Features

- Synthesizer, Reverb, Chorus on a 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 Spatial Effects or Four-channel Surround [(1)]
  - 3DMIDI™ Four-speaker MIDI [(1)]
  - 4-band Stereo Equalizer
- State-of-the-art Synthesis for Best Quality/Price Products
  - 38-voice Polyphony + Effects
  - On-chip Wavetable Data, Firmware, RAM Delay Lines
- Synthesizer Chipset: SAM9773 + DAC
- Hardware-programmable DAC Mode
  - I^2S 16 to 20 bits
  - Japanese 16 bits
- Typical Applications: Cost-sensitive PC Wavetable Synthesis/Portable Karaoke/VCD Karaoke
- 80-lead TQFP Package: Small Footprint, Easy Mounting
- Ideal for Battery Operation
  - Low Power
  - Power-down Mode
  - Wide Supply Voltage Range : 2.45V to 2.95V Core, 3V to 5.5V Periphery

Note: 1. Four-channel surround and 3DMIDI™ require additional DAC.

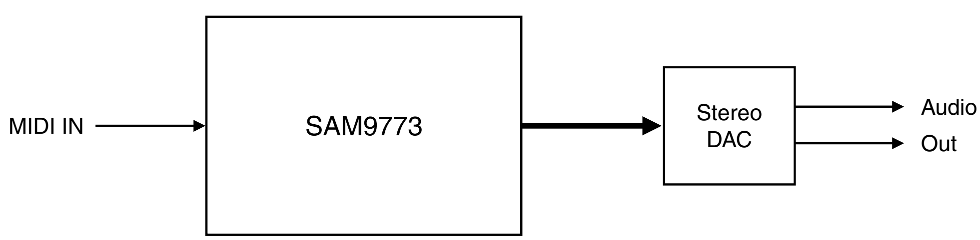
Single-chip Synthesizer with Effects, Serial Interface

SAM9773

Description

The SAM9773 provides a single-chip, low-cost MIDI sound system. Equipped with a serial MIDI input, it provides state-of-the-art sound synthesis together with a range of compatible effects. Its low power consumption makes it ideal for battery-powered applications such as portable Karaoke or VCD Karaoke systems. It can also be used for cost-sensitive PC-based wavetable synthesis applications.

Figure 1. Typical Hardware Configuration



Rev. 1715C–12/01

Pin Description

Pins by Function

Table 1. Power Supply Group

Pin Name	Pin Number	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, 2.45V to 2.95V All pins should be connected to nominal 2.7V.

Table 2. Serial MIDI

Pin Name	Pin Number	Type	Function
MIDI IN	15	IN	Serial TTL MIDI IN. All controls are received by this pin.

Table 3. Digital Audio Group

Pin Name	Pin Number	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 = I^2S 16 to 20 bits, 1 = Japanese 16 bits

Table 4. Miscellaneous Group

Pin Name	Pin Number	Type	Function
X1 - X2	10, 9	–	9.6 MHz crystal connection. An external 9.6 MHz clock can also be used on X1 (2.7V 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
$\overline{\text{RESET}}$	11	IN	Reset input, active low. This is a Schmidt trigger input, allowing direct connection of an RC network
$\overline{\text{PDWN}}$	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, $\overline{\text{PDWN}}$ should be high and $\overline{\text{RESET}}$ 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.

Pinout by Pin Number

Table 5. Pinout by Pin Number [1]

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

Note: 1. Signals marked NC should be left unconnected.

Mechanical Dimensions

Figure 2. 80-lead Thin Plastic Quad Flat Pack

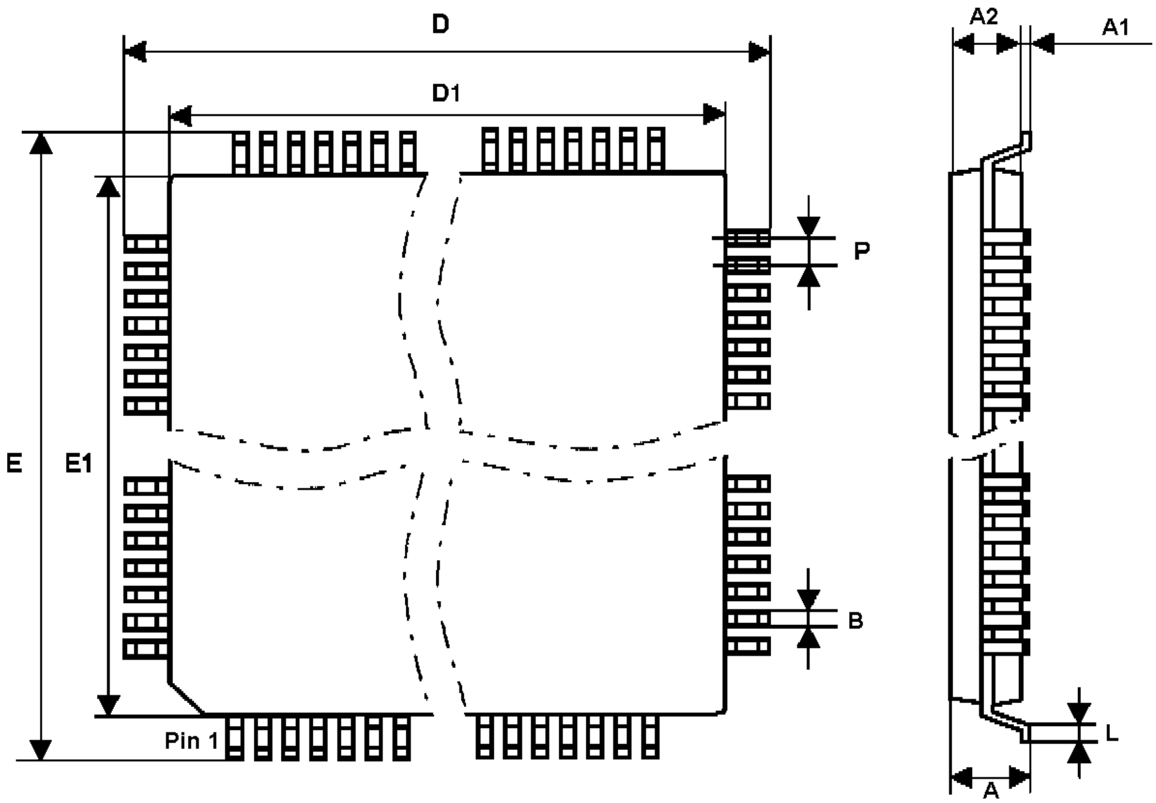


Table 6. Package Dimensions (in millimeters)

Dimension	Min	Typ	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

Absolute Maximum Ratings

Table 7. Absolute Maximum Ratings

Symbol	Parameter/Condition	Min	Typ	Max	Unit
	Ambient Temperature (Power applied)	-40		+85	°C
	Storage Temperature	-6.5		+150	°C
	Voltage on any pin (except X1)	-0.5		V_{CC} + 0.5	V
	Voltage on X1 pin	-0.5		V_{C3} + 0.25	V
V_{CC}	Supply Voltage	-0.5		6.5	V
V_{C3}	Supply Voltage	-0.5		2.95	V
	Maximum IOL per I/O pin			10	mA

Recommended Operating Conditions

Table 8. Recommended Operating Conditions

Symbol	Parameter/Condition	Min	Typ	Max	Unit
V_{CC}	Supply Voltage (1)	3	3.3/5.0	5.5	V
V_{C3}	Supply Voltage	2.45	2.7	2.95	V
T_A	Operating Ambient Temperature	0	–	70	°C

Note: 1. When using 3.3V supply in a 5V environment, care must be taken that pin voltage does not exceed V_{CC} + 0.5V. Pin X1 is powered by V_{C3} input. If X1 is driven by a 5V device, then a minimum series resistor is required (typ 330Ω).

DC Characteristics

Table 9. DC Characteristics (T_A = 25°C, V_{C3} = 2.7V ± 10%)

Symbol	Parameter/Condition	VCC	Min	Typ	Max	Unit
V_{IL}	Low-level Input Voltage	3.3 5.0	-0.5 -0.5		1.0 1.7	V V
V_{IH}	High-level Input Voltage	3.3 5.0	2.3 3.3		V_{CC} + 0.5 V_{CC} + 0.5	V V
V_{OL}	Low-level Output Voltage (I_{OL} = -3.2 mA)	3.3 5.0			0.45 0.45	V V
V_{OH}	High-level Output Voltage (I_{OH} = 0.8 mA)	3.3 5.0	2.8 4.5			V V
I_{CC}	Power Supply Current (crystal freq. = 9.6 MHz)	3.3 5.0		50 10	70 15	mA mA
	Power Down Supply Current			70	100	µA

Digital Audio

Figure 3. Digital Audio Timing

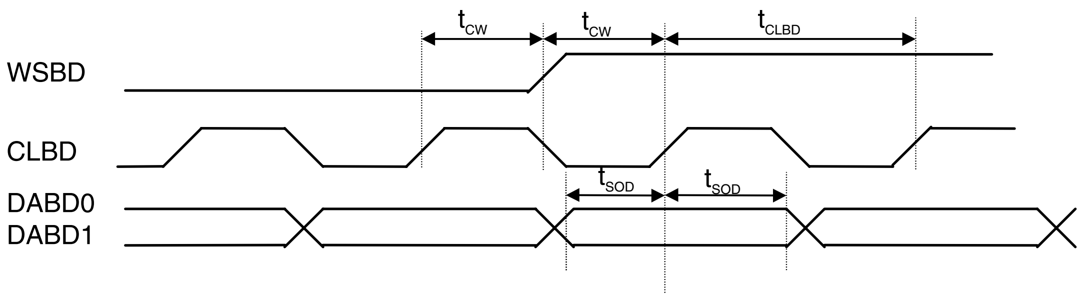
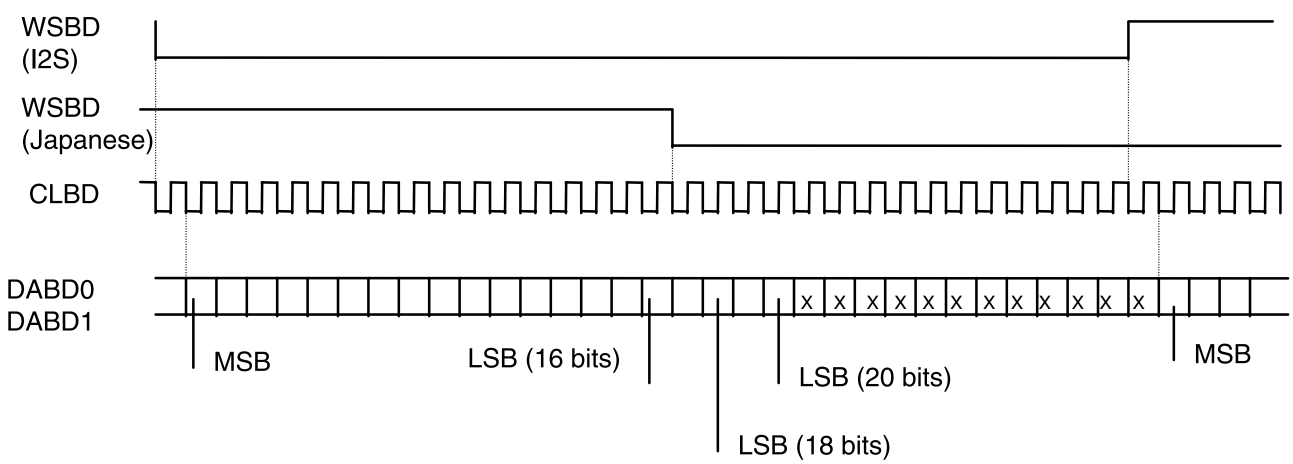


Table 10. Timing Parameters

Symbol	Parameter	Min	Typ	Max	Unit
t_{CW}	CLBD Rising to WSBD Change	200			ns
t_{SOD}	DABDx Valid Prior to/after CLBD Rising	200			ns
t_{CLBD}	CLBD Cycle Time		416.67		ns

Digital Audio Frame

Figure 4. Digital Audio Frame Format (1)



Note: 1. Selection between I^2S and Japanese format is through DACSEL pin .

Reset and Power-down

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

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

If $\overline{PDWN}$ 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, $\overline{PDWN}$ has to be asserted high, then $\overline{RESET}$ applied.

Recommended Board Layout

As for all HCMOS high-integration ICs, some rules of board layout should be followed for reliable operation:

- GND, V_{CC}, V_{C3} distribution, decouplings

All GND, V_{CC}, V_{C3} pins should be connected. GND + V_{CC} planes are strongly recommended below the SAM9773. The board GND + V_{CC} distribution should be in grid form. For 5V operation, if 2.7V is not available, then V_{C3} can be connected to V_{CC} by three 1N4148 diodes in series.

Recommended V_{CC} decoupling is 0.1 µF at each corner of the IC with an additional 10 µT decoupling close to the crystal. V_{C3} requires a single 0.1 µF 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.

Recommended Crystal Compensation and LFT Filter

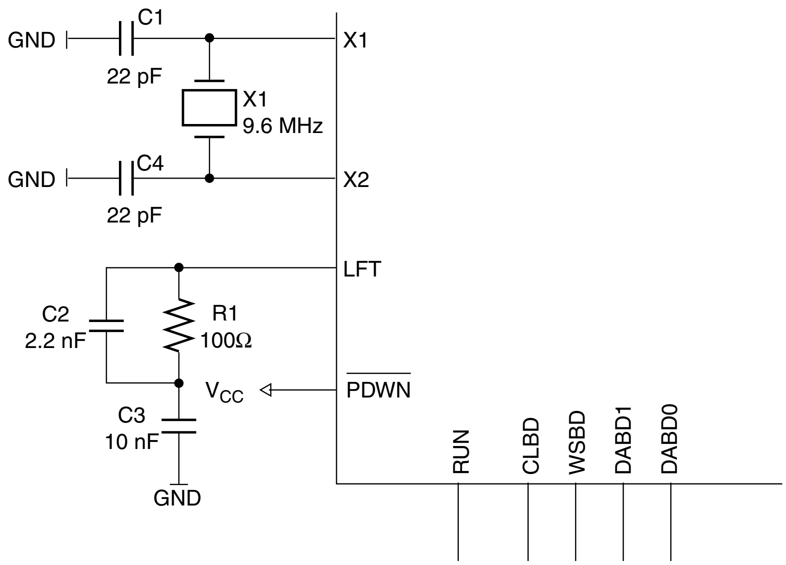


Figure 5. Recommended Crystal Compensation and LFT Filter

Atmel Headquarters

Corporate Headquarters
2325 Orchard Parkway
San Jose, CA 95131
TEL (408) 441-0311
FAX (408) 487-2600

Europe
Atmel SarL
Route des Arsenaux 41
Casa Postale 80
CH-1705 Fribourg
Switzerland
TEL (41) 26-426-5555
FAX (41) 26-426-5500

Asia
Atmel Asia, Ltd.
Room 1219
Chinachem Golden Plaza
77 Mody Road Tsimhatsui
East Kowloon
Hong Kong
TEL (852) 2721-9778
FAX (852) 2722-1369

Japan
Atmel Japan K.K.
9F, Tonetsu Shinkawa Bldg.
1-24-8 Shinkawa
Chuo-ku, Tokyo 104-0033
Japan
TEL (81) 3-3523-3551
FAX (81) 3-3523-7581

Atmel Product Operations

Atmel Colorado Springs
1150 E. Cheyenne Mtn. Blvd.
Colorado Springs, CO 80906
TEL (719) 576-3300
FAX (719) 540-1759

Atmel Grenoble
Avenue de Rochepleine
BP 123
38521 Saint-Egreve Cedex, France
TEL (33) 4-7658-3000
FAX (33) 4-7658-3480

Atmel Heilbronn
Theresienstrasse 2
POB 3535
D-74025 Heilbronn, Germany
TEL (49) 71 31 67 25 94
FAX (49) 71 31 67 24 23

Atmel Nantes
La Chantrerie
BP 70602
44306 Nantes Cedex 3, France
TEL (33) 0 2 40 18 18 18
FAX (33) 0 2 40 18 19 60

Atmel Rousset
Zone Industrielle
13106 Rousset Cedex, France
TEL (33) 4-4253-6000
FAX (33) 4-4253-6001

Atmel Smart Card ICs
Scottish Enterprise Technology Park
East Kilbride, Scotland G75 0QR
TEL (44) 1355-357-000
FAX (44) 1355-242-743

e-mail
literature@atmel.com

Web Site
http://www.atmel.com

1715C–12/01/0M