



SAM9773



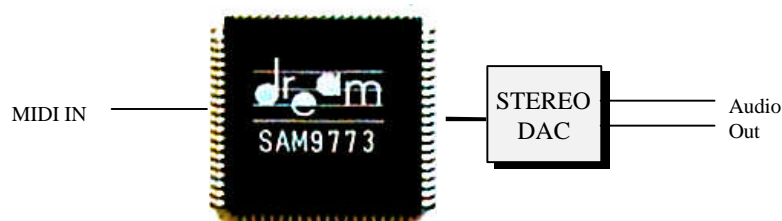
SINGLE CHIP SYNTHESIZER WITH EFFECTS

Synthesizer, Reverb, Chorus on single chip

No external ROM or RAM

- Single chip all-in-one design, only requires external DAC
 - MIDI control processor
 - Synthesis, General MIDI wavetable implementation
 - Compatible effects : reverb + chorus
 - Programmable Spatializer or four channels surround (*)
 - 3DMIDI™ four speakers MIDI (*)
 - 4 bands stereo equalizer.
- State of the art synthesis for best quality/price products
 - 38 voices polyphony + effects
 - On-chip wavetable data, firmware, RAM delay lines
- Synthesizer chipset : SAM9773 + DAC
- Hardware programmable DAC mode
 - I2S 16 to 20 bits
 - Japanese 16 bits
- Typical applications : cost sensitive PC wavetable synthesis / portable karaoke / VCD karaoke
- TQFP80 package : small footprint, easy mounting
- Ideal for battery operation
 - Low power
 - Power down mode
 - Wide supply voltage range : 3V to 4.5V core, 3V to 5.5V periphery

(*) Four channels surround and 3DMIDI™ require additional DAC



Typical hardware configuration



1- PIN DESCRIPTION

1-1- PINS BY FUNCTION

Power supply group

PIN NAME	PIN #	TYPE	FUNCTION
GND	5,14,21,23,30,38,57, 59,61,65,74	PWR	DIGITAL GROUND All pins should be connected to a ground plane
VCC	6,13,18,22,32,56 64,80	PWR	POWER SUPPLY, 3V to 5.5V All pins should be connected to a VCC plane
VC3	1,7,17,60,63	PWR	CORE POWER SUPPLY, 3V to 4.5V All pins should be connected to nominal 3.3V. If 3.3V is not available, then VC3 can be derived from 5V by two 1N4148 diodes in series.

Serial MIDI

PIN NAME	PIN #	TYPE	FUNCTION
MIDI IN	15	IN	Serial TTL MIDI IN. All controls are received by this pin.

DIGITAL AUDIO GROUP

PIN NAME	PIN #	TYPE	FUNCTION
CLBD	19	OUT	Digital audio bit clock
WSBD	27	OUT	Digital audio left/right select
DABD0	25	OUT	Digital audio main stereo output
DABD1	26	OUT	Auxiliary digital stereo output. Surround or 3DMIDI™ output.
DACSEL	24	IN	DAC type : 0 = I2S 16 to 20 bits, 1 = Japanese 16 bits

MISCELLANEOUS GROUP

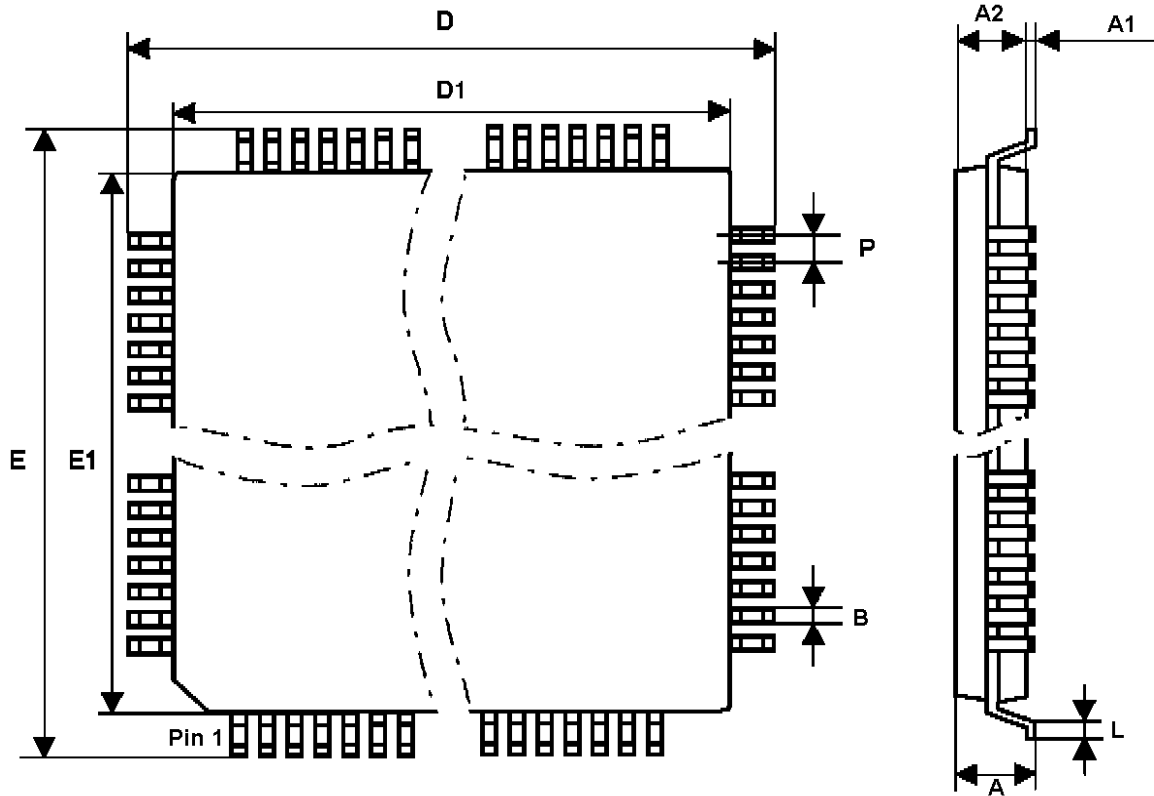
PIN NAME	PIN #	TYPE	FUNCTION
X1-X2	10, 9	-	9.6 MHz crystal connection. An external 9.6 MHz clock can also be used on X1 (3.3V input). X2 cannot be used to drive external circuits, use CKOUT instead.
CKOUT	20	OUT	Buffered X2 output, can be used to drive external DAC master clock (256 x Fs)
LFT	8	-	PLL external RC network
RESET/	11	IN	Reset input, active low. This is a Schmidt trigger input, allowing direct connection of an RC network
PDWN/	12	IN	Power down, active low. When power down is active, then all output pins will be floated. The crystal oscillator will be stopped. To exit from power down, PDWN/ should be high and RESET applied.
TEST0-TEST4	33, 34, 35, 36, 62	IN	Test pins. Should be grounded
RUN	16	OUT	When high, indicates that the synthesizer is up and running.

1-2- PINOUT BY PIN #

PIN#	PIN NAME	PIN #	PIN NAME	PIN#	PIN NAME	PIN#	PIN NAME
1	VC3	21	GND	41	N.C.	61	GND
2	N.C.	22	VCC	42	N.C.	62	TEST4
3	N.C.	23	GND	43	N.C.	63	VC3
4	N.C.	24	DACSEL	44	N.C.	64	VCC
5	GND	25	DABD0	45	N.C.	65	GND
6	VCC	26	DABD1	46	N.C.	66	N.C.
7	VC3	27	N.C.	47	N.C.	67	N.C.
8	LFT	28	N.C.	48	N.C.	68	N.C.
9	X2	29	N.C.	49	N.C.	69	N.C.
10	X1	30	GND	50	N.C.	70	N.C.
11	RESET/	31	N.C.	51	N.C.	71	N.C.
12	PDWN/	32	VCC	52	N.C.	72	N.C.
13	VCC	33	TEST0	53	N.C.	73	N.C.
14	GND	34	TEST1	54	N.C.	74	GND
15	MIDI IN	35	TEST2	55	N.C.	75	N.C.
16	RUN	36	TEST3	56	VCC	76	N.C.
17	VC3	37	N.C.	57	GND	77	N.C.
18	VCC	38	GND	58	N.C.	78	N.C.
19	CLBD	39	N.C.	59	GND	79	N.C.
20	CKOUT	40	N.C.	60	VC3	80	VCC

Important : Signals marked N.C. should be left unconnected.

1-3- MECHANICAL DIMENSIONS



**SAM9773
THIN PLASTIC 80 LEAD QUAD FLAT PACK (TQFP80)**

	MIN.	NOM.	MAX.
A	1.40	1.50	1.60
A1	0.05	0.10	0.15
A2	1.35	1.40	1.45
D	15.90	16.00	16.10
D1	13.90	14.00	14.10
E	15.90	16.00	16.10
E1	13.90	14.00	14.10
L	0.45	0.60	0.75
P		0.65	
B	0.22	0.32	0.38

All dimensions in mm

2- ABSOLUTE MAXIMUM RATINGS (All voltages with respect to 0V, GND=0V)

Parameter	Symbol	Min	Typ	Max	Unit
Ambient temperature (Power applied)	-	-40	-	+85	°C
Storage temperature	-	-65	-	+150	°C
Voltage on any pin (except X1)	-	-0.5	-	VCC+0.5	V
Supply voltage	VCC	-0.5	-	6.5	V
Supply voltage	VC3	-0.5	-	4.5	V
Maximum IOL per I/O pin	-	-	-	10	MA

3- RECOMMENDED OPERATING CONDITIONS

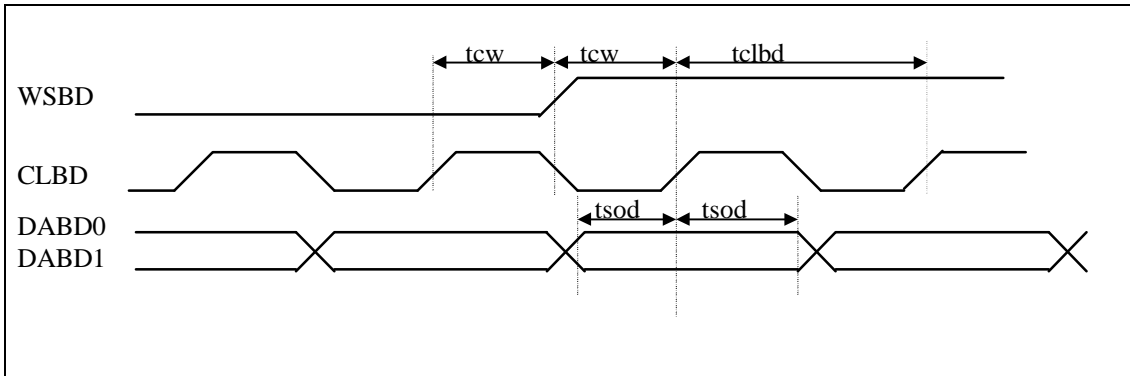
Parameter	Symbol	Min	Typ	Max	Unit
Supply voltage (note 1)	VCC	3	3.3/5.0	5.5	V
Supply voltage	VC3	3	3.3	4.5	V
Operating ambient temperature	tA	0	-	70	°C

note 1 : When using 3.3V VCC supply in a 5V environment, care must be taken that pin voltage does not exceed VCC+0.5V. Pin X1 is powered by VC3 input. If X1 is driven by a 5V device, then a minimum series resistor is required (typ 330 Ohms).

4- D.C. CHARACTERISTICS (TA=25°C, VC3=3.3V±10%)

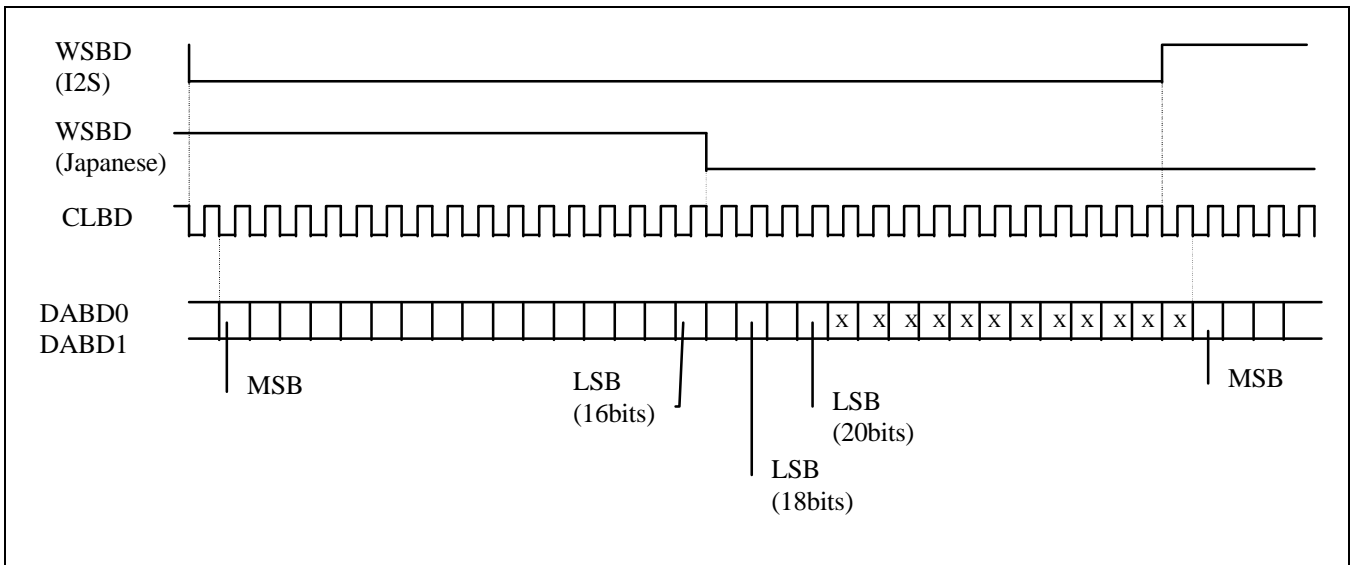
Parameter	Symbol	VCC	Min	Typ	Max	Unit
Low level input voltage	VIL	3.3	-0.5	-	1.0	V
		5.0	-0.5	-	1.7	
High level input voltage	VIH	3.3	2.3	-	VCC+0.5	V
		5.0	3.3	-	VCC+0.5	
Low level output voltage IOL=-3.2mA	VOL	3.3	-	-	0.45	V
		5.0	-	-	0.45	
High level output voltage IOH=0.8mA	VOH	3.3	2.8	-	-	V
		5.0	4.5	-	-	
Power supply current (crystal freq.=9.6MHz)	ICC	3.3	-	20	45	MA
		5.0	-	30	70	
Power down supply current	-	-	-	70	100	µA

5- DIGITAL AUDIO TIMINGS



Parameter	Symbol	Min	Typ	Max	Unit
CLBD rising to WSBD change	tcw	200	-	-	Ns
DABDx valid prior/after CLBD rising	tsod	200	-	-	Ns
CLBD cycle time	tclbd	-	416.67	-	Ns

DIGITAL AUDIO FRAME FORMAT



Notes :

- Selection between I2S and Japanese format is through pin DACSEL

6- RESET AND POWER DOWN

During power-up, the RESET/ input should be held low until the crystal oscillator and PLL are stabilized, which can take about 20ms. A typical RC/diode power-up network can be used.

After RESET/, the SAM9773 enters an initialization routine. It will take around 50 ms before a MIDI IN message can be processed.

If PDWN/ is asserted low, then all I/Os and outputs will be floated, the crystal oscillator and PLL will be stopped. The chip enters a deep power down sleep mode. To exit power down, PDWN/ has to be asserted high, then RESET/ applied.

7- RECOMMENDED BOARD LAYOUT

Like all HCMOS high integration ICs, following simple rules of board layout is mandatory for reliable operations :

- GND, VCC, VC3 distribution, decouplings

All GND, VCC, VC3 pins should be connected. GND + VCC planes are strongly recommended below the SAM9773. The board GND + VCC distribution should be in grid form. For 5V VCC operation, if 3.3V is not available, then VC3 can be connected to VCC by two 1N4148 diodes in series. This guarantees a minimum voltage drop of 1.2V.

Recommended VCC decoupling is 0.1 μ F at each corner of the IC with an additional 10 μ FT decoupling close to the crystal. VC3 requires a single 0.1 uF decoupling close to the IC.

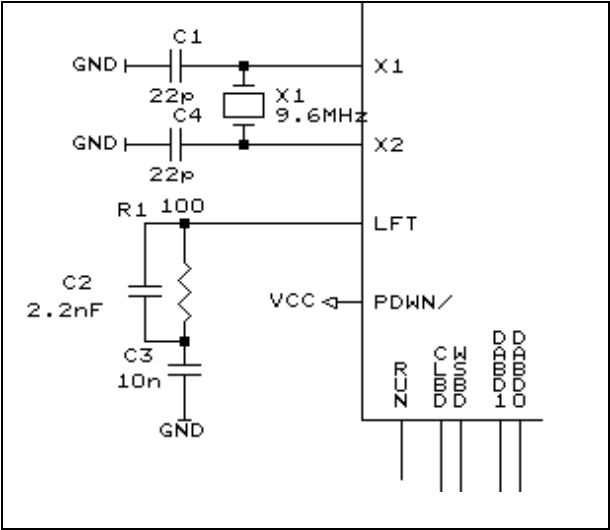
- Crystal, LFT

The paths between the crystal, the crystal compensation capacitors, the LFT filter R-C-R and the SAM9773 should be short and shielded. The ground return from the compensation capacitors and LFT filter should be the GND plane from SAM9773.

- Analog section

A specific AGND ground plane should be provided, which connects by a single trace to the GND ground. No digital signals should cross the AGND plane. Refer to the Codec vendor recommended layout for correct implementation of the analog section.

8- RECOMMENDED CRYSTAL COMPENSATION AND LFT FILTER



SAM9773 USER'S MANUAL

1- CONFIGURATION AND SPECIAL MIDI CONTROLS

1-1 DAC CONFIGURATION

DACSEL	Configuration
GND	IIS format DAC (16 to 22 bits)
VCC	Sony format DAC, 16 bits

1-2 CONFIGURATION NRPN 3755H : OUTPUT MODE SELECT

MIDI message code (in hexadecimal) : B0H 63h 37h, B0H 62h 55h, B0H 06h vv

7	6	5	4	3	2	1	0
0	0	0	0	1	OM	0	0

- OM = 0 : Spatializer effect ON. Spatializer parameters can be controlled using NRPN 3720h (volume), 372Ch (delay time), 372Dh (stereo/mono) and 372Eh (2/4 speaker mode) (see paragraph 1.3)
- OM = 1 : 3DMIDI™ mode, 4 speakers MIDI output . Each MIDI channel can be output to front or rear speakers using NRPN 3800h till 380Fh, reverb and chorus can be routed as well.

NRPN 38xxh = 0h : MIDI channel xxh is front speaker output

NRPN 38xxh = 7Fh : MIDI channel xxh is rear speaker output

NRPN 3810h assign all MIDI channels to front or rear speakers :

NRPN 3810h= 0h : all MIDI channels are front speaker output

NRPN 3810h=07Fh : all MIDI channels are rear speaker output

NRPN 3820h and 3821h control reverb output volume :

NRPN 3820h= 0h to 7Fh : reverb front speaker volume (Default value=07Fh)

NRPN 3821h=0h to 7Fh : reverb rear speaker volume (Default value=0h)

NRPN 3830h and 3831h control chorus output volume :

NRPN 3830h=0h to 7Fh : chorus front speakers volume (Default value=07Fh)

NRPN 3831h=0h to 7Fh : chorus rear speakers volume (Default value=0h)

- Default power-on value : OM = 0 (Spatializer ON)

1-3 SPECIAL MIDI CONTROLS

Various features of SAM9773 are controlled by NRPN MIDI messages.

NRPN # (High Low)	Description		Power-up default
3700H	Equalizer Low band (bass)	0=-12dB, 40H=0dB, 7FH=+12dB	60H
3701H	Equalizer Med Low band	0=-12dB, 40H=0dB, 7FH=+12dB	40H
3702H	Equalizer Med High band	0=-12dB, 40H=0dB, 7FH=+12dB	40H
3703H	Equalizer High band (treble)	0=-12dB, 40H=0dB, 7FH=+12dB	60H
3707H	Master Volume	0 to 7FH	7FH
3708H	Equalizer Low cutoff freq	0=0Hz, 7FH=4.7 kHz	0CH
3709H	Equalizer Med Low cutoff freq	0=0Hz, 7FH=4.2 kHz	1BH
370AH	Equalizer Med High cutoff freq	0=0Hz, 7FH=4.2 kHz	72H
370BH	Equalizer High cutoff freq	0=0Hz, 7FH=18.75 kHz	40H
3713H	Clipping mode select	0=soft clip, 7FH=hard clip	00H
3715H	General MIDI reverb send	0=no send,40H=default send,7FH=max	40H
3716H	General MIDI chorus send	0=no send,40H=default send,7FH=max	40H
3718H	Post effects applied on GM	0= Post effects not applied 7Fh=Post effects applied	7FH
371AH	Post effects applied on Reverb/Chorus	0= Post effects not applied 7Fh=Post effects applied	7FH
3720H	Spatializer effect volume	0= no effect, 7FH= maximum effect	00H
3722H	General MIDI volume	0 to 7FH	7FH
3723H	General MIDI pan	0=left, 40H=center, 7FH=right	40H
372CH	Spatializer effect delay	0=shortest to 7Fh=longest	1DH
372DH	Spatializer effect input	0=stereo 7Fh=mono	00H
372EH	Spatializer effect output mode	0=2 speaker mode 7Fh=4 speaker mode	00H
3751H	Auto - test	See paragraph 4 below	
3755H	Effects on/off	See paragraph 1-2 above	
3757H	System Exclusive Device ID	0 to 1Fh, 20h=all accepted	20H
380xH	3DMIDI™ control, x = MIDI channel	0= output channel to front speakers 7FH= output channel to rear speakers	00H
3810H	3DMIDI™ global control	0= output all channels to front speakers 7FH= output all channels to rear speakers	00H
3820H	3DMIDI™ reverb volume front speakers	0 to 7FH	7FH
3821H	3DMIDI™ reverb volume rear speakers	0 to 7FH	00H
3830H	3DMIDI™ chorus volume front speakers	0 to 7FH	7FH
3831H	3DMIDI™ chorus volume rear speakers	0 to 7FH	00H

2- DETAILED MIDI IMPLEMENTATION

MIDI MESSAGE	HEX CODE	DESCRIPTION	COMPATIBILITY
NOTE ON	9nH kk vv	MIDI channel n(0-15) note ON #kk(1-127), velocity vv(1-127). vv=0 means NOTE OFF	MIDI
NOTE OFF	8nH kk vv	MIDI channel n(0-15) note OFF #kk(1-127), vv is don't care.	MIDI
PITCH BEND	EnH bl bh	Pitch bend as specified by bh bl (14 bits) Maximum swing is +/- 1 tone (power-up). Can be changed using « pitch bend sensitivity ». Center position is 00H 40H.	GM
PROGRAM CHANGE	CnH pp	Program (patch) change. Specific action on channel 10 (n=9) : select drumset. Refer to sounds / drumset list. Drumsets can be assigned to other channels (see SYSEX MIDI channel to part assign and part to rhythm allocation)	GM/GS
CHANNEL AFTERTOUCH	DnH vv	vv pressure value. Effect set using Sys. Ex. 40H 2nH 20H-26H	MIDI
MIDI RESET	FFH	Reset to power-up condition	
CTRL 00	BnH 00H cc	Bank select : Refer to sounds list. No action on drumset. cc=64 reserved for dream sound editor	GS/DREAM
CTRL 01	BnH 01H cc	Modulation wheel. Rate and maximum depth can be set using SYSEX	MIDI
CTRL 05	BnH 05H cc	Portamento time.	MIDI
CTRL 06	BnH 06H cc	Data entry : provides data to RPN and NRPN	MIDI
CTRL 07	BnH 07H cc	Volume (default=100)	MIDI
CTRL 10	BnH 0AH cc	Pan (default=64 center)	MIDI
CTRL 11	BnH 0BH cc	Expression (default=127)	MIDI/GM
CTRL 64	BnH 40H cc	Sustain (damper) pedal	MIDI
CTRL 65	BnH 41H cc	Portamento ON/OFF	MIDI
CTRL 66	BnH 42H cc	Sostenuto pedal	MIDI
CTRL 67	BnH 43H cc	Soft pedal	MIDI
CTRL 80	BnH 50H vv	Reverb program vv=00H to 07H (default 04H) 00H : Room1 01H : Room2 02H : Room3 03H : Hall1 04H : Hall2 05H : Plate 06H : Delay 07H : Pan delay	DREAM
CTRL 81	BnH 51H vv	Chorus program vv=00H to 07H (default 02H) 00H : Chorus1 01H : Chorus2 02H : Chorus3 03H : Chorus4 04H : Feedback 05H : Flanger 06H : Short delay 07H : FB delay	DREAM
CTRL 91	BnH 5BH vv	Reverb send level vv=00H to 7FH	GS
CTRL 93	BnH 5DH vv	Chorus send level vv=00H to 7FH	GS
CTRL 120	BnH 78H 00H	All sound off (abrupt stop of sound on channel n)	MIDI
CTRL 121	BnH 79H 00H	Reset all controllers	MIDI
CTRL 123	BnH 7BH 00H	All notes off	MIDI
CTRL 126	BnH 7EH 00H	Mono on	MIDI
CTRL 127	BnH 7FH 00H	Poly on (default power-up)	MIDI
CTRL CC1	BnH ccH vvH	Assignable Controller 1. cc=Controller number (0-5Fh), vv=Control value (0-7Fh). Control number (ccH) can be set on CC1 CONTROLLER NUMBER (Sys. Ex 40 1x 1F). The resulting effect is determined by CC1 controller function (Sys.Ex. 40 2x 40-4A)	GS
CTRL CC2	BnH ccH vvH	Assignable Controller 2. cc=Controller number (00h-5Fh), vv=control value (0-7Fh). Control number can be set on CC2 CONTROLLER NUMBER (Sys.Ex. 40 1x 20). The resulting effect is determined by CC2 controller function (Sys.Ex.40 2x 50-5A).	GS
RPN 0000H	BnH 65H 00H 64H 00H 06H vv	Pitch bend sensitivity in semitones (default=2)	MIDI/GM
RPN 0001H	BnH 65H 00H 64H 01H 06H vv	Fine tuning in cents (vv=00 -100, vv=40H 0, vv=7FH +100)	MIDI
RPN 0002H	BnH 65H 00H 64H 02H 06H vv	Coarse tuning in half-tones (vv=00 -64, vv=40H 0, vv=7FH +64)	MIDI
NRPN 0108H	BnH 63H 01H 62H 08H 06H vv	Vibrate rate modify (vv=40H -> no modif)	GS
NRPN 0109H	BnH 63H 01H 62H 09H 06H vv	Vibrate depth modify (vv=40H -> no modif)	GS
NRPN 010AH	BnH 63H 01H 62H 0AH 06H vv	Vibrate delay modify (vv=40H -> no modif)	GS
NRPN 0120H	BnH 63H 01H 62H 20H 06H vv	TVF cutoff freq modify(vv=40H -> no modif)	GS
NRPN 0121H	BnH 63H 01H 62H 21H 06H vv	TVF resonance modify (vv=40H -> no modif)	GS
NRPN 0163H	BnH 63H 01H 62H 63H 06H vv	Env. attack time modify(vv=40H ->no modif)	GS
NRPN 0164H	BnH 63H 01H 62H 64H 06H vv	Env. decay time modify(vv=40H -> no modif)	GS
NRPN 0166H	BnH 63H 01H 62H 66H 06H vv	Env. release time modify(vv=40H ->no modif)	GS
NRPN 18rrH	BnH 63H 18H 62H rr 06H vv	Pitch coarse of drum instr. note rr in semitones (vv=40H -> no modif)	GS

NRPN 1ArrH	BnH 63H 1AH 62H rr 06H vv	Level of drum instrument note rr (vv=00 to 7FH)	GS								
NRPN 1CrrH	BnH 63H 1CH 62H rr 06H vv	Pan of drum instrument note rr (40H = middle)	GS								
NRPN 1DrrH	BnH 63H 1DH 62H rr 06H vv	Reverb send level of drum instrument note rr (vv=00 to 7FH)	GS								
NRPN 1ErrH	BnH 63H 1EH 62H rr 06H vv	Chorus send level of drum instrument note rr (vv=00 to 7FH)	GS								
NRPN 37xxH	BnH 63H 37H 62H xx 06H vv	Special Synthesis features controls (see §1-3- above)	DREAM								
NRPN 38xxH	BnH 63H 38H 62H xx 06H vv	3DMIDI™ control (See §1-3- above)	DREAM								
Standard Sysex	F0H 7EH 7FH 09H 01H F7H	General MIDI reset	GM								
Standard Sysex	F0H 7FH 7FH 04H 01H 00H 11 F7H	Master volume (11=0 to 127, default 127)	GM								
SYSEX	F0H 41H 00H 42H 12H 40H 00H 00H dd dd dd dd xx F7H	Master tune (default dd= 00H 04H 00H 00H) -100.0 to +100.0 cents. Nibblized data should be used (always four bytes). For example, to tune to +100.0 cents, sent data should be 00H 07H 0EH 08H	GS								
SYSEX	F0H 41H 00H 42H 12H 40H 00H 04H vv xx F7H	Master volume (default vv=7FH)	GS								
SYSEX	F0H 41H 00H 42H 12H 40H 00H 05H vv xx F7H	Master key-shift (default vv=40H, no transpose)	GS								
SYSEX	F0H 41H 00H 42H 12H 40H 00H 06H vv xx F7H	Master pan (default vv=40H, center)									
SYSEX	F0H 41H 00H 42H 12H 40H 00H 7FH 00H xx F7H	GS reset	GS								
SYSEX	F0H 41H 00H 42H 12H 40 01H 10H vv1 vv2 vv3 vv4 vv5 vv6 vv7 vv8 vv9 vv10 vv11 vv12 vv13 vv14 vv15 vv16 xx F7h	Voice reserve : vv1= Part 10 (Default vv=2) vv2 to vv10 = Part 1 to 9 (Default vv=2) vv11 to vv16= Part 11 to 16 (Default vv=0)	GS								
SYSEX	F0H 41H 00H 42H 12H 40H 01H 30H vv xx F7H	Reverb type (vv=0 to 7), default = 04H 00H : Room1 01H : Room2 02H : Room3 03H : Hall1 04H : Hall2 05H : Plate 06H : Delay 07H : Pan delay	GS								
SYSEX	F0H 41H 00H 42H 12H 40H 01H 31H vv xx F7H	Reverb character, default 04H	GS								
SYSEX	F0H 41H 00H 42H 12H 40H 01H 33H vv xx F7H	Reverb master level, default = 64	GS								
SYSEX	F0H 41H 00H 42H 12H 40H 01H 34H vv xx F7H	Reverb time	GS								
SYSEX	F0H 41H 00H 42H 12H 40H 01H 35H vv xx F7H	Reverb delay feedback. Only if reverb number=6 or 7 (delays)	GS								
SYSEX	F0H 41H 00H 42H 12H 40H 01H 38H vv xx F7H	Chorus type (vv=0 to 7), default = 02H 00H : Chorus1 01H : Chorus2 02H : Chorus3 03H : Chorus4 04H : Feedback 05H : Flanger 06H : Short delay 07H : FB delay	GS								
SYSEX	F0H 41H 00H 42H 12H 40H 01H 3AH vv xx F7H	Chorus master level, default = 64	GS								
SYSEX	F0H 41H 00H 42H 12H 40H 01H 3BH vv xx F7H	Chorus feedback	GS								
SYSEX	F0H 41H 00H 42H 12H 40H 01H 3CH vv xx F7H	Chorus delay	GS								
SYSEX	F0H 41H 00H 42H 12H 40H 01H 3DH vv xx F7H	Chorus rate	GS								
SYSEX	F0H 41H 00H 42H 12H 40H 01H 3EH vv xx F7H	Chorus depth	GS								
SYSEX	F0H 41H 00H 42H 12H 40H 1pH 02H nn xx F7H	MIDI channel to part assign, p is part (0 to 15), nn is MIDI channel (0 to 15, 16=OFF). This SYSEX allows to assign several parts to a single MIDI channel or to mute a part. Default assignment : <table border="0"> <tr> <td><u>part</u></td> <td><u>MIDI channel</u></td> </tr> <tr> <td>0</td> <td>9 (DRUMS)</td> </tr> <tr> <td>1-9</td> <td>0-8</td> </tr> <tr> <td>10-15</td> <td>10-15</td> </tr> </table>	<u>part</u>	<u>MIDI channel</u>	0	9 (DRUMS)	1-9	0-8	10-15	10-15	GS
<u>part</u>	<u>MIDI channel</u>										
0	9 (DRUMS)										
1-9	0-8										
10-15	10-15										
SYSEX	F0H 41H 00H 42H 12H 40H 1pH 15H vv xx F7H	Part to rhythm allocation, p is part (0 to 15), vv is 00 (sound part) or 01 (rhythm part). This SYSEX allows a part to play sound or drumset. There is no limitation of the number of parts playing drumset. Default assignment : part 0 plays drums (default MIDI channel 9) all other parts play sound.	GS								
SYSEX	F0H 41H 00H 42H 12H 40H 1nH 40H v1 v2 ... v12 xx F7H	Scale tuning, n is MIDI channel (0 to 15), v1 to v12 are 12 semi-tones tuning values (C, C#, D, ... A#, B), in the range -64 (00H) 0 (40H) +63(7FH) cents.	GS								

		This SYSEX allows non chromatic tuning of the musical scale on a given MIDI channel. Default v1, v2, ... ,v12 = 40H, 40H,...,40H (chromatic tuning). Scale tuning has no effect if the part is assigned to a rhythm channel or if the sound played is not of chromatic type.	
SYSEX	F0H 41H 00H 42H 12H 40H 1nH 1AH vv xx F7H	Velocity slope from 00H to 7FH (default = 40H)	GS
SYSEX	F0H 41H 00H 42H 12H 40H 1nH 1BH vv xx F7H	Velocity offset from 00H to 7FH (default = 40H)	GS
SYSEX	F0H 41H 00H 42H 12H 40H 1nH 1FH vv xx F7H	CC1 Controller number (00-5FH) (default = 10H)	GS
SYSEX	F0H 41H 00H 42H 12H 40H 1nH 20H vv xx F7H	CC2 Controller number (00-5FH) (default = 11H)	GS
SYSEX	F0H 41H 00H 42H 12H 40H 2nH 00H vv xx F7H	Mod pitch control (-24,+24 semitone) (default = 40H)	GS
SYSEX	F0H 41H 00H 42H 12H 40H 2nH 01H vv xx F7H	Mod tvf cutoff control (default = 40H)	GS
SYSEX	F0H 41H 00H 42H 12H 40H 2nH 02H vv xx F7H	Mod Amplitude control (-100%+100%) (default=40H)	GS
SYSEX	F0H 41H 00H 42H 12H 40H 2nH 03H vv xx F7H	Mod lfo1 rate control (default = 40H). n is don't care. Rate is common on all channels	GS
SYSEX	F0H 41H 00H 42H 12H 40H 2nH 04H vv xx F7H	Mod lfo1 pitch depth (0-600 cents) (default=0AH)	GS
SYSEX	F0H 41H 00H 42H 12H 40H 2nH 05H vv xx F7H	Mod lfo1 tvf depth (default = 0H)	GS
SYSEX	F0H 41H 00H 42H 12H 40H 2nH 06H vv xx F7H	Mod lfo1 tva depth (0-100%) (default = 0H)	GS
SYSEX	F0H 41H 00H 42H 12H 40H 2nH 10H vv xx F7H	Bend pitch control (-24,+24 semitone) (default = 42H)	GS
SYSEX	F0H 41H 00H 42H 12H 40H 2nH 11H vv xx F7H	Bend tvf cutoff control (default = 40H)	GS
SYSEX	F0H 41H 00H 42H 12H 40H 2nH 12H vv xx F7H	Bend Amplitude control (-100%+100%) (default=40H)	GS
SYSEX	F0H 41H 00H 42H 12H 40H 2nH 14H vv xx F7H	Bend lfo1 pitch depth (0-600 cents) (default=0AH)	GS
SYSEX	F0H 41H 00H 42H 12H 40H 2nH 15H vv xx F7H	Bend lfo1 tvf depth (default = 0H)	GS
SYSEX	F0H 41H 00H 42H 12H 40H 2nH 16H vv xx F7H	Bend lfo1 tva depth (0-100%) (default = 0H)	GS
SYSEX	F0H 41H 00H 42H 12H 40H 2nH 20H vv xx F7H	CAF pitch control (-24,+24 semitone) (default = 40H)	GS
SYSEX	F0H 41H 00H 42H 12H 40H 2nH 21H vv xx F7H	CAF tvf cutoff control (default = 40H)	GS
SYSEX	F0H 41H 00H 42H 12H 40H 2nH 22H vv xx F7H	CAF Amplitude control (-100%+100%) (default=40H)	GS
SYSEX	F0H 41H 00H 42H 12H 40H 2nH 24H vv xx F7H	CAF lfo1 pitch depth (0-600 cents) (default=0AH)	GS
SYSEX	F0H 41H 00H 42H 12H 40H 2nH 25H vv xx F7H	CAF lfo1 tvf depth (default = 0H)	GS
SYSEX	F0H 41H 00H 42H 12H 40H 2nH 26H vv xx F7H	CAF lfo1 tva depth (0-100%) (default = 0H)	GS
SYSEX	F0H 41H 00H 42H 12H 40H 2nH 40H vv xx F7H	CC1 pitch control (-24,+24 semitone) (default = 40H)	GS
SYSEX	F0H 41H 00H 42H 12H 40H 2nH 41H vv xx F7H	CC1 tvf cutoff control (default = 40H)	GS
SYSEX	F0H 41H 00H 42H 12H 40H 2nH 42H vv xx F7H	CC1 Amplitude control (-100%+100%) (default=40H)	GS
SYSEX	F0H 41H 00H 42H 12H 40H 2nH 44H vv xx F7H	CC1 lfo1 pitch depth (0-600 cents) (default=0AH)	GS
SYSEX	F0H 41H 00H 42H 12H 40H 2nH 45H vv xx F7H	CC1 lfo1 tvf depth (default = 0H)	GS
SYSEX	F0H 41H 00H 42H 12H 40H 2nH 46H vv xx F7H	CC1 lfo1 tva depth (0-100%) (default = 0H)	GS
SYSEX	F0H 41H 00H 42H 12H 40H 2nH 50H vv xx F7H	CC2 pitch control (-24,+24 semitone) (default = 40H)	GS
SYSEX	F0H 41H 00H 42H 12H 40H 2nH 51H vv xx F7H	CC2 tvf cutoff control (default = 40H)	GS
SYSEX	F0H 41H 00H 42H 12H 40H 2nH 52H vv xx F7H	CC2 Amplitude control (-100%+100%) (default=40H)	GS
SYSEX	F0H 41H 00H 42H 12H 40H 2nH 54H vv xx F7H	CC2 lfo1 pitch depth (0-600 cents) (default=0AH)	GS
SYSEX	F0H 41H 00H 42H 12H 40H 2nH 55H vv xx F7H	CC2 lfo1 tvf depth (default = 0H)	GS
SYSEX	F0H 41H 00H 42H 12H 40H 2nH 56H vv xx F7H	CC2 lfo1 tva depth (0-100%) (default = 0H)	GS



SAM9773

notes :

NRPN sending method : CTRL#99=high byte, CTRL#98=low byte, CTRL#6=vv
Example : NRPN 0108H = 40H -> CTRL#99=1, CTRL#98=8, CTRL#6=64

x or xx means « don't care »

3- SOUNDS

3-1- MAIN SOUNDS - GENERAL MIDI (all channels except 10)

PC : Program change

PC	GENERAL MIDI	PC	GENERAL MIDI	PC	GENERAL MIDI	PC	GENERAL MIDI
1	(Grand) Piano 1	33	Acoustic Bass	65	Soprano Sax	97	FX 1 (rain)
2	(Bright) Piano 2	34	Finger Bass	66	Alto Sax	98	FX 2 (soundtrack)
3	(El. Grd) Piano 3	35	Picked Bass	67	Tenor Sax	99	FX 3 (crystal)
4	Honky-tonk Piano	36	Fretless Bass	68	Baritone Sax	100	FX4 (atmosphere)
5	El. Piano 1	37	Slap Bass 1	69	Oboe	101	FX 5 (brightness)
6	El. Piano 2	38	Slap Bass 2	70	English Horn	102	FX 6 (goblins)
7	Harpsichord	39	Synth Bass 1	71	Bassoon	103	FX 7 (echoes)
8	Clavi	40	Synth Bass 2	72	Clarinet	104	FX 8 (sci-fi)
9	Celesta	41	Violin	73	Piccolo	105	Sitar
10	Glockenspiel	42	Viola	74	Flute	106	Banjo
11	Music Box	43	Cello	75	Recorder	107	Shamisen
12	Vibraphone	44	Contrabass	76	Pan Flute	108	Koto
13	Marimba	45	Tremolo Strings	77	Blown Bottle	109	Kalimba
14	Xylophone	46	Pizzicato Strings	78	Shakuhachi	110	Bag pipe
15	Tubular Bells	47	Orchestral Harp	79	Whistle	111	Fiddle
16	Santur	48	Timpani	80	Ocarina	112	Shanai
17	Drawbar Organ	49	String Ensemble 1	81	Lead 1 (square)	113	Tinkle Bell
18	Percussive Organ	50	String Ensemble 2	82	Lead 2 (sawtooth)	114	Agogo
19	Rock Organ	51	Synth Strings 1	83	Lead 3 (calliope)	115	Steel Drums
20	Church Organ	52	Synth Strings 2	84	Lead 4 (chiff)	116	Woodblock
21	Reed Organ	53	Choir Aahs	85	Lead 5 (charang)	117	Taiko Drum
22	Accordion (french)	54	Voice Oohs	86	Lead 6 (voice)	118	Melodic Tom
23	Harmonica	55	Synth Voice	87	Lead 7 (fifths)	119	Synth Drum
24	Tango Accordion	56	Orchestra Hit	88	Lead8 (bass+lead)	120	Reverse Cymbal
25	Ac. Guitar (nylon)	57	Trumpet	89	Pad 1 (fantasia)	121	Gt. Fret Noise
26	Ac. Guitar (steel)	58	Trombone	90	Pad 2 (warm)	122	Breath Noise
27	El. Guitar (jazz)	59	Tuba	91	Pad 3 (polysynth)	123	Seashore
28	El. Guitar (clean)	60	Muted Trumpet	92	Pad 4 (choir)	124	Bird Tweet
29	El. Guitar (muted)	61	French Horn	93	Pad 5 (bowed)	125	Teleph. Ring
30	Overdriven Guitar	62	Brass Section	94	Pad 6 (metallic)	126	Helicopter
31	Distortion Guitar	63	Synth Brass 1	95	Pad 7 (halo)	127	Applause
32	Guitar harmonics	64	Synth Brass 2	96	Pad 8 (sweep)	128	Gunshot

3-2- MT-32 SOUND VARIATION #127

(all channels except 10)

To select variation : send CTRL 0 = 127, then PC

PC : Program change

C0 : controller 0 value (zero for General MIDI capital sounds)

PC#	Instrument name	PC#	Instrument name	PC#	Instrument name	PC#	Instrument name
1	Piano 1	2	Piano 2	3	Piano 3	4	Detuned EP 1
5	E.Piano1	6	E.Piano2	7	Detuned EP2	8	Honky-Tonk
9	Organ 1	10	Organ 2	11	Organ 3	12	Detuned Or. 1
13	Church Org. 2	14	Church Org.	15	Church Org.	16	Accordion Fr.
17	Harpsichord	18	Coupled Hps.	19	Coupled Hps.	20	Clav.
21	Clav.	22	Clav.	23	Celesta	24	Celesta
25	Synth Brass1	26	Synth Brass2	27	Synth Brass3	28	Synth Brass4
29	Synth Bass1	30	Synth Bass2	31	Synth Bass3	32	Synth Bass4
33	Fantasia	34	Syn Calliope	35	Choir Aahs	36	Bowed Glass
37	Soundtrack	38	Atmosphere	39	Crystal	40	Bag Pipe
41	Tinkle Bell	42	Ice Rain	43	Oboe	44	Pan Flute
45	Saw Wave	46	Charang	47	Tubular Bells	48	Square Wave
49	Strings	50	Tremolo Str.	51	Slow Strings	52	Pizzicato Str.
53	Violin	54	Viola	55	Cello	56	Cello
57	Contrabass	58	Harp	59	Harp	60	Nylon-str. Gt
61	Steel-Str. Gt	62	Chorus Gt.	63	Funk Gt.	64	Sitar
65	Acoustic Bs.	66	Fingered Bs.	67	Picked Bs.	68	Fretless Bs.
69	Slap Bs. 1	70	Slap Bs. 2	71	Fretless Bs.	72	Fretless Bs.
73	Flute	74	Flute	75	Piccolo	76	Piccolo
77	Recorder	78	Pan Flute	79	Soprano Sax	80	Alto Sax
81	Tenor Sax	82	Baritone Sax	83	Clarinet	84	Clarinet
85	Oboe	86	English Horn	87	Bassoon	88	Harmonica
89	Trumped	90	Muted Trumpet	91	Trombone	92	Trombone
93	French Horn	94	French Horn	95	Tuba	96	Brass
97	Brass 2	98	Vibraphone	99	Vibraphone	100	Kalimba
101	Tinkle Bell	102	Glockenspiel	103	Tubular-Bell	104	Xylophone
105	Marimba	106	Koto	107	Taisho Koto	108	Shakuhachi
109	Whistle	110	Whistle	111	Bottle Blow	112	Pan Flute
113	Timpani	114	Melo Tom	115	Concert BD	116	Synth Drum
117	Melo Tom	118	Taiko	119	Taiko	120	Reverse Cym.
121	Castanets	122	Tinkle Bell	123	Orchestra Hit	124	Telephone
125	Bird	126	Helicopter	127	Bowed Glass	128	Ice Rain

3-3- DRUM SET TABLE (MIDI CHANNEL 10)

	Prog 1 : STANDARD SET	Prog 17 : POWER SET	Prog 41 : BRUSH	Prog 49 : ORCHESTRA	Prog 127: CM -64/32 (Partial)
27 - D#1				Closed Hi Hat	*
28 - E1				Pedal Hi-Hat	*
29 - F1				Open Hi Hat	*
30 - F#1				Ride Cymbal	*
31 - G1					*
32 - G#1					*
33 - A1					*
34 - A#1					*
35 - B1	Kick drum2		Jazz BD 2		Kick drum
36 - C2	Kick drum1		Jazz BD 1		Kick drum
37 - C#2	Side Stick				Rim Shot
38 - D2	Snare Drum 1	Gated Snare	Brush Tap	Snare Drum 2	Snare Drum
39 - D#2	Hand Clap		Brush Slap	Castanets	Hand Clap
40 - E2	Snare Drum 2		Brush Swirl	Snare Drum 2	Elec Snare Drum
41 - F2	Low Floor Tom			Timpani F	Acoustic Low Tom
42 - F#2	Closed Hi Hat [EXC1]			Timpani F#	Closed Hi-Hat [Exc1]
43 - G2	High Floor Tom			Timpani G	Acoustic Low Tom
44 - G#2	Pedal Hi-Hat [EXC1]			Timpani G#	Open Hi-Hat 2
45 - A2	Low Tom			Timpani A	Acoustic Middle Tom
46 - A#2	Open Hi-Hat [EXC1]			Timpani A#	Open Hi-Hat 1 [Exc1]
47 - B2	Low-Mid Tom			Timpani B	Acoustic Middle Tom
48 - C3	Hi Mid Tom			Timpani c	Acoustic High Tom
49 - C#3	Crash Cymbal 1			Timpani c#	Crash Cymbal
50 - D3	High Tom			Timpani d	Acoustic High Tom
51 - D#3	Ride Cymbal 1			Timpani d#	Ride Cymbal
52 - E3	Chinese Cymbal			Timpani e	*
53 - F3	Ride Bell			Timpani f	*
54 - F#3	Tambourine				Tambourine
55 - G3	Splash Cymbal				*
56 - G#3	Cowbell				Cowbell
57 - A3	Crash Cymbal 2				*
58 - A#3	Vibraslap				*
59 - B3	Ride Cymbal 2				*
60 - C4	Hi Bongo				
61 - C#4	Low Bongo				
62 - D4	Mute Hi Conga				
63 - D#4	Open Hi Conga				
64 - E4	Low Conga				
65 - F4	High Timbale				
66 - F#4	Low Timbale				
67 - G4	High Agogo				
68 - G#4	Low Agogo				
69 - A4	Cabasa				
70 - A#4	Maracas				
71 - B4	Short Whistle[EXC2]				
72 - C5	Long Whistle[EXC2]				
73 - C#5	Short Guiro [EXC3]				Vibra Slap
74 - D5	Long Guiro [EXC3]				*
75 - D#5	Claves				Claves
76 - E5	Hi Wood Block				*
77 - F5	Low Wood Block				*
78 - F#5	Mute Cuica [EXC4]				*
79 - G5	Open Cuica [EXC4]				*
80 - G#5	Mute Triangle [EXC5]				*
81 - A5	Open Triangle[EXC5]				*
82 - A#5					Applauses
83 - B5					*
84 - C6					*
85 - C#6					*
86 - D6					*
87 - D#6					*
88 - E6				Applauses	*
89 - F6					*

90 - f#6					*
91 - G6					*
92 - G#6					*
93 - A6					*
94 - A#6					Helicopter
95 - B6					*
96 - C7					Gun Shot
97 - C#7					*
98 - D7					*
99 - D#7					*
100 - E7					*
101 - F7					*
102 - F#7					Birds
103 - G7					*
104 - g#7					*
105 - A7					*
106 - A#7					SeaShore

Notes :

*: No sound Blank : Same sound as "Standard Set"
 [EXC] : Sounds with same EXC number are mutually exclusive

4- AUTO-TEST

Built-in auto-test program is included which can be used for board production testing.
 To start auto-test, send NRPN 3751H = 23H

Sine waveforms at different frequencies will be output to the DAC to indicate the test in progress, as follows :

Test in progress	Output frequency
On chip RAM	1.18 kHz
On chip ROM	876 Hz
PASS	295 Hz

If PASS frequency is detected, this means that part is OK.

APPENDIX**INSTRUMENTS REQUIRING 2 VOICES (2 LAYER INSTRUMENT).**

PC	Name
4	Honky-tonk Piano
19	Rock Organ
22	Accordion (french)
24	Tango Accordion
40	Synth Bass 2
52	Synth Strings 2
56	Orchestra Hit
61	French Horn
63	Synth Brass 1
64	Synth Brass 2
81	Lead 1 (square wave)
82	Lead 2 (saw wave)
83	Lead 3 (calliope)
84	Lead 4 (chiff)
85	Lead 5 (charang)
86	Lead 6 (voice)
87	Lead 7 (fifths)
88	Lead8 (bass+lead)
89	Pad 1 (new age)
91	Pad 3 (polysynth)
93	Pad 5 (bowed)
94	Pad 6 (metallic)
95	Pad 7 (halo)
97	FX 1 (rain)
98	FX 2 (soundtrack)
99	FX 3 (crystal)
100	FX4 (atmosphere)
101	FX 5 (brightness)
102	FX 6 (goblins)
104	FX 8 (sci-fi)
123	Seashore
124	Bird
127	Applause

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