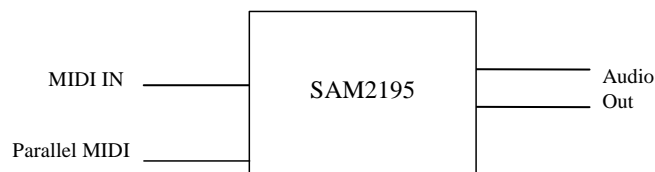


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**LOW POWER SINGLE CHIP SYNTHESIZER  
WITH EFFECTS**

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- Single chip all-in-one design.
  - MIDI control processor, serial and parallel interface
  - Synthesis, General MIDI wavetable implementation
  - General MIDI compatible effects: reverb + chorus
  - Spatial Effect
  - 4-band stereo equalizer
  - Stereo DAC. DR: 86dB min, THD+N: -80dB max
  
- State of the art synthesis for best quality/price products
  - 64-voice polyphony (without effects)
  - 38-voice polyphony + effects
  - On-chip CleanWave™ wavetable data, firmware, RAM delay lines
  
- Audio stereo line output.
  
- Typical applications: battery operated musical keyboards, portable phones, karaokes.
  
- QFN44 (7mm x 7mm) package: small footprint, small pin count
  
- Low power
  - 75mW typ. operating
  - Single 3.3V or single 1.8V power supply
  - Built-in power switch and 3.3V to 1.8V regulator



**Typical hardware configuration**

## 1- PIN DESCRIPTION

### 1-1- PINS BY FUNCTION – 44-lead QFN Package

#### Power supply group

PIN NAME	PIN #	TYPE	FUNCTION
GND	20, 31, 33	PWR	DIGITAL GROUND All pins should be connected to a ground plane
GND	exposed die pad	PWR	DIGITAL GROUND Ground supply; down bonded to the exposed die pad (heatsink). It is recommended, but not obligatory, to connect this pad to a ground plane during PCB layout
VD33	21	PWR	I/O POWER SUPPLY <ul style="list-style-type: none"> <li>- This pin should be connected to a nominal 3.3V power for 3.3V single supply applications.</li> <li>- This pin should be connected to a nominal 1.8V power for 1.8V single supply applications</li> </ul>
VD18	19, 30	PWR	CORE POWER SUPPLY These pins should be connected to nominal 1.8V. <ul style="list-style-type: none"> <li>- <u>3.3V single supply application:</u> If the built-in regulator is used, then these pins should be connected to the output of the regulator OUTVC18 (pin 35).</li> <li>- <u>1.8V single supply application:</u> If the built-in power switch is used for minimum power down consumption, then all these pins should be connected to the output of the power switch PWROUT (pin 39).</li> </ul>
AGND	43, 44	PWR	ANALOG GROUND These pins should be connected to an analog ground plane
VA33	4	PWR	DAC PERIPHERY ANALOG SUPPLY <ul style="list-style-type: none"> <li>- <u>3.3V single supply application:</u> This pin should be connected to a nominal 3.3V power through a serial inductor filter (better result) or a 10 ohm resistor.</li> <li>- <u>1.8V single supply application:</u> This pin should be connected to a nominal 1.8V power through a serial inductor filter (better result) or a 10 ohm resistor.</li> </ul>
VA18	2	PWR	DAC 1.8V ANALOG SUPPLY This pin should be connected to a clean 1.8V. <ul style="list-style-type: none"> <li>- <u>3.3V single supply application:</u> If the built-in regulator is used, then this pin should be connected to the output of the regulator OUTVC18 (pin 35) through a serial inductor filter (better result) or a 10 ohm resistor.</li> <li>- <u>1.8V single supply application:</u> If the built-in power switch is used, then this pin should be connected to the output of the power switch PWROUT (pin 39) through a serial inductor filter (better result) or a 10 ohm resistor.</li> </ul>
REGIN	34	PWR	Regulator input <ul style="list-style-type: none"> <li>- This pin should be connected to a nominal 3.3V power for 3.3V single supply applications.</li> <li>- This pin should be grounded for 1.8V single supply applications</li> </ul>
PWRIN	38	PWR	Power switch input. <ul style="list-style-type: none"> <li>- This pin should be left not connected for 3.3V single supply applications.</li> <li>- This pin should connected to a 1.8V nominal power for 1.8V single supply applications</li> </ul>

### Serial MIDI, parallel MIDI (MPU-401)

PIN NAME	PIN #	TYPE	FUNCTION
MIDI IN	10	IN	Serial TTL MIDI IN. Connected to the built-in synthesizer at power-up or after MPU reset. Connected to the D0-D7 bus (read mode) when MPU switched to UART mode. This pin should be tied HIGH if not used.
D0-D7	15, 16, 17, 18, 22, 23, 24, 25	I/O	8 bit bi-directional bus, under control of CS/, RD/, WR/. These pins have a built-in pull down. They should be left unconnected if not used
A0	11	IN	Select data(0) or control(1) for write, data(0) or status(1) for read. This pin has a built-in pull-down. It should be left unconnected if not used.
CS/	12	IN	Chip select, active low. This pin has a built-in pull up. It should be left unconnected if not used.
RD/	13	IN	Read, active low. When CS/ and RD/ are low, data(A0=0) or status(A0=1) is read on D0-D7. Read data is acknowledged on the rising edge of RD/. This pin has a built-in pull up. It should be left unconnected if not used.
WR/	14	IN	Write, active low. When CS/ and WR/ are low, data (A0=0) or control (A0=1) is written from the D0-D7 bus to the SAM2195 on the rising edge of WR/. This pin has a built-in pull up. It should be left unconnected if not used.
IRQ	26	OUT	A rising edge indicates that a MIDI byte is available for read on D0-D7. Acknowledged by reading the byte.

### Analog audio group

PIN NAME	PIN #	TYPE	FUNCTION
AGNDREF	42	IN	These pin is used as a reference by the internal DAC. It should be connected to a clean analog ground plane
VREF	41	OUT	Reference voltage. Generated on-chip. Should be stabilized by external capacitors 10uF // 100nF to AGND.
VCM	40	OUT	On-chip output stage common-mode voltage. Should be stabilized by external capacitors 10uF // 100nF to AGND.
VBG	3	OUT	Bandgap voltage. Can be stabilized by capacitors 1uF // 100nF to AGND. Can be left unconnected for low-cost application.
AOUTL	1	OUT	Left channel audio output
AOUTR	5	OUT	Right channel audio output

### Digital audio group

PIN NAME	PIN #	TYPE	FUNCTION
OUTLEV	6	IN	Selects the full scale output level for AOUTL and AOUTR. - OUTLEV = 0 for 1.1Vpp - OUTLEV = 1 for 2.2Vpp If 1.8V single supply (VA33 = 1.8V), OUTLEV should be tied to 0.
DITH0-DITH1	7, 8	IN	Activate a dither signal to reduce eventual noise tones at the output. See Dither Modes Description.

Miscellaneous group

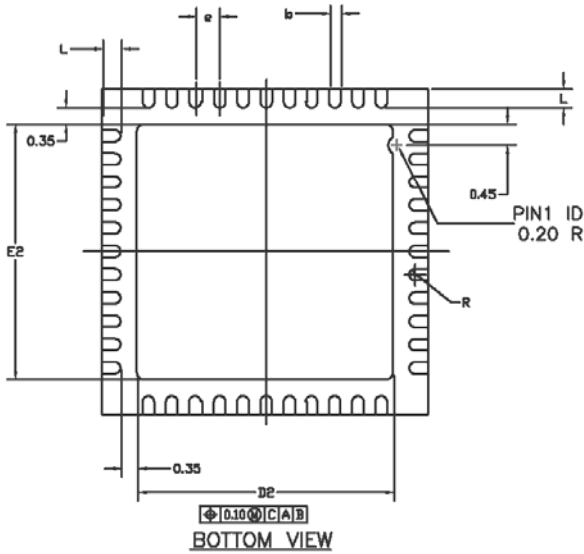
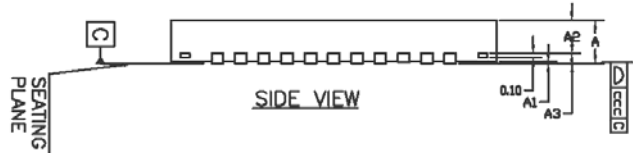
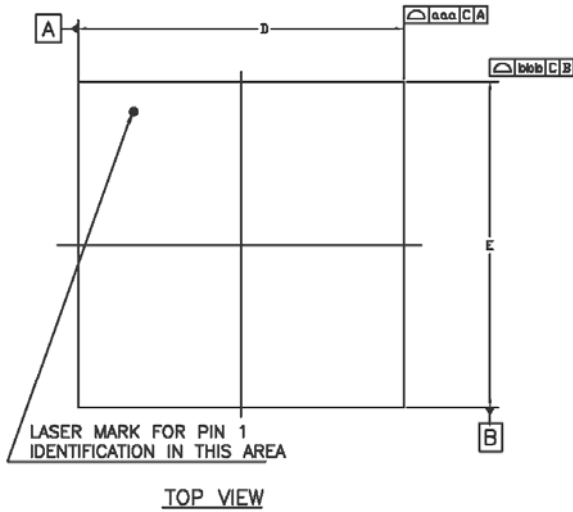
PIN NAME	PIN #	TYPE	FUNCTION
X1-X2	29, 28	-	9.6 MHz crystal connection. An external 9.6 MHz clock can also be used on X1 (1.95V pp max through 47pF capacitor). X2 cannot be used to drive external circuits.
RESET/	9	IN	Reset input, active low. This is a Schmitt trigger input, allowing direct connection to an RC network
OUTVC18	35	PWR	3.3V to 1.8 V regulator output. When 3.3V single supply application this pin can be used to power VD18 pins, and VA18 pin through a serial inductor filter (better result) or a 10 ohm resistor. Decoupling capacitors 470pF in parallel with 2.2 or 4.7µF must be connected between OUTVC18 and GND.
PWROUT	39	PWR	Power switch output. When 1.8V single supply application this pin can be used to power VD18 pins, and VA18 pin through a serial inductor filter (better result) or a 10 ohm resistor.
PDWN/	37	IN	Power down, active low. When power down is active, all digital outputs are set to logic level 0, D0-D7 bus is set in high Z, analog outputs decrease to 0V, the PLL and crystal oscillator are stopped. <u>3.3V single supply application:</u> If the built-in regulator is used then 1.8V supply is removed from the core. To exit from power down, PDWN/ must be set to VD33, then RESET/ applied. When unused this pin must be connected to VD33. <u>1.8V single supply application:</u> If the built-in power switch is used then 1.8V supply is removed from the core. To exit from power down, PDWN/ must be set to VD18, then RESET/ applied. When unused this pin must be connected to VD18
TEST0-TEST1-TEST2	36, 27, 32	IN	Test pins. Should be grounded

1-2- PINOUT BY PIN # - 44-lead QFN Package

PIN#	PIN NAME	PIN #	PIN NAME	PIN#	PIN NAME	PIN#	PIN NAME
1	AOUTL	12	CS/	23	D5	34	REGIN
2	VA18	13	RD/	24	D6	35	OUTVC18
3	VBG	14	WR/	25	D7	36	TEST0
4	VA33	15	D0	26	IRQ	37	PDWN/
5	AOUTR	16	D1	27	TEST1	38	PWRIN
6	OUTLEV	17	D2	28	X2	39	PWROUT
7	DITH0	18	D3	29	X1	40	VCM
8	DITH1	19	VD18	30	VD18	41	VREF
9	RESET/	20	GND	31	GND	42	AGNDREF
10	MIDI IN	21	VD33	32	TEST2	43	AGND
11	A0	22	D4	33	GND	44	AGND

1-3- MECHANICAL DIMENSIONS – 44-lead QFN Package

R-QFN044\_D - QFN



SYMBOL	R-QFN044_D		
	MIN.	NOM.	MAX.
A	—	—	0.90
A1	—	—	0.05
A2	—	0.65	0.70
A3	0.20 REF.		
b	0.18	0.25	0.30
D	6.90	7.00	7.10
D2	5.40	5.50	5.60
E	6.90	7.00	7.10
E2	5.40	5.50	5.60
L	0.35	0.40	0.45
e	0.50 bsc		
R	0.090	—	—
TOLERANCES			
aaa	0.10		
bbb	0.10		
ccc	0.05		

Note : 1. All dimensions are in mm

1-4- MARKING



↑  
Pin 1

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

Parameter	Symbol	Min	Typ	Max	Unit
Temperature under bias	-	-55	-	+125	°C
Storage temperature	-	-65	-	+150	°C
Voltage on any input pin (except X1)	-	-0.3	-	VD33+0.3	V
Voltage on X1	-	-0.3	-	VD18+0.3	V
Supply voltage (I/O)	VD33	-0.3	-	3.6	V
Supply voltage (core)	VD18	-0.3	-	1.95	V
Supply voltage (DAC analog 3.3V)	VA33	-0.3	-	3.6	V
Supply voltage (DAC analog 1.8V)	VA18	-0.3	-	1.95	V
Maximum IOL per I/O pin	-	-	-	4	mA
Maximum IOH per I/O pin	-	-	-	4	mA
Maximum Output current from PWROUT pin (max duration = 1sec)	IPWRO	-	-	650	mA
Maximum Output current from OUTVC18 pin (max duration = 1sec)	IREGO	-	-	100	mA

\*NOTICE: Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

## 3- RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Min	Typ	Max	Unit
Digital supply voltage: - OUTLEV = 1	VD33	3	3.3	3.6	V
- OUTLEV = 0	VD33	1.65		1.95	V
Digital supply voltage	VD18	1.65	1.8	1.95	V
Analog supply voltage: - OUTLEV = 1	VA33	3	3.3	3.6	V
- OUTLEV = 0	VA33	1.65	1.8	1.95	V
Analog supply voltage	VA18	1.65	1.8	1.95	V
Power switch supply	PWRIN	1.75	1.80	1.95	V
Regulator supply	REGIN	2.7	3.3	3.6	V
Power Switch output current	IPWRO	-	-	217	mA
OUTVC18 output current	IREGO	-	60	-	mA
Operating ambient temperature	tA	0	-	+70	°C

## 4- DIGITAL CHARACTERISTICS

(TA=25°C, VD33=3.3V±10%, 1.65 V < VD18 < 1.95V)

Parameter	Symbol	Min	Typ	Max	Unit
Low level input voltage (Except X1)	VIL	-0.3	-	0.8	V
High level input voltage (Except X1)	VIH	2	-	3.6	V
Low level input voltage for X1	VIL	-0.3	-	0.3	V
High level input voltage for X1	VIH	1.2	-	VD18+0.3	V
Low level output voltage IOL=-2mA	VOL	-	-	0.4	V
High level output voltage IOH=2mA	VOH	VD33-0.4	-	-	V
Power consumption (crystal freq.=9.6MHz)	-	-	75		mW
Power down supply current (using power switch)	-		<1		µA
Drop down from PWRIN to PWROUT (at IPWRO = 180mA)	-			0.1	V
Voltage on OUTVC18 (at IREGO = 60mA)	VREGO	1.65	1.8	1.95	V

## 5- ANALOG. CHARACTERISTICS

(TA=25°C)

Parameter	Symbol	Min	Typ	Max	Unit
Total Harmonic Distortion + Noise (at 0 dB, full scale)					
- VA33 = 3.3V, OUTLEV = 1	THD + N	-	-	-80	dB
- VA33 = 1.8V, OUTLEV = 0	THD + N	-	-	-76	dB
Dynamic Range (A-Weighted)					
- VA33 = 3.3V, OUTLEV = 1	DR	86	-	-	dB
- VA33 = 1.8V, OUTLEV = 0	DR	80	-	-	dB
Inter-channel isolation (1kHz)					
- VA33 = 3.3V, OUTLEV = 1	-	83	-	-	dB
- VA33 = 1.8V, OUTLEV = 0	-	80	-	-	dB
Inter-channel gain mismatch	-	-0.1	-	+01	dB
Gain drift	-	-	± 100	-	ppm/ °C
Full-scale output voltage					
- VA33 = 3.3V, OUTLEV = 1	-	2.04	2.2	2.36	Vpp
- VA33 = 1.8V or 3.3V, OUTLEV = 0	-	1.02	1.1	1.18	Vpp
VCM Maximum allowable DC current source	-	-	-	0.1	mA
VCM Nominal voltage					
- VA33 = 3.3V, OUTLEV = 1	-	1.38	1.5	1.58	V
- VA33 = 1.8V or 3.3V, OUTLEV = 0	-	0.74	0.80	0.84	V
AC-Load resistance	RL	3	4.7		kΩ
Load capacitance	CL	-	10	100	pF

## 6- FILTER. CHARACTERISTICS

(TA=25°C)

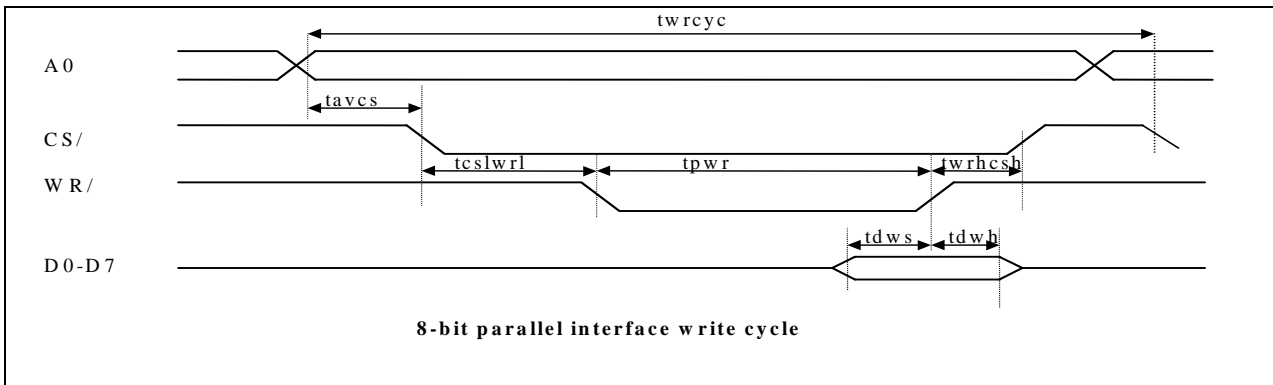
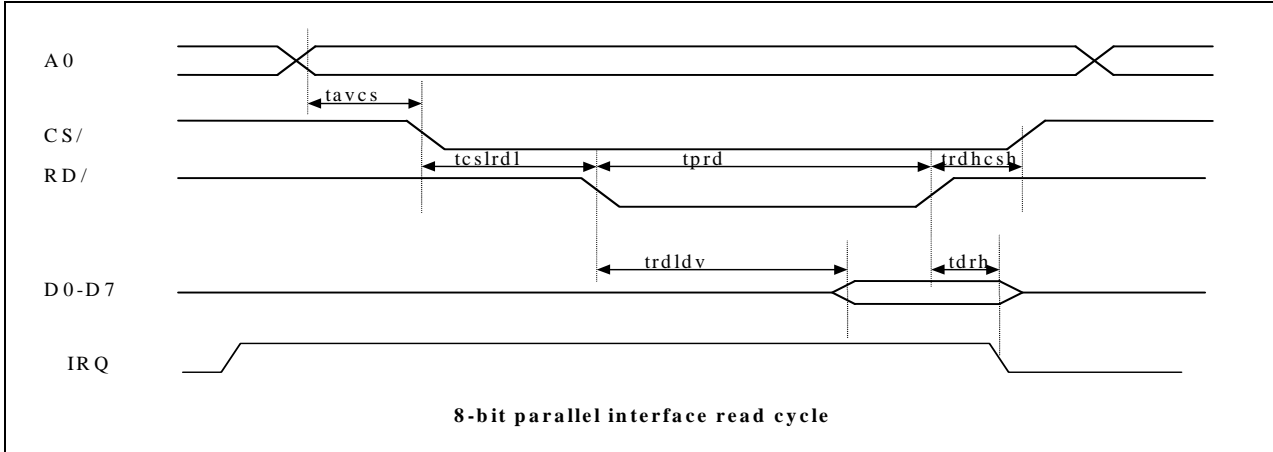
Parameter	Symbol	Min	Typ	Max	Unit
Frequency response (10Hz – 17kHz)	-	-0.05	-	+0.05	dB
Passband					
- to -0.1dB corner	PB	0	-	17	kHz
- to -6 dB corner	PB	0	-	18.74	kHz
Stopband	SB		20.49		kHz
Stopband attenuation (20.49kHz – 112.5kHz)	SA	65	-	-	dB
Group delay	GD		1.12		ms
Gain drift	-	-	± 100	-	ppm/ °C



**7- TIMINGS**

**7-1- SLAVE 8-BIT PARALLEL INTERFACE**

This interface is typically used to connect the chip to an host processor.



Parameter	Symbol	Min	Typ	Max	Unit
Address valid to chip select low	tavgcs	0	-	-	ns
Chip select low to RD/ low	tcslrdl	5	-	-	ns
RD/ high to CS/ high	trdhcsh	5	-	-	ns
RD/ pulse width	tprd	50	-	-	ns
Data out valid from RD/	trlddv	-	-	20	ns
Data out hold from RD/	tdrh	5	-	10	ns
Chip select low to WR/ low	tcslwrll	5	-	-	ns
WR/ high to CS/ high	twrhcsh	5	-	-	ns
WR/ pulse width	tpwr	50	-	-	ns
Write data setup time	tdws	10	-	-	ns
Write data hold time	tdwh	0	-	-	ns
Write cycle	twrcyc	3.5			µs

**Notes:**

- When data is pending on parallel port, the host should read it within 1 ms. If not, the parallel port will be deactivated. Reactivating the port can be done with the following control sequence: 0FFh (Closed port), 03Fh (Open port).
- For safe operation, write cycle time should not be lower than 3.5µs.

**8- 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 SAM2195 enters an initialization routine. It takes around 50 ms before a MIDI IN or MPU message can be processed.

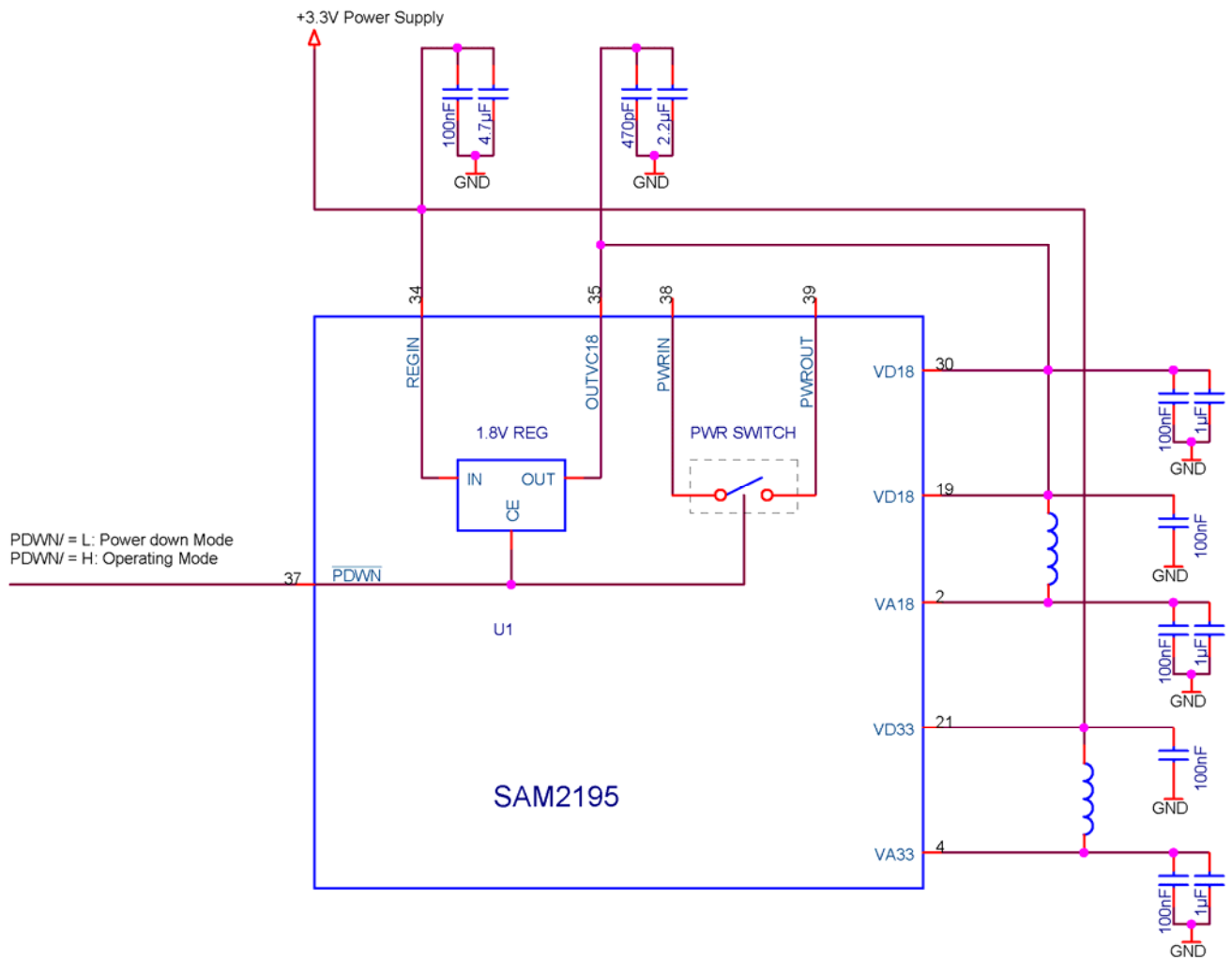
Audio will begin after 500 ms, maximum.

To enter power-down, Reset should be held low 500ms min and then PDWN/ is asserted low. In Power-down mode 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.

**8-1- 3.3V SINGLE SUPPLY APPLICATION**

Power down mode is managed by the internal regulator. The equivalent schematic and standard connection is shown on the diagram below.

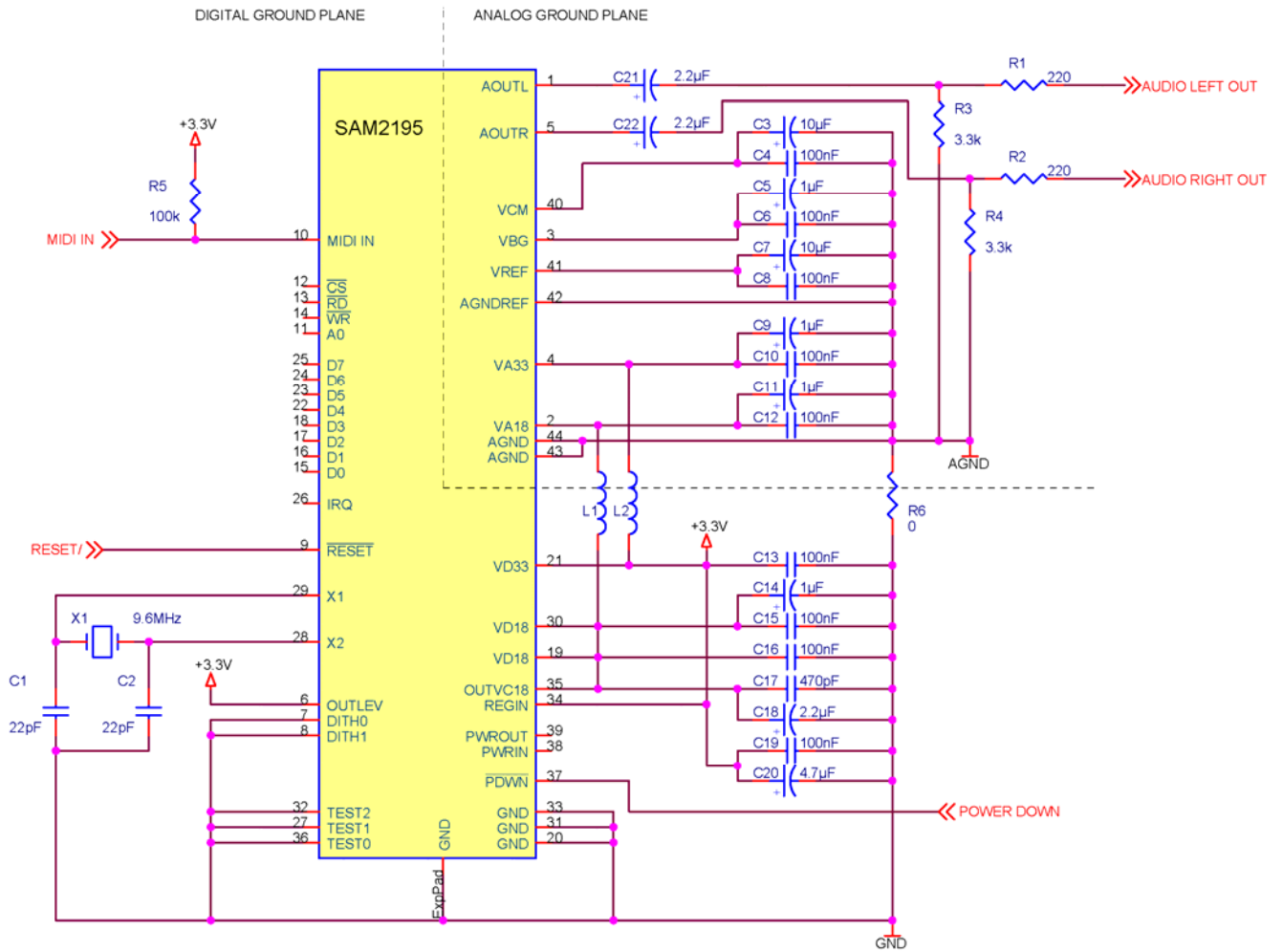




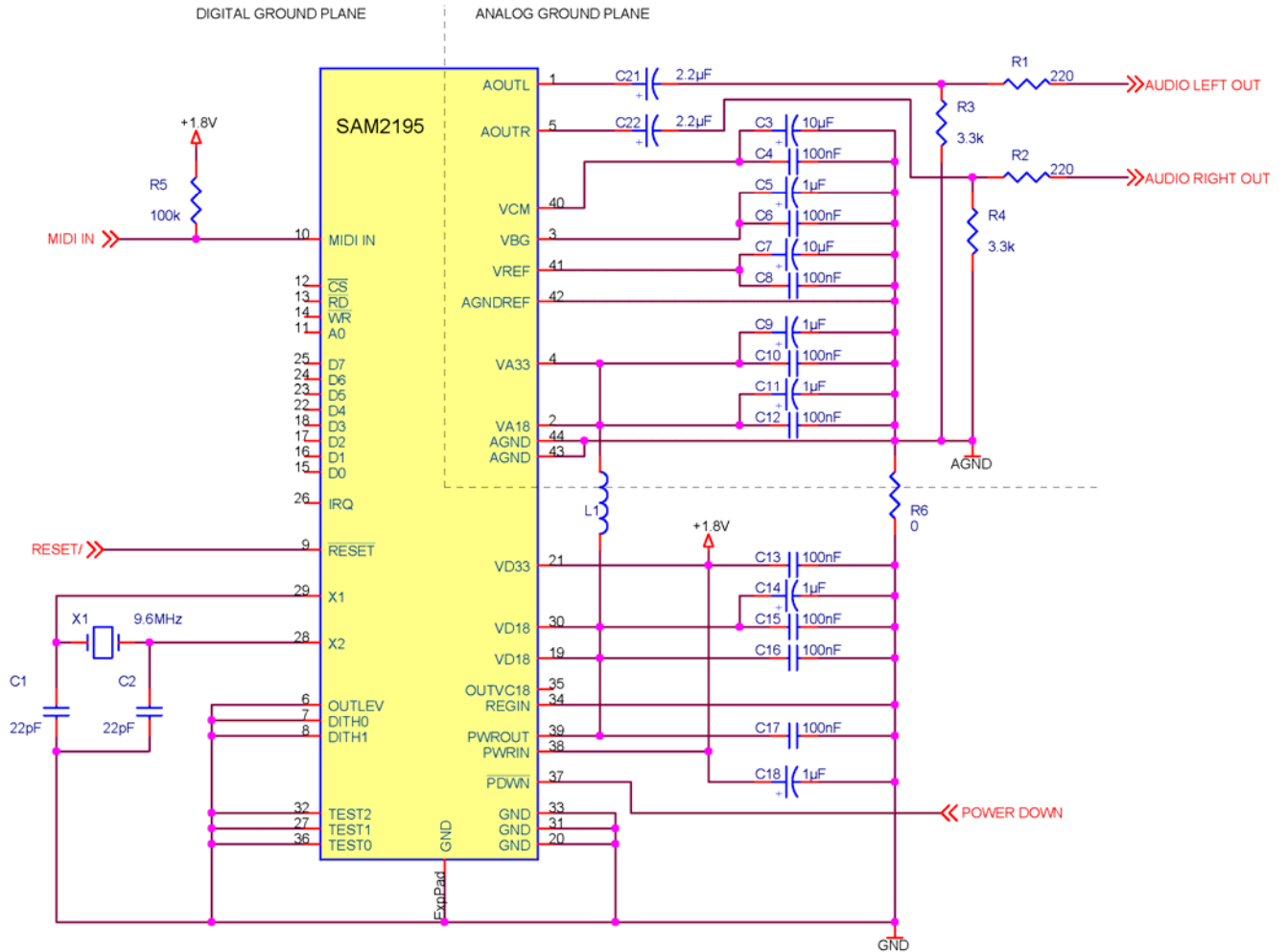
**10- SYSTEM DESIGN**

The schematics of this section are the reference designs for applications with SAM2195. The conformity with these schematics ensures the best performances.

**10-1- 3.3V SINGLE SUPPLY APPLICATION**



## 10-2- 1.8V SINGLE SUPPLY APPLICATION



## 11- RECOMMENDED BOARD LAYOUT

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

- GND, VD33, VD18, VA33, VA18 distribution and decoupling

All GND, VD33, VD18, VA33, VA18 pins should be connected. A GND plane is strongly recommended below the SAM2195. The board GND, VD33, VD18 distribution should be in grid form. Recommended decoupling is 0.1 $\mu$ F at each VD33, VD18, VA33, VA18 pin of the IC with an additional 1 $\mu$ F-T between pins 30 and 31. Decoupling capacitors should be implemented close to the IC.

- Crystal

The paths between the crystal and the SAM2195 should be short and shielded. The ground return from the crystal compensation capacitors should be pin 31.

- 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.

## SAM2195 USER'S MANUAL

### 1- PARALLEL AND SERIAL MIDI MODES

The SAM2195 can be controlled both from the parallel interface (D0-D7, CS/, WR/, RD/, INT) or from the serial MIDI interface (MIDI IN).

The parallel Interface consists of two byte registers and one IRQ (interrupt request) line:

I/O address	Write from host	Read to host
A0 = 0	DATA8	DATA8
A0 = 1	CONTROL	STATUS

#### **Status Register**

TE	RF	X	X	X	X	X	X
----	----	---	---	---	---	---	---

**TE:** Transmit empty.

If 0, data from SAM2195 to host is pending and IRQ is high.

When host is reading the data in DATA8 register (A0 = 0), TE goes to 1 and IRQ is low again.

**RF:** Receiver full.

If 0 then SAM2195 is ready to accept CONTROL or DATA from host. However, minimum time between two consecutive writes must be 3.5 µs (even if RF is not set).

#### **Serial & Parallel modes**

##### **Serial mode:**

After power-up, hardware reset or parallel reset control, the SAM2195 is in **serial mode**:

In this mode, the parallel MIDI interface is inactive and the IRQ line is floating. The serial MIDI IN is connected to the synthesis.

In serial mode, the 8-bit parallel interface accepts two controls:

- 3Fh to switch to **parallel mode**  
SAM2195 is acknowledging 3Fh control by sending to host FEh in DATA8 register.
- BEh to send any control (see list of control message in chapter 2-2).  
BEh allows to send only one control, which means that each control sent in serial mode should start with BEh control.

##### **Parallel mode:**

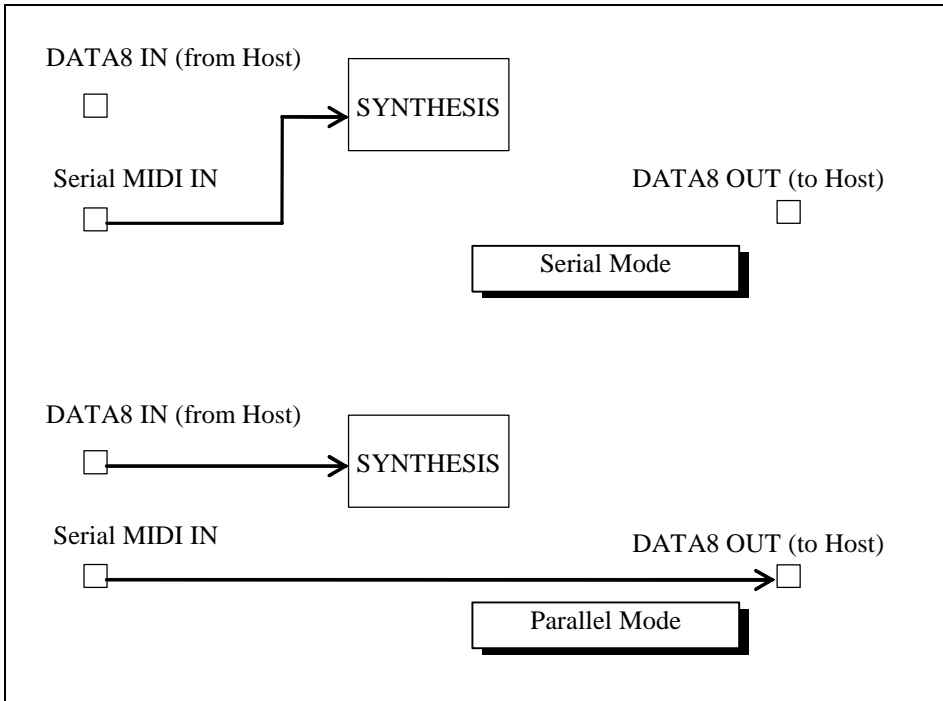
In parallel mode, all data received by SAM2195 on its serial MIDI IN pin is sent to host through the 8-bit register DATA8 but is not sent to synthesis.

Midi Data received by SAM2195 from host through register DATA8 is sent to the synthesis.

Parallel mode accepts following controls:

- FFh (parallel mode reset) switch back to **serial mode**.
  - Additional controls listed in paragraph 2.2.  
These additional controls, being independent of the MIDI data flow, allow to easily insert some special messages (for controlling some SAM2195 effect modules), in the middle of a MIDI data flow.

The following diagram illustrates serial and parallel mode:





## 2- CONFIGURATION AND SPECIAL MESSAGES

SAM2195 includes the following modules: 4-band Equalizer, Chorus effect, Reverb effect, Spatial effect. Some special messages allow to set parameters for these modules. Messages have two formats:

- NRPN or SysEx midi messages: this format can be use either in serial mode or in parallel mode
- Parallel controls: this format should be used in parallel mode only.

### 2-1 SPECIAL MIDI MESSAGES

(received on serial MIDI in serial mode or on 8-bit data port in parallel mode)

Special midi messages are sent using midi Nrpn messages. These NRPN messages are mainly using NRPN high=037h. For example, master volume can be set using NRPN "3707h", which means:

- NRPN high = 037h: midi control 99 (63h) = 55 (37h) --> midi message = 0B0h 063h 037h
- NRPN low = 07h: midi control 98 (62h) = 07 (07h) --> midi message = 0B0h 062h 07h
- NRPN value=vv: midi control 6 (06h) =vv --> midi message = 0B0h 006h vv  
vv being master volume value in range 0 to 127 (0 to 7Fh).

Here is below list of all special NRPNs.

For controlling reverb/chorus, use standard reverb/chorus midi system exclusive messages listed in paragraph 3 "Detailed MIDI implementation".

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 (1) 7Fh=Post effects applied (1)	7Fh
371Ah	Post effects applied on Reverb/Chorus 0= Post effects not applied (1) 7Fh=Post effects applied (1)	7Fh
3720h	Spatial Effect volume (2) 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	Spatial Effect delay (2) 0=shortest to 7Fh=longest	1Dh
372Dh	Spatial Effect input (2) 0=stereo 7Fh=mono	00h
3751h	Auto - test See section 6	
3757h	System Exclusive Device ID 0 to 1Fh, 20h=all accepted	20h
375Fh	Effect ON/OFF – Polyphony Select. See section 5	20h

Notes:

- (1) Post effects are Spatial Effect + equalizer
- (2) See Block diagram in Appendix

## SPECIAL MIDI MESSAGES DETAILS

### SYSTEM MESSAGES

NRPN # (High Low)	CONTROL NAME	Parameters (Data)	Action
3707h	MASTER_VOL	Data (byte 0-7Fh,7Fh)	Master volume

#### - MASTER\_VOL:

Master volume.

Data range : 0-7Fh. Default=7Fh.

### SPATIAL EFFECT DEVICE

See Block diagram in Appendix.

NRPN # (High Low)	CONTROL NAME	Parameters (Data)	Action
3720h	SUR_VOL	-Data(byte 0-7Fh,0)	Spatial Effect volume
372Ch	SUR_DEL	-Data(byte 0-7Fh,1Dh)	Spatial Effect delay
372Dh	SUR_INP	-Data(byte 0/7Fh,0)	Input mono/stereo select for Spatial Effect

- **SUR\_VOL:** Spatial Effect volume.  
Default=0

- **SUR\_DEL:** Delay time  
Default=1Dh

- **SUR\_INP:** Input type select  
 0 Stereo (default), Stereo wide, Input to delay line is left - right.  
 7Fh Mono, Pseudo stereo Input to delay line is left + right.

### ROUTING MESSAGES

NRPN # (High Low)	CONTROL NAME	Parameters (Data)	Action
3718h	GM_POST	-Data(byte 0/7Fh,7Fh)	Post effects applied on General MIDI
371Ah	EFF_POST	-Data(byte 0/7Fh,7Fh)	Post effects applied on Reverb-chorus

#### - xxx\_POST:

Post effects are Spatial Effect and equalizer.

Post effects can be separately applied on each module. However general settings of post effects (EQ\_XXX, EQF\_XXX, EQU\_TYPE, SUR\_VOL, SUR\_DEL, SUR\_INP) are common for all modules.

Data = 00h: post effects not applied on module.

Data = 7Fh: post effects applied on module.

Default value = 7Fh

## MIDI MESSAGES

NRPN # (High Low)	CONTROL NAME	Parameters (Data)	Action
3722h	GM_VOL	-Data(byte 0-7Fh,7Fh)	General MIDI volume
3723h	GM_PAN	-Data(byte 0-7Fh,40h)	General MIDI pan

### - GM\_VOL

Range 0-7Fh, linear scale.

Default value: GM\_VOL=07Fh

### - GM\_PAN

0=hard left, 40h=center, 7Fh=hard right.

Same as GM system exclusive message « 40h 00h 06h »

Default value: GM\_PAN=40h

## EQUALIZER DEVICE

NRPN # (High Low)	CONTROL NAME	Parameters (Data)	Action
3700h	EQ_LB	-Level (byte 0-7Fh,60h)	Equalizer low band
3701h	EQ_MLB	-Level (byte 0-7Fh,40h)	Equalizer med low band
3702h	EQ_MHB	-Level (byte 0-7Fh,40h)	Equalizer med high band
3703h	EQ_HB	-Level (byte 0-7Fh,60h)	Equalizer high band
3708h	EQF_LB	-Data (byte 0-7Fh,0Ch)	Equalizer low band frequency
3709h	EQF_MLB	-Data (byte 0-7Fh,1Bh)	Equalizer med low band frequency
370Ah	EQF_MHB	-Data (byte 0-7Fh,72h)	Equalizer med high band frequency
370Bh	EQF_HB	-Data (byte 0-7Fh,40h)	Equalizer high band frequency

**EQ\_xxx:** Band level

00h	20h	40h	60h	7Fh
-12dB	-6dB	0dB	+6dB	+12dB

Default =60h (+6dB) for LB-HB, =40h(0dB) for MLB-MHB

**EQF\_xxx:** Band frequency (0-7Fh), linear scale

Band	Range	Default
LB	0-4.7Khz	0Ch
MLB	0-4.2Khz	1Bh
MHB	0-4.2Khz	72h
HB	0-18.75Khz	40h

## 2-2- CONTROLS

(received on parallel CONTROL register)

Controls are normally sent in parallel mode. Individual controls can also be sent on 8-bit port in serial mode if preceded by control BEh.

### CONTROL MESSAGES OVERVIEW

A control message consists of one CONTROL byte followed by one DATA8 byte (parameter).

Ctrl #	Description	Power-up default	Compatible NRPN/SYSEX
7h	Master Volume	0 to FFh	FFh Nrpnp 3707h
10h	Equalizer low band left (bass)	0=-12dB, 40h=0dB, 7Fh=+12dB	60h Nrpnp 3700h
11h	Equalizer med low band left	0=-12dB, 40h=0dB, 7Fh=+12dB	40h Nrpnp 3701h
12h	Equalizer med high band left	0=-12dB, 40h=0dB, 7Fh=+12dB	40h Nrpnp 3702h
13h	Equalizer high band left (treble)	0=-12dB, 40h=0dB, 7Fh=+12dB	60h Nrpnp 3703h
14h	Equalizer low band right (bass)	0=-12dB, 40h=0dB, 7Fh=+12dB	60h Nrpnp 3700h
15h	Equalizer med low band right	0=-12dB, 40h=0dB, 7Fh=+12dB	40h Nrpnp 3701h
16h	Equalizer med high band right	0=-12dB, 40h=0dB, 7Fh=+12dB	40h Nrpnp 3702h
17h	Equalizer high band right (treble)	0=-12dB, 40h=0dB, 7Fh=+12dB	60h Nrpnp 3703h
18h	Equalizer Low cutoff freq	0=0Hz, 7Fh=4.7 kHz	0Ch Nrpnp 3708h
19h	Equalizer Med Low cutoff freq	0=0Hz, 7Fh=4.2 kHz	1Bh Nrpnp 3709h
1Ah	Equalizer Med High cutoff freq	0=0Hz, 7Fh=4.2 kHz	72h Nrpnp 370Ah
1Bh	Equalizer High cutoff freq	0=0Hz, 7Fh=18.75 kHz	40h Nrpnp 370Bh
25h	General MIDI reverb send	0=no send, 80h=default send, FFh=max	80h Nrpnp 3715h
26h	General MIDI chorus send	0=no send, 80h=default send, FFh=max	80h Nrpnp 3716h
30h	Spatial Effect volume (2)	0= no effect, FFh= maximum effect	00h Nrpnp 3720h
31h	Spatial Effect delay (2)	0=shortest to 7Fh=longest	1Dh Nrpnp 372Ch
32h	Spatial Effect input (2)	0=stereo 7Fh=mono	00h Nrpnp 372Dh
38h	General MIDI volume	0 to FFh	FFh Nrpnp 3722h
39h	General MIDI pan	0=left, 40h=center, 7Fh=right	40h Nrpnp 3723h
3Ah	Reverb general volume	0 to FFh	(2) SysEx 40h 01h 33h
3Bh	Chorus general volume	0 to FFh	(2) SysEx 40h 01h 3Ah
3Fh	Switch to UART mode		
62h	Post effects applied on GM	0= Post effects not applied (1) 7Fh=Post effects applied (1)	7Fh Nrpnp 3718h
66h	Post effects applied on Reverb/Chorus	0= Post effects not applied (1) 7Fh=Post effects applied (1)	7Fh Nrpnp 371Ah
69h	Reverb program select	0 to 7h	04h SysEx 40h 01h 30h
6Ah	Chorus program select	0 to 7h	02h SysEx 40h 01h 38h
74h	Chorus delay		(3) SysEx 40h 01h 3Ch
75h	Chorus feedback		(3) SysEx 40h 01h 3Bh
76h	Chorus rate		(3) SysEx 40h 01h 3Dh
77h	Chorus depth		(3) SysEx 40h 01h 3Eh
78h	Reverb time		(3) SysEx 40h 01h 34h
79h	Reverb feedback. Only if reverb number=6 or 7 (delays)		(3) SysEx 40h 01h 35h
7Eh	Clipping mode select	0=soft clip, 7Fh=hard clip	00h Nrpnp 3713h
BEh	Enable Dream control in stand alone mode		
FFh	Reset UART mode		

#### Notes:

- (1) Post effects are Spatial Effect + equalizer
- (2) See Block diagram in Appendix
- (3) See CONTROL MESSAGES DETAILS

## CONTROL MESSAGES DETAILS

### SYSTEM MESSAGES

Ctrl #	CONTROL NAME	Parameters (Data)	Action	Answer
07h	MASTER_VOL	Data (byte 0-FFh,FFh)	Master volume	
BEh	EN_CONTROL	None	Enable dream control in stand alone mode	
FFh	RESET	None	Reset UART mode	
3Fh	UART_MOD	None	Switch to UART mode	Data= FEh

#### - MASTER\_VOL:

Master volume.

Data range : 0-FFh. Default=FFh.

#### - EN\_CONTROL:

This control has been implemented to enable to send any parallel control even in **Serial mode**.

It allows to send only one parallel control, which means that each control sent in serial mode should start with EN\_CONTROL control.

#### - RESET:

Switch SAM2195 in serial mode

#### - UART\_MODE:

Switch SAM2195 in parallel mode

### SPATIAL EFFECT DEVICE

See Block diagram in Appendix.

Ctrl #	CONTROL NAME	Parameters (Data)	Action	Answer
30h	SUR_VOL	-Data(byte 0-FFh,0)	Spatial Effect volume	
31h	SUR_DEL	-Data(byte 0-7Fh,1Dh)	Spatial Effect delay	
32h	SUR_INP	-Data(byte 0/7Fh,0)	Input mono/stereo select for Spatial Effect	

- **SUR\_VOL:** Spatial Effect volume.  
Default=0

- **SUR\_DEL:** Delay time  
Default=1Dh

- **SUR\_INP:** Input type select  
 0 Stereo (default), Stereo wide, Input to delay line is left - right.  
 7Fh Mono, Pseudo stereo Input to delay line is left + right.

### ROUTING MESSAGES

Ctrl #	CONTROL NAME	Parameters (Data)	Action	Answer
62h	GM_POST	-Data(byte 0/7Fh,7Fh)	Post effects applied on general MIDI	
66h	EFF_POST	-Data(byte 0/7Fh,7Fh)	Post effects applied on Reverb-chorus	

#### - xxx\_POST:

Post effects are Spatial Effect and equalizer.

Post effects can be separately applied on each module. However general settings of post effects (EQ\_XXX, EQF\_XXX, EQU\_TYPE, SUR\_VOL, SUR\_DEL, SUR\_INP) are common for all modules.

Data = 00h: post effects not applied on module.

Data = 7Fh: post effects applied on module.

Default value = 7Fh

## MIDI MESSAGES

Ctrl #	CONTROL NAME	Parameters (Data)	Action	Answer
38h	GM_VOL	-Data(byte 0-FFh,FFh)	General MIDI volume	
39h	GM_PAN	-Data(byte 0-7Fh,40h)	General MIDI pan	

### - GM\_VOL

Range 0-FFh, linear scale.

Default value: GM\_VOL=0FFh

### - GM\_PAN

0=hard left, 40h=center, 7Fh=hard right.

Same as GM system exclusive message « 40h 00h 06h »

Default value: GM\_PAN=40h

## REVERB DEVICE

Ctrl #	CONTROL NAME	Parameters (Data)	Action	Answer
69h	REV_TYPE	-Data(byte 0-7,4)	Reverb program select	
3Ah	REV_VOL	-Data(byte 0-FFh)	Reverb general volume	
78h	REV_TIME	-Data(byte 0-7Fh)	Reverb time	
79h	REV_FEED	-Data(byte 0-7Fh)	Reverb feedback	
25h	GMREV_SEND	-Data(byte 0-FFh,80h)	General MIDI Reverb Send	

### - REV\_TYPE: Reverb program.

Same as GM system exclusive message « 40h 01h 30h » or control 80.

room1	room2	room3	hall1	hall2	plate	delay	pan delay
0h	1h	2h	3h	4h	5h	6h	7h

Default=4 (hall2)

### REV\_VOL: Reverb volume

Same as GM system exclusive message « 40h 01h 33h »

Default values:

room1	room2	room3	hall1	hall2	plate	delay	pan delay
90h	90h	90h	C0h	90h	90h	FFh	FFh

### - REV\_TIME: Reverb time.

Same as GM system exclusive message « 40h 01h 34h »

Default values:

room1	room2	room3	hall1	hall2	plate	delay	pan delay
7Fh	7Fh	7Fh	7Fh	7Fh	7Fh	18h	7Fh

### - REV\_FEED: Reverb delay feedback.

Only if reverb number=6 or 7 (delays)

This control is same as GM system exclusive message « 40h 01h 35h »

Default values:

delay	pan delay
22h	26h

### -GMREV\_SEND: Modify reverb send level for General MIDI.

80h: original reverb send levels of MIDI sequence not modified

0 to 7Fh: original reverb send levels decreased

81h to FFh: original reverb send levels increased

Default=80h

**CHORUS DEVICE**

Ctrl #	CONTROL NAME	Parameters (Data)	Action	Answer
6Ah	CHR_TYPE	-Data(byte 0-7,2)	Chorus program select	
3Bh	CHR_VOL	-Data(byte 0-FFh)	Chorus general volume	
74h	CHR_DEL	-Data(byte 0-7Fh)	Chorus delay	
75h	CHR_FEED	-Data(byte 0-7Fh)	Chorus feedback	
76h	CHR_RATE	-Data(byte 0-7Fh)	Chorus rate	
77h	CHR_DEPTH	-Data(byte 0-7Fh)	Chorus depth	
26h	GMCHR_SEND	-Data(byte 0-FFh,80h)	General MIDI Chorus Send	

- **CHR\_TYPE:** Chorus program.  
Same as GM system exclusive message « 40h 01h 38h » or control 81.

chorus1	chorus2	chorus3	chorus4	FB chorus	flanger	short del	FB delay
00h	01h	02h	03h	04h	05h	06h	07h

Default = 2 (chorus3)

- **CHR\_VOL:** Chorus Volume  
Same as GM system exclusive message « 40h 01h 3Ah »

- **CHR\_DEL:** Chorus delay  
Same as GM system exclusive message « 40h 01h 3Ch »

- **CHR\_FEED:** Chorus feedback  
Same as GM system exclusive message « 40h 01h 3Bh »

- **CHR\_RATE:** Chorus rate  
Same as GM system exclusive message « 40h 01h 3Dh »

- **CHR\_DEPTH:** Chorus depth  
Same as GM system exclusive message « 40h 01h 3Eh »

- **GMCHR\_SEND:** Modify chorus send level for General MIDI.  
Data = 80h: original chorus send levels of MIDI sequence not modified  
Data = 00h to 7Fh: original chorus send levels decreased  
Data = 81h to FFh: original chorus send levels increased  
Default = 80h

Default values:

	chorus1	Chorus2	chorus3	chorus4	FB chorus	flanger	short del	FB delay
CHR_VOL	90h	90h	90h	90h	90h	90h	FFh	FFh
CHR_DEL	4Bh	40h	40h	2Bh	7Fh	56h	7Fh	7Fh
CHR_FEED	00h	07h	09h	0Ch	48h	7Fh	00h	50h
CHR_RATE	03h	09h	03h	09h	02h	01h	00h	00h
CHR_DEPTH	05h	13h	13h	10h	0Ch	03h	00h	00h

**EQUALIZER DEVICE**

Ctrl #	CONTROL NAME	Parameters (Data)	Action	Answer
10h	EQ_LBL	-Level (byte 0-7Fh,60h)	Equalizer low band left	
11h	EQ_MLBL	-Level (byte 0-7Fh,40h)	Equalizer med low band left	
12h	EQ_MHBL	-Level (byte 0-7Fh,40h)	Equalizer med high band left	
13h	EQ_HBL	-Level (byte 0-7Fh,60h)	Equalizer high band left	
14h	EQ_LBR	-Level (byte 0-7Fh,60h)	Equalizer low band right	
15h	EQ_MLBR	-Level (byte 0-7Fh,40h)	Equalizer med low band right	
16h	EQ_MHBR	-Level (byte 0-7Fh,40h)	Equalizer med high band right	
17h	EQ_HBR	-Level (byte 0-7Fh,60h)	Equalizer high band right	
18h	EQF_LB	-Data (byte 0-7Fh,0Ch)	Equalizer low band frequency	
19h	EQF_MLB	-Data (byte 0-7Fh,1Bh)	Equalizer med low band frequency	
1Ah	EQF_MHB	-Data (byte 0-7Fh,72h)	Equalizer med high band frequency	
1Bh	EQF_HB	-Data (byte 0-7Fh,40h)	Equalizer high band frequency	

**EQ\_xxx:** Band level

00h	20h	40h	60h	7Fh
-12dB	-6dB	0dB	+6dB	+12dB

Default =60h (+6dB) for LB-HB, =40h(0dB) for MLB-MHB

**EQF\_xxx:** Band frequency (0-7Fh), linear scale

Band	Range	Default
LB	0-4.7Khz	0Ch
MLB	0-4.2Khz	1Bh
MHB	0-4.2Khz	72h
HB	0-18.75Khz	40h



### 3- DETAILED MIDI IMPLEMENTATION

MIDI messages are received by the built-in wavetable synthesizer from:

- Serial MIDI IN pin serial mode
- 8-bit parallel data port in parallel mode

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.	GS
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 vv	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

MIDI MESSAGE	HEX CODE	DESCRIPTION	COMPATIBILITY
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	BnN 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 modif(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 §2-1)	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	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

MIDI MESSAGE	HEX CODE	DESCRIPTION	COMPATIBILITY
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	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: part      MIDI channel 0            9            (DRUMS) 1-9        0-8 10-15     10-15	GS
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. 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.	GS
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 = 00h)	GS

MIDI MESSAGE	HEX CODE	DESCRIPTION	COMPATIBILITY
SYSEX	F0h 41h 00h 42h 12h 40h 2nh 06h vv xx F7h	Mod lfo1 tva depth (0-100%) (default = 00h)	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 = 00h)	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 = 00h)	GS
SYSEX	F0h 41h 00h 42h 12h 40h 2nh 26h vv xx F7h	CAF lfo1 tva depth (0-100%) (default = 00h)	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 = 00h)	GS
SYSEX	F0h 41h 00h 42h 12h 40h 2nh 46h vv xx F7h	CC1 lfo1 tva depth (0-100%) (default = 00h)	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 = 00h)	GS
SYSEX	F0h 41h 00h 42h 12h 40h 2nh 56h vv xx F7h	CC2 lfo1 tva depth (0-100%) (default = 00h)	GS

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 »

## 4- SOUNDS

### 4-1- 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

## 4-2- 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	Melo Tom	116	Synth Drum
117	Synth Drum	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

### 4-3- DRUM SET TABLE (MIDI CHANNEL 10)

	Prog 1: STANDARD SET	Prog 17: POWER SET	Prog 41: BRUSH	Prog 49: ORCHESTRA	Prog 128: CM -64/32 (Partial)
27 - D#1				Closed Hi Hat [EXC1]	*
28 - E1				Pedal Hi-Hat [EXC1]	*
29 - F1				Open Hi Hat [EXC1]	*
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					*

	Prog 1: STANDARD SET	Prog 17: POWER SET	Prog 41: BRUSH	Prog 49: ORCHESTRA	Prog 127: CM -64/32 (Partial)
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

## **5- NRPN 0375Fh: Effect on/off – Polyphony selection**

Midi message code (in hexadecimal): B0h 63h 37h, B0h 62h 5Fh, B0h 06h vv  
 Each bit of vv byte is used for selecting an effect ON or OFF as following:

7	6	5	4	3	2	1	0
0	0	REV	0	OM2	0	EQ2	EQ1

Each time an effect is ON polyphony will be decreased.

**REV** bit=1: Reverb ON, polyphony decreased by 13

**OM2** bit : output mode select:

- OM2=0: Spatial effect OFF
- OM2=1: Spatial effect ON, polyphony decreased by 2. Spatial effect parameters can be controlled using NRPN 3720h (volume), 372Ch (delay time) and 372Dh (stereo/mono). (See paragraph 2-1).

**EQ2, EQ1** bits: Equalizer

- EQ2=0, EQ1=0: equalizer off
- EQ2=1, EQ1=0: 2 band equalizer, polyphony decreased by 4
- EQ2=1, EQ1=1: 4 band equalizer, polyphony decreased by 8



The table below shows all possible NRPN 375F values with their impacts.

NRPN 375F vv	REV	CHR	Spacial Effect	EQ	POLY	Comment
[0010 1000] - 28h	ON	OFF	ON	OFF	49	
[0010 1010] – 2Ah	ON	OFF	ON	2-Band	45	
[0010 1011] – 2Bh	ON	OFF	ON	4-Band	41	
[0010 0000] - 20h	ON	OFF	OFF	OFF	50	
[0010 0010] – 22h	ON	OFF	OFF	2-Band	46	
[0010 0011] – 23h	ON	OFF	OFF	4-Band	42	
[0000 1000] - 08h	OFF	OFF	ON	OFF	62	
[0000 1010] – 0Ah	OFF	OFF	ON	2-Band	58	
[0000 1011] – 0Bh	OFF	OFF	ON	4-Band	54	
[0000 0000] - 00h	OFF	OFF	OFF	OFF	64	
[0000 0010] – 02h	OFF	OFF	OFF	2-Band	59	
[0000 0011] – 03h	OFF	OFF	OFF	4-Band	55	
45h	ON	ON	ON	4-Band	38	Default setting (1)

Note:

(1) Value 45h will reset all. This is the only way to restore the default setting, and to set chorus on again. The firmware will be stopped during reset procedure (50 ms about), before to be ready again to process MIDI messages.

## **6- AUTO-TEST**

A 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:

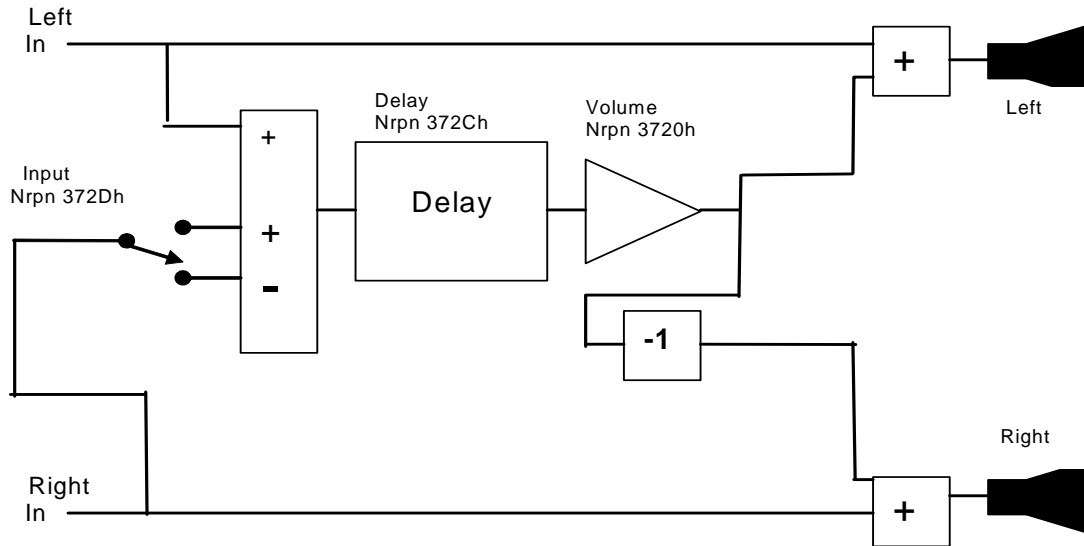
Test in progress	Output frequency
On chip RAM	1.18 kHz
On chip ROM	876 Hz
PASS	295 Hz

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

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

<b>PC</b>	<b>Name</b>
4	Honky-tonk Piano
5	El. Piano 1
6	El. Piano 2
9	Celesta
10	Glockenspiel
11	Music Box
15	Tubular Bells
19	Rock Organ
20	Church Organ
22	Accordion (french)
24	Tango Accordion
31	Distortion Guitar
37	Slap Bass 1
40	Synth Bass 2
52	Synth Strings 2
54	Voice Oohs
55	Synth Voice
56	Orchestra Hit
61	French Horn
63	Synth Brass 1
64	Synth Brass 2
73	Piccolo
77	Blown Bottle
78	Shakuhachi
79	Whistle
80	Ocarina
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)
92	Pad 4 (choir)
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)
113	Tinkle Bell
115	Steel Drums
118	Melodic Tom
127	Applause

**SPACIAL EFFECT BLOCK DIAGRAM**



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