Select	OFF / ON	01

Rx. Bank Select is set to ON by power-on reset or by "GS RESET".

40 1x 30	00 00 01	0E - 72	TONE MODIFY 1 Vibrato rate	-50 - +50 (=Bn 63 01 62 08 06 vv)	40
40 1x 31	00 00 01	0E - 72	TONE MODIFY 2 Vibrato depth	-50 - +50 (=Bn 63 01 62 09 06 vv)	40
40 1x 32	00 00 01	0E - 72	TONE MODIFY 3 TVF cutoff freq.	-50 - +50 (=Bn 63 01 62 20 06 vv)	40
40 1x 33	00 00 01	0E - 72	TONE MODIFY 4 TVF resonance	-50 - +50 (=Bn 63 01 62 21 06 vv)	40
40 1x 34	00 00 01	0E - 72	TONE MODIFY 5 TVF&TVA Env.attack	-50 - +50 (=Bn 63 01 62 63 06 vv)	40
40 1x 35	00 00 01	0E - 72	TONE MODIFY 6 TVF&TVA Env.decay	-50 - +50 (=Bn 63 01 62 64 06 vv)	40
40 1x 36	00 00 01	0E - 72	TONE MODIFY 7 TVF&TVA Env.release	-50 - +50 (=Bn 63 01 62 66 06 vv)	40
40 1x 37	00 00 01	0E - 72	TONE MODIFY 8 Vibrato delay	-50 - +50 (=Bn 63 01 62 0A 06 vv)	40
40 1x 40	00 00 0C	00 - 7F	SCALE TUNING C	-64 - +63 [cent]	40
40 1x 41#		00 - 7F	SCALE TUNING C#	-64 - +63 [cent]	40
40 1x 42#		00 - 7F	SCALE TUNING D	-64 - +63 [cent]	40
40 1x 43#		00 - 7F	SCALE TUNING D#	-64 - +63 [cent]	40
40 1x 44#		00 - 7F	SCALE TUNING E	-64 - +63 [cent]	40
40 1x 45#		00 - 7F	SCALE TUNING F	-64 - +63 [cent]	40
40 1x 46#		00 - 7F	SCALE TUNING F#	-64 - +63 [cent]	40
40 1x 47#		00 - 7F	SCALE TUNING G	-64 - +63 [cent]	40
40 1x 48#		00 - 7F	SCALE TUNING G#	-64 - +63 [cent]	40
40 1x 49#		00 - 7F	SCALE TUNING A	-64 - +63 [cent]	40
40 1x 4A#		00 - 7F	SCALE TUNING A#	-64 - +63 [cent]	40
40 1x 4B#		00 - 7F	SCALE TUNING B	-64 - +63 [cent]	40

40 2x 00	00 00 01	28 - 58	MOD PITCH CONTROL	-24 - +24 [semitone]	40
40 2x 01	00 00 01	00 - 7F	MOD TVF CUTOFF CONTROL	-9600 - +9600 [cent]	40
40 2x 02	00 00 01	00 - 7F	MOD AMPLITUDE CONTROL	-100.0 - +100.0 [%]	40
40 2x 03	00 00 01	00 - 7F	MOD LFO1 RATE CONTROL	-10.0 - +10.0 [Hz]	40
40 2x 04	00 00 01	00 - 7F	MOD LFO1 PITCH DEPTH	0 - 600 [cent]	0A
40 2x 05	00 00 01	00 - 7F	MOD LFO1 TVF DEPTH	0 - 2400 [cent]	00
40 2x 06	00 00 01	00 - 7F	MOD LFO1 TVA DEPTH	0 - 100.0 [%]	00
40 2x 07	00 00 01	00 - 7F	MOD LFO2 RATE CONTROL	-10.0 - +10.0 [Hz]	40
40 2x 08	00 00 01	00 - 7F	MOD LFO2 PITCH DEPTH	0 - 600 [cent]	00
40 2x 09	00 00 01	00 - 7F	MOD LFO2 TVF DEPTH	0 - 2400 [cent]	00
40 2x 0A	00 00 01	00 - 7F	MOD LFO2 TVA DEPTH	0 - 100.0 [%]	00
40 2x 10	00 00 01	40 - 58	BEND PITCH CONTROL	0 - 24 [semitone]	42
40 2x 11	00 00 01	00 - 7F	BEND TVF CUTOFF CONTROL	-9600 - +9600 [cent]	40
40 2x 12	00 00 01	00 - 7F	BEND AMPLITUDE CONTROL	-100.0 - +100.0 [%]	40
40 2x 13	00 00 01	00 - 7F	BEND LFO1 RATE CONTROL	-10.0 - -10.0 [Hz]	40
40 2x 14	00 00 01	00 - 7F	BEND LFO1 PITCH DEPTH	0 - 600 [cent]	00
40 2x 15	00 00 01	00 - 7F	BEND LFO1 TVF DEPTH	0 - 2400 [cent]	00
40 2x 16	00 00 01	00 - 7F	BEND LFO1 TVA DEPTH	0 - 100.0 [%]	00
40 2x 17	00 00 01	00 - 7F	BEND LFO2 RATE CONTROL	-10.0 - +10.0 [Hz]	40
40 2x 18	00 00 01	00 - 7F	BEND LFO2 PITCH DEPTH	0 - 600 [cent]	00
40 2x 19	00 00 01	00 - 7F	BEND LFO2 TVF DEPTH	0 - 2400 [cent]	00
40 2x 1A	00 00 01	00 - 7F	BEND LFO2 TVA DEPTH	0 - 100.0 [%]	00
40 2x 20	00 00 01	28 - 58	CAf PITCH CONTROL	-24 - +24 [semitone]	40
40 2x 21	00 00 01	00 - 7F	CAf TVF CUTOFF CONTROL	-9600 - +9600 [cent]	40
40 2x 22	00 00 01	00 - 7F	CAf AMPLITUDE CONTROL	-100.0 - +100.0 [%]	40
40 2x 23	00 00 01	00 - 7F	CAf LFO1 RATE CONTROL	-10.0 - +10.0 [Hz]	40
40 2x 24	00 00 01	00 - 7F	CAf LFO1 PITCH DEPTH	0 - 600 [cent]	00
40 2x 25	00 00 01	00 - 7F	CAf LFO1 TVF DEPTH	0 - 2400 [cent]	00
40 2x 26	00 00 01	00 - 7F	CAf LFO1 TVA DEPTH	0 - 100.0 [%]	00
40 2x 27	00 00 01	00 - 7F	CAf LFO2 RATE CONTROL	-10.0 - +10.0 [Hz]	40
40 2x 28	00 00 01	00 - 7F	CAf LFO2 PITCH DEPTH	0 - 600 [cent]	00
40 2x 29	00 00 01	00 - 7F	CAf LFO2 TVF DEPTH	0 - 2400 [cent]	00
40 2x 2A	00 00 01	00 - 7F	CAf LFO2 TVA DEPTH	0 - 100.0 [%]	00
40 2x 30	00 00 01	28 - 58	PAf PITCH CONTROL	-24 - +24 [semitone]	40
40 2x 31	00 00 01	00 - 7F	PAf TVF CUTOFF CONTROL	-9600 - +9600 [cent]	40
40 2x 32	00 00 01	00 - 7F	PAf AMPLITUDE CONTROL	-100.0 - +100.0 [%]	40
40 2x 33	00 00 01	00 - 7F	PAf LFO1 RATE CONTROL	-10.0 - +10.0 [Hz]	40
40 2x 34	00 00 01	00 - 7F	PAf LFO1 PITCH DEPTH	0 - 600 [cent]	00
40 2x 35	00 00 01	00 - 7F	PAf LFO1 TVF DEPTH	0 - 2400 [cent]	00
40 2x 36	00 00 01	00 - 7F	PAf LFO1 TVA DEPTH	0 - 100.0 [%]	00
40 2x 37	00 00 01	00 - 7F	PAf LFO2 RATE CONTROL	-10.0 - +10.0 [Hz]	40
40 2x 38	00 00 01	00 - 7F	PAf LFO2 PITCH DEPTH	0 - 600 [cent]	00
40 2x 39	00 00 01	00 - 7F	PAf LFO2 TVF DEPTH	0 - 2400 [cent]	00
40 2x 3A	00 00 01	00 - 7F	PAf LFO2 TVA DEPTH	0 - 100.0 [%]	00
40 2x 40	00 00 01	28 - 58	CC1 PITCH CONTROL	-24 - +24 [semitone]	40
40 2x 41	00 00 01	00 - 7F	CC1 TVF CUTOFF CONTROL	-9600 - +9600 [cent]	40
40 2x 42	00 00 01	00 - 7F	CC1 AMPLITUDE CONTROL	-100.0 - +100.0 [%]	40
40 2x 43	00 00 01	00 - 7F	CC1 LFO1 RATE CONTROL	-10.0 - +10.0 [Hz]	40
40 2x 44	00 00 01	00 - 7F	CC1 LFO1 PITCH DEPTH	0 - 600 [cent]	00
40 2x 45	00 00 01	00 - 7F	CC1 LFO1 TVF DEPTH	0 - 2400 [cent]	00
40 2x 46	00 00 01	00 - 7F	CC1 LFO1 TVA DEPTH	0 - 100.0 [%]	00
40 2x 47	00 00 01	00 - 7F	CC1 LFO2 RATE CONTROL	-10.0 - +10.0 [Hz]	40
40 2x 48	00 00 01	00 - 7F	CC1 LFO2 PITCH DEPTH	0 - 600 [cent]	00
40 2x 49	00 00 01	00 - 7F	CC1 LFO2 TVF DEPTH	0 - 2400 [cent]	00
40 2x 4A	00 00 01	00 - 7F	CC1 LFO2 TVA DEPTH	0 - 100.0 [%]	00
40 2x 50	00 00 01	28 - 58	CC2 PITCH CONTROL	-24 - +24 [semitone]	40
40 2x 51	00 00 01	00 - 7F	CC2 TVF CUTOFF CONTROL	-9600 - +9600 [cent]	40
40 2x 52	00 00 01	00 - 7F	CC2 AMPLITUDE CONTROL	-100.0 - +100.0 [%]	40
40 2x 53	00 00 01	00 - 7F	CC2 LFO1 RATE CONTROL	-10.0 - +10.0 [Hz]	40
40 2x 54	00 00 01	00 - 7F	CC2 LFO1 PITCH DEPTH	0 - 600 [cent]	00
40 2x 55	00 00 01	00 - 7F	CC2 LFO1 TVF DEPTH	0 - 2400 [cent]	00
40 2x 56	00 00 01	00 - 7F	CC2 LFO1 TVA DEPTH	0 - 100.0 [%]	00

40 2x 57	00 00 01	00 - 7F	CC2 LFO2 RATE CONTROL	-10.0 - +10.0 [Hz] 40
40 2x 58	00 00 01	00 - 7F	CC2 LFO2 PITCH DEPTH	0 - 600 [cent] 00
40 2x 59	00 00 01	00 - 7F	CC2 LFO2 TVF DEPTH	0 - 2400 [cent] 00
40 2x 5A	00 00 01	00 - 7F	CC2 LFO2 TVA DEPTH	0 - 100.0 [%] 00

DRUM SETUP PARAMETERS

*m:Map number (0 = MAP1, 1 = MAP2)
*rr:drum part note number (00H - 7FH)

Address(H)	*SIZE(H)*	*Data(H)*	*Parameter*	*Description*
41 m0 00 : 41 m0 0B#	00 00 0C	20 - 7F	DRUM MAP NAME	ASCII Character
41 m1 rr	00 00 01	00 - 7F	PLAY NOTE NUMBER	Pitch coarse
41 m2 rr	00 00 01	00 - 7F	LEVEL	TVA level (=Bn 63 1A 62 rr 06 vv)
41 m3 rr	00 00 01	00 - 7F	ASSIGN GROUP NUMBER	Non, 1 - 127
41 m4 rr	00 00 01	00 - 7F	PANPOT	Random, -63(LEFT) - +63(RIGHT) (=Bn 63 1C 62 rr 06 vv)
41 m5 rr	00 00 01	00 - 7F	REVERB SEND LEVEL	0.0 - 1.0 Multiplicand of the part reverb depth (=Bn 63 1D 62 rr 06 vv)
41 m6 rr	00 00 01	00 - 7F	CHORUS SEND LEVEL	0.0 - 1.0 Multiplicand of the part chorus depth (=Bn 63 1E 62 rr 06 vv)
41 m7 rr	00 00 01	00 - 01	Rx. NOTE OFF	OFF / ON
41 m8 rr	00 00 01	00 - 01	Rx. NOTE ON	OFF / ON

When you change Drum Sets, all values of the DRUM SETUP PARAMETERS will be initialized.

Bulk Dump

You can send or request bulk data which contains a large amount of parameter data by using Bulk Dump communication.
It is used for storing bulk data in a sequencer or a computer. To send or request bulk data, use the Address and Size indicated in the following map.
You cannot use any address having "#" for the top address in a System Exclusive message except the following case.
Messages which include large data (more than 128 bytes) are sent out in separate packets, then, the top address of the following messages may be the address marked "#".
To send several packets of large DT1 messages at a time, insert intervals of at least 40ms in between those packets.

All Parameters (System Parameters and all Patch Parameters)

Address(H)	*SIZE(H)*	*Description*	*Number of packets*
48 00 00 : 48 1D 0F#	00 1D 10	ALL	30 packets

System Parameters

Address(H)	*SIZE(H)*	*Description*	*Number of packets*
48 00 00 : 48 00 0F#	00 00 10	SYSTEM PARAMETERS	1 packet

Patch Parameters

Address(H)	*SIZE(H)*	*Description*	*Number of packets*
48 00 10 : 48 01 0F#	00 01 00	PATCH COMMON	1 packet
48 01 10 : 48 02 6F#	00 01 60	BLOCK 0	2 packets
48 02 70 : 48 04 4F#	00 01 60	BLOCK 1	2 packets
48 04 50 : 48 06 2F#	00 01 60	BLOCK 2	2 packets
48 06 30 : 48 08 0F#	00 01 60	BLOCK 3	2 packets
48 08 10 : 48 09 6F#	00 01 60	BLOCK 4	2 packets
48 09 70 : 48 0B 4F#	00 01 60	BLOCK 5	2 packets
48 0B 50 : 48 0D 2F#	00 01 60	BLOCK 6	2 packets
48 0D 30 : 48 0F 0F#	00 01 60	BLOCK 7	2 packets
48 0F 10 : 48 10 6F#	00 01 60	BLOCK 8	2 packets
48 10 70 : 48 12 4F#	00 01 60	BLOCK 9	2 packets
48 12 50 : 48 14 2F#	00 01 60	BLOCK A	2 packets
48 14 30 : 48 16 0F#	00 01 60	BLOCK B	2 packets
48 16 10 : 48 17 6F#	00 01 60	BLOCK C	2 packets
48 17 70 : 48 19 4F#	00 01 60	BLOCK D	2 packets
48 19 50 : 48 1B 2F#	00 01 60	BLOCK E	2 packets
48 1B 30 : 48 1D 0F#	00 01 60	BLOCK F	2 packets

DRUM SETUP PARAMETERS

*m: map number (0 = MAP1, 1 = MAP2)

Address(H)	*SIZE(H)*	*Description*	*Number of packets*
49 m0 00 : 49 m1 7F	00 02 00	PLAY NOTE NUMBER	2 packets
49 m2 00 : 49 m3 7F	00 02 00	LEVEL	2 packets
49 m4 00 : 49 m5 7F	00 02 00	ASSIGN GROUP NUMBER	2 packets
49 m6 00 : 49 m7 7F	00 02 00	PANPOT	2 packets
49 m8 00 : 49 m9 7F	00 02 00	REVERB SEND LEVEL	2 packets
49 mA 00 : 49 mB 7F	00 02 00	CHORUS SEND LEVEL	2 packets
49 mC 00 : 49 mD 7F	00 02 00	Rx. NOTE ON/OFF	2 packets
49 mE 00 : 49 mE 17	00 00 18	DRUM MAP NAME	1 packet

4 Useful Information

Decimal and Hexadecimal
It is common to use 7-bit Hexadecimal numbers in MIDI communication. The following is a conversion table between decimal numbers and 7-bit Hexadecimal numbers.

Decimal	Hexa-decimal	Decimal	Hexa-decimal	Decimal	Hexa-decimal	Decimal	Hexa-decimal
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

*To indicate a decimal number for the MIDI channel, Bank number, and Program number, add one to the values in the table.
*The resolution of 7-bit Hexadecimal numbers is 128. Use several bytes for values which require more resolution.
i.e. The number "ad bbH" in 7-bit Hexadecimal is "ad x 128 + bb" in Decimal form.
*A signed number (with a sign +/-) is indicated as 00H = -64, 40H = 0, 7FH = +63. So the signed number "aaH" in 7-bit Hexadecimal is "ad - 64" (ad is the decimal number of aaH).
In case of two bytes, it is regarded as 00 00H = -8192, 40 00H = 0, 7F 7FH = +8191.
So the signed number "ad bbH" in 7-bit Hexadecimal is "ad bbH - 40 00H = ad x 128 + bb - 64 x 128", where, ad and bb is the decimal number of aaH and bbH respectively.
*The data indicated as "nibbled" is a 4-bit Hexadecimal number.
i.e. "0a 0bH" is "a x 16 + b".

<Example 1> Convert "5AH" in Hexadecimal to a Decimal number.
(By using the table)5AH = 90

<Example 2> Convert "12 34H" in 7-bit Hexadecimal to a Decimal number.
(By using the table) 12H = 18, 34H = 52
So,18 x 128 + 52 = 2356

<Example 3> Convert "0A 03 09 0D" in nibblized form to a Decimal number.
(By using the table)0AH = 10, 03H = 3, 09H = 9, 0DH = 13
So,((10 x 16 + 3) x 16 + 9) x 16 + 13 = 41885

Example of actual MIDI messages

<Example 1> 92 3E 5F
"9n" is a status of a Note On message, and "n" is a MIDI channel number.
The second byte is the Note number, and the third is Velocity.
2H = 2, 3EH = 62, 5FH = 95
So, this is a Note On message of MIDI channel=3, Note number=62(D4) and Velocity=95.

<Example 2> CE 49
"Cn" is a status of a Program change message, and "n" is a MIDI channel number.
The second byte is a Program number.
EH = 14, 49H = 73
So, this is a Program change message of MIDI channel=15, Program number= 74 (Flute in GS).

<Example 3> EA 00 28
"EnH" is a status of a Pitch bend change message, and "n" is a MIDI channel number.
The second byte (00H) is an LSB and the third (28H) is an MSB of a Pitch bend value (signed).

The Pitch bend value is:
28 00H - 40 00H = 40 x 128 + 0 - (64 x 128 + 0) = 5120 - 8192 = -3072
So, this is a Pitch bend change message of MIDI channel=11,
Pitch bend value = -3072

If the Pitch bend sensitivity is set to 2 semitones, and the Pitch bend value -8192 (00 00H) is defined as -200 cents,
The actual pitch bend value of this message is: -200 x (-3072) / (-8192) = -75 cent

<Example 4> B3 64 00 65 00 06 0C 26 00 64 7F 65 7F
"Bn" is a status of a Control change message, and "n" is a MIDI channel number.
The second byte is a Control number and the third is the value.
This packet uses the running status rule, that is, when you send a series of messages with the same status, you can omit the following status bytes.
This message contains :

B3 64 00	MIDI CH = 4	LSB	of RPN parameter number	: 00H
(B3) 65 00	MIDI CH = 4	MSB	of RPN parameter number	: 00H
(B3) 06 0C	MIDI CH = 4	MSB	of Data entry	: 0CH
(B3) 26 00	MIDI CH = 4	LSB	of Data entry	: 00H
(B3) 64 7F	MIDI CH = 4	LSB	of RPN parameter number	: 7FH
(B3) 65 7F	MIDI CH = 4	MSB	of RPN parameter number	: 7FH

This message string means 'send data "0C 00H" to RPN parameter number"00 00H", after that, set RPN parameter number to "7F 7F"'.

RPN parameter number "00 00H" is Pitch bend sensitivity and the unit of the MSB value is a semitone, so 0CH = 12 is a value
to set the Pitch bend sensitivity = 12 semitones (one octave).
GS devices ignore the LSB value of Pitch bend sensitivity. However, you had better send both MSB and LSB(=00H) to maintain data compatibility.

Once an RPN or NRPN number is set, all the Data entry messages sent after are effective.
Sometimes this rule may cause a problem if the MIDI data is played by a sequencer and it is operated in fast forward or backward made. It is recommended, therefore, to set the RPN or NRPN number to 7F 7FH after sending the Data entry messages.

*To use running-status for several MIDI event like <example 4> in a song data (e.g. Standard MIDI File data) is not recommended.
There may be a sequencer which can not handle such data correctly when it is operated in fast forward or backward. Putting the status byte for every event is the reliable way.
*The parameter number and the value of RPN or NRPN must be sent in correct order. As some sequencers may send those recorded data in different order if an event is too close to another, it is recommended to place each event in a different tick. (1-CLK for TPQN=92, or 5-CLK for TPQN=480 is recommended.)

The send order may be different as each sequencer if the events are in the same clock in sequence data.

Checksum of Roland System Exclusive messages
Roland System Exclusive messages (RQ1 and DT1) have a Checksum at the end of the data (just before EOX) to be able to check
for communication errors.
The Checksum is determined by values of address and data (or size) included in the message.

<How to calculate Checksums> ("H" indicates Hexadecimal.)

The error checking process employs a sum-ckeck error detection. It provides binary bit figures whose lower 7 bits are zero when values for an address, data (or size) and the Checksum are summed.

One practical equation to determine Checksum is:
If the address is "ad bb ccH" and the data(or the size) is "dd ee ffH"
ad + bb + cc + dd + ee + ff = sum
sum / 128 = quotient and remainder
128 - remainder = checksum

<Example 1> Set "REVERB MACRO" to "ROOM 3"

According to the Parameter Address Map, the Address of REVERB MACRO is 40 01 30H, and the Value correspond to ROOM 3 is 02H.
So, the message should be :

F0 41 10 42 12 40 01 30 02 ?? F7

(1) (2) (3) (4) (5) address data checksum (6)

(1)Exclusive Status (2)ID (Roland) (3)Device ID (16) (4)Model ID (GS) (5)Command ID (DT1) (6)End of Exclusive

The Checksum is :
40H + 01H + 30H + 02H = 64 + 1 + 48 + 2 = 115(sum)
115(sum) / 128 = 0(quotient) 115(remainder)
checksum = 128 - 115(remainder) = 13 = 0DH

Therefore, the message to send is : F0 41 10 42 12 40 01 30 02 0D F7

<Example 2> To request LEVEL of NOTE NUMBER 75(D#5; Claves) in DRUM MAP 1

NOTE NUMBER 75(D#5) is 4BH in Hexadecimal.
The Address of "LEVEL of NOTE NUMBER 75(D#5; Claves) in DRUM MAP 1" is 41 02 4BH, and the size is 00 00 01H. So, the message should be :

F0 41 10 42 11 41 02 4B 00 00 01 ?? F7

(1) (2) (3) (4) (5) address data checksum (6)

(1)Exclusive Status (2)ID (Roland) (3)Device ID (16) (4)Model ID (GS) (5)Command ID (RQ1) (6)End of Exclusive

The Checksum is :
41H + 02H + 4BH + 00H + 00H + 01H = 65 + 2 + 75 + 0 + 0 + 1 = 143(sum)
143(sum) / 128 = 1(quotient) 15(remainder)
checksum = 128 - 15(remainder) = 113 = 71H

Therefore, the message to send is : F0 41 10 42 11 41 02 4B 00 00 01 71 F7

<Example 3> Set "MASTER TUNE" to +23.4 cents by System Exclusive
The Address of "MASTER TUNE" is 40 00 00H, and the Size is 00 00 04H.
The Value should be nibblized data whose resolution is 0.1 cents, and which is a signed value
(00 04 00 00H (= 1024) = 0).
+23.4[cents] = 234 + 1024 = 1258 =(hexadecimal)=> 04 EAH =(nibblized)=> 00 04 0E 0AH

So, the message should be :

F0 41 10 42 12 41 00 00 00 04 0A ?? F7

(1) (2) (3) (4) (5) address data checksum (6)

(1)Exclusive Status (2)ID (Roland) (3)Device ID (16) (4)Model ID (GS) (5)Command ID (DT1) (6)End of Exclusive

The Checksum is :
41H + 00H + 00H + 00H + 04H + 0EH + 0AH = 65 + 0 + 0 + 0 + 4 + 14 + 10 = 93(sum)
93(sum) / 128 = 0(quotient) 93(remainder)
checksum = 128 - 93(remainder) = 35 = 23H

Therefore, the message to send is : F0 41 10 42 12 41 00 00 00 04 0E 0A 23 F7

MIDI IMPLEMENTATION CHART

[INTELLIGENT KEYBOARD] (Sound Module & Keyboard Section) Date: June 1996
Model E-28 Version: 1.0

FUNCTION		TRANSMITTED	RECOGNIZED	REMARKS
Basic	Default	4	1-16	4 = Upper 1
Channel	Changed	X	1-16, OFF	
Mode	Default	Mode 3	Mode 3	
	Messages	Mode 3, 4 (M=1)	Mode 3, 4 (M=1)	*2
	Altered	**********		
Note		0-127	0-127	
Number:	True voice	**********	0-127	
Velocity	Note ON	O	O	
	Note OFF	X	X	
After	Key's	X	O *1	
Touch	Ch's	X	O *1	
Pitch Bender		O	O *1	
Control Change	0,32	O	O (MSB only) *1	Bank select
	1	O	O *1	Modulation
	5	X	O *1	Portamento time
	6,38	X	O *1	Data entry
	7	X	O *1	Volume
	10	X	O *1	Panpot
	11	X	O *1	Expression
	64	O	O *1	Hold 1
	65	X	O *1	Portamento
	66	X	O *1	Sostenuto
	67	X	O *1	Soft
	84	X	O *1	Portamento control
	91	X	O (Reverb) *1	Effect 1 depth
	93	O	O (Chorus) *1	Effect 3 depth
	98,99	X	O *1	NRPN LSB, MSB
	100,101	X	O *1	RPN LSB, MSB
	120	X	O	All sound off
	121	X	O	Reset all controllers
Prog		O	O *1	
change:	True #	**********	0-127	Prog. 1-128
System Exclusive		O	O	
System	: Song Pos	X	X	
	: Song Sel	X	X	
Common	: Tune	X	X	
System	: Clock	x	x	
Real Time	: Commands	x	x	
Aux	: Local ON/OFF	X	X	
	: All Notes OFF	X	O (123-125)	
Messages	: Active Sense	O	O	
	: Reset	X	X	

Notes

*1 O X is selectable
*2 Recognize as M=1 even if M%1

Mode 1: OMNI ON, POLY **Mode 2:** OMNI ON, MONO O: YES
Mode 3: OMNI OFF, POLY **Mode 4:** OMNI OFF, MONO X: NO

Roland®

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