

**ALS 200  
Integrated Audio Controller  
w/ Wavetable Synthesizer**

**Revision 1.30  
January 20, 1997**

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## **1.0 Introduction**

Sound system designs based on the ALS200 Integrated Audio Subsystems are true Plug and Play systems. ALS200 Integrated Audio Subsystems bring forth a new age of highly integrated, single chip sound products. They are cost-efficient audio solutions for motherboard and add-in card implementations. Avance Logic, Inc. has taken the approach of integrating the following functions into a single ASIC.

- Subsystem control logic
- Digital to analog and analog to digital converters
- Mixer functions
- FM/Wavetable engine
- CD-ROM controller(ATAPI IDE)
- Enhanced game/MIDI port

By bringing these functions into a single ASIC, the overall product cost is reduced. Additionally, reliability and compatibility are improved by the reduced number of components required to build a sound system.

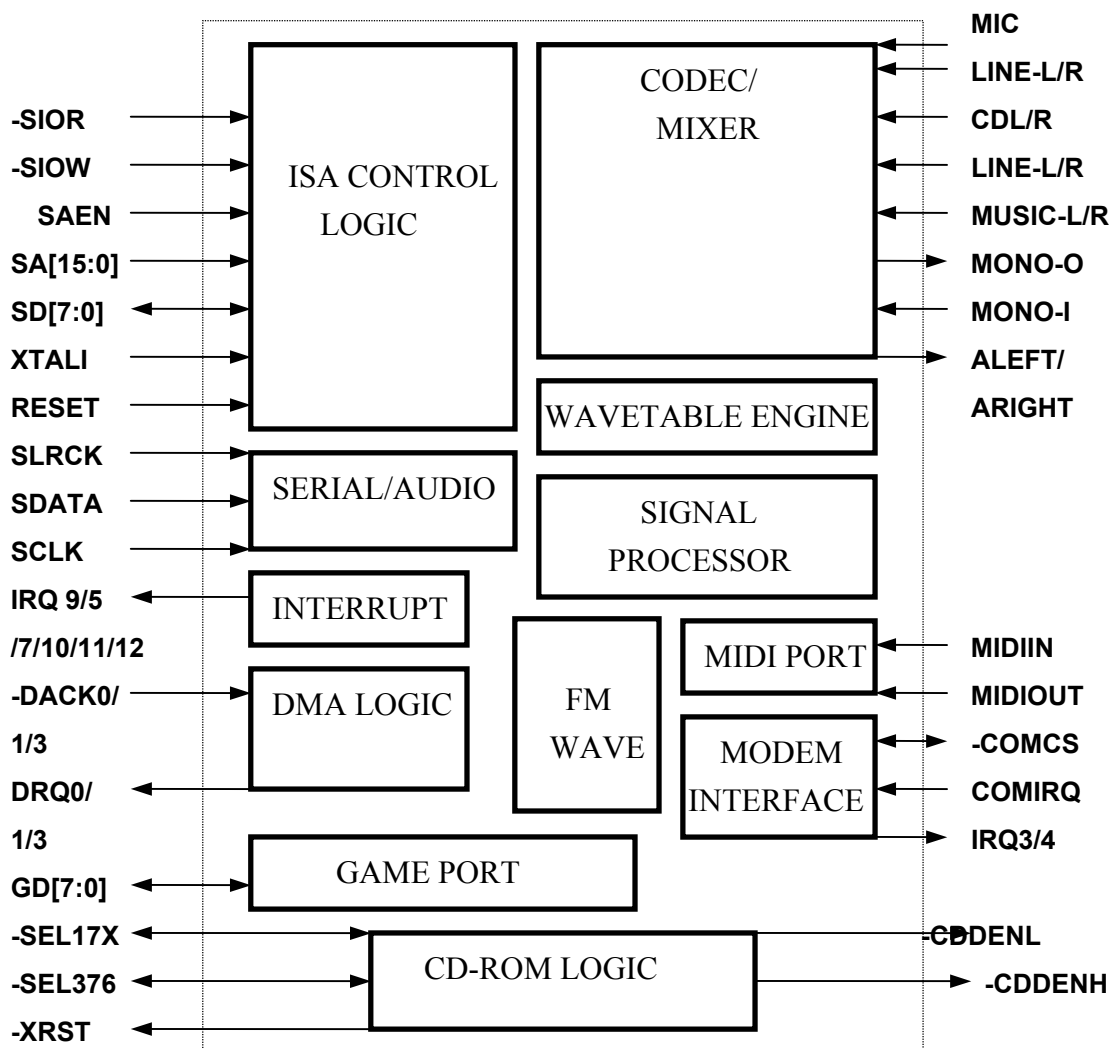
ALS200 Integrated Audio Subsystems fully support the ISA Plug and Play standard. For non-ISA Plug and Play compatible systems, a software utility is available that sets the IRQ and DMA resources. Add-in sound cards and motherboard implementations designed around the ALS200 Integrated Audio Subsystems are completely jumper and switch free.

ALS200 Integrated Audio Subsystems support the following functions:

- Audio Input
  - ✓ CD-ROM Audio
  - ✓ Monaural In
  - ✓ Stereo Line In
  - ✓ Microphone In
- Audio Output

- ✓ Stereo Line Out
- ✓ Mono/modem Out
- Enhanced game/MIDI Port
  - ✓ External MIDI input and output
  - ✓ Joystick input
- CD-ROM Controller
  - ✓ ATAPI IDE

FIGURE 1.1 FUNCTIONAL BLOCK DIAGRAM



## **2.0 Features**

- Single, mixed-signal, high performance VLSI sound ASIC
- Compatible with Sound Blaster™, Sound Blaster Pro™, Sound Blaster 16 Emulation and Windows Sound System™
- Internal FM Synthesizer Emulation/External FM Synthesis Support
- Wavetable synthesizer
- ISA Plug and Play support logic
- External PNP modem chip interface
- Power down mode support
- I<sup>2</sup>S interface support
- Supports Sound Blaster ADPCM decompression
- MPU-401 MIDI controller with FIFO
- Supports 8-bit Type F DMA playback
- Software selectable DMA lines(0, 1, 3)
- Software selectable interrupt lines(5, 7, 9, 10, 11, 12)
- 8/16 bit mono/stereo digital audio from 4 kHz to 48 kHz
- 8/16 bit CD-ROM interface
- Enhanced game port support
- MIDI port with input and output FIFO
- Full duplex for concurrent recording and playback
- 16 bit PNP address I/O decoder
- 5.0V digital/analog mode
- 100 pin PQFP package

### 3.0 Module I/O Pins

#### ISA Address

Item	Pin Name	Type	Pin No.	Description
1	SA0	I	92	ISA SYSTEM ADDRESS BIT 0
2	SA1	I	93	ISA SYSTEM ADDRESS BIT 1
3	SA2	I	94	ISA SYSTEM ADDRESS BIT 2
4	SA3	I	95	ISA SYSTEM ADDRESS BIT 3
5	SA4	I	96	ISA SYSTEM ADDRESS BIT 4
6	SA5	I	97	ISA SYSTEM ADDRESS BIT 5
7	SA6	I	98	ISA SYSTEM ADDRESS BIT 6
8	SA7	I	99	ISA SYSTEM ADDRESS BIT 7
9	SA8	I	100	ISA SYSTEM ADDRESS BIT 8
10	SA9	I	1	ISA SYSTEM ADDRESS BIT 9
11	SA10	I	2	ISA SYSTEM ADDRESS BIT 10
12	SA11	I	3	ISA SYSTEM ADDRESS BIT 11
13	SA12	I	4	ISA SYSTEM ADDRESS BIT 12
14	SA13	I	5	ISA SYSTEM ADDRESS BIT 13
15	SA14	I	6	ISA SYSTEM ADDRESS BIT 14
16	SA15	I	7	ISA SYSTEM ADDRESS BIT 15
17	SAEN	I	8	ISA DMA ADDRESS ENABLE

**ISA Data**

Item	Pin Name	Type	Pin No.	Description
18	SD0	I/O	9	ISA SYSTEM DATA BIT 0
19	SD1	I/O	10	ISA SYSTEM DATA BIT 1
20	SD2	I/O	11	ISA SYSTEM DATA BIT 2
21	SD3	I/O	12	ISA SYSTEM DATA BIT 3
22	SD4	I/O	14	ISA SYSTEM DATA BIT 4
23	SD5	I/O	15	ISA SYSTEM DATA BIT 5
24	SD6	I/O	16	ISA SYSTEM DATA BIT 6
25	SD7	I/O	17	ISA SYSTEM DATA BIT 7

**ISA Control**

Item	Pin Name	Type	Pin No.	Description
26	-SIOW	I	67	ISA I/O WRITE STROBE
27	-SIOR	I	68	ISA I/O READ STROBE
28	RESET	I	19	ISA SYSTEM RESET
29	XTALI	I	74	CRYSTAL/OSCILLATOR IN
30	XTALO	O	75	CRYSTAL OUT

**ISA DMA**

Item	Pin Name	Type	Pin No.	Description
31	DRQ0	hiZ	85	ISA DMA REQUEST 0
32	DRQ1	hiZ	78	ISA DMA REQUEST 1
33	DRQ3	hiZ	70	ISA DMA REQUEST 3
34	-DACK0	I	84	ISA DMA ACKNOWLEDGE 0
35	-DACK1	I	77	ISA DMA ACKNOWLEDGE 1
36	-DACK3	I	69	ISA DMA ACKNOWLEDGE 3



**ISA INTERRUPT**

Item	Pin Name	Type	Pin No.	Description
37	IRQ9	hiZ	66	ISA INTERRUPT REQUEST 9
38	IRQ5	hiZ	80	ISA INTERRUPT REQUEST 5
39	IRQ7	hiZ	79	ISA INTERRUPT REQUEST 7
40	IRQ10	hiZ	81	ISA INTERRUPT REQUEST 10
41	IRQ11	hiZ	82	ISA INTERRUPT REQUEST 11
42	IRQ12	hiZ	83	ISA INTERRUPT REQUEST 12

**MIDI INTERFACE**

Item	Pin Name	Type	Pin No.	Description
43	MIDIIN	I	71	MIDI SERIAL INPUT
44	MIDIOUT	I/O	72	MIDI SERIAL OUTPUT

**EXTERNAL SERIAL AUDIO DATA**

Item	Pin Name	Type	Pin No.	Description
45	SDATA	I	55	YAC512/I <sup>2</sup> S SERIAL DATA INPUT
46	SLRCK	I	56	YAC512/I <sup>2</sup> S LEFT/RIGHT CHANNEL SELECT INPUT
47	SCLK	I	57	YAC512/I <sup>2</sup> S BIT CLOCK INPUT

**MODEM**

Item	Pin Name	Type	Pin No.	Description
48	-COMCS/ -BIOW	I/O	59	MODEM CHIP SELECT/BUFFERED SYSTEM I/O WRITE STROBE
49	COMIRQ/ BA0	I/O	60	MODEM INTERRUPT REQUEST/ BUFFERED SYSTEM ADDRESS 0
50	IRQ3/ BA2	O	62	ISA INTERRUPT REQUEST 3/ BUFFERED SYSTEM ADDRESS 2
51	IRQ4/ BA1	O	61	ISA INTERRUPT REQUEST 4/ BUFFERED SYSTEM ADDRESS 1

**ANALOG AUDIO**

Item	Pin Name	Type	Pin No.	Description
52	MIC	I	40	MICROPHONE INPUT
53	LINE-L	I	34	EXTERNAL LINE INPUT LEFT
54	LINE-R	I	47	EXTERNAL LINE INPUT RIGHT
55	CDL	I	33	EXTERNAL CD AUDIO INPUT LEFT
56	CDR	I	48	EXTERNAL CD AUDIO INPUT RIGHT
57	MUSIC-L	I	36	EXTERNAL WAVETABLE MUSIC INPUT LEFT
58	MUSIC-R	I	45	EXTERNAL WAVETABLE MUSIC INPUT RIGHT
59	MONO-I	I	53	PC SPEAKER/MODEM MONO INPUT
60	MONO-O	O	41	PC SPEAKER/MODEM MONO OUTPUT
61	ALEFT	O	35	AUDIO MIXER LEFT OUTPUT
62	ARIGHT	O	46	AUDIO MIXER RIGHT OUTPUT
63	VREF1	O	42	2.5V REFERENCE VOLTAGE OUTPUT
64	VREF2	O	39	2.5V REFERENCE VOLTAGE OUPUT
65	ADL-O	I	30	LEFT A/D CONVERTER ANTI-ALIAS FILTER
66	ADR-O	I	51	RIGHT A/D CONVERTER ANTI-ALIAS FILTER
67	ADL-I	I	29	LEFT INPUT MIXER LOOP BACK FILTER
68	ADR-I	I	52	RIGHT INPUT MIXER LOOP BACK FILTER

69	DAL-O	I	31	LEFT D/A CONVERTER LOW-PASS SMOOTH FILTER
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**ANALOG AUDIO(CONT.)**

Item	Pin Name	Type	Pin No.	Description
70	DAR-O	I	50	RIGHT D/A CONVERTER LOW-PASS SMOOTH FILTER
71	DAL-I	I	32	LEFT D/A CONVERTER LOOP BACK FILTER
72	DAR-I	I	49	RIGHT D/A CONVERTER LOOP BACK FILTER
73	SYNDACL-F	I	37	SYNTHESIZER LEFT D/A LOW-PASS FILTER
74	SYNDACR-F	I	44	SYNTHESIZER RIGHT D/A LOW-PASS FILTER

**EXTERNAL GAME PORT, CD-ROM, AND EXPANSION**

Item	Pin Name	Type	Pin No.	Description
75	GD0	I/O	20	GAME PORT A TIMER X
76	GD1	I/O	21	GAME PORT A TIMER Y
77	GD2	I/O	22	GAME PORT B TIMER X
78	GD3	I/O	23	GAME PORT B TIMER Y
79	GD4	I	24	GAME PORT A BUTTON A
80	GD5	I	25	GAME PORT A BUTTON B
81	GD6	I	26	GAME PORT B BUTTON A
82	GD7	I	27	GAME PORT B BUTTON B
83	-SEL17X	I/O	89	IDE CD-ROM I/O PORT 170-177
84	-SEL376	I/O	90	IDE CD-ROM I/O PORT 376
85	-CDDENL	O	88	IDE CD-ROM LOW BYTE DATA ENABLE
86	-CDDENH	O	87	IDE CD-ROM HIGH BYTE DATA

				ENABLE
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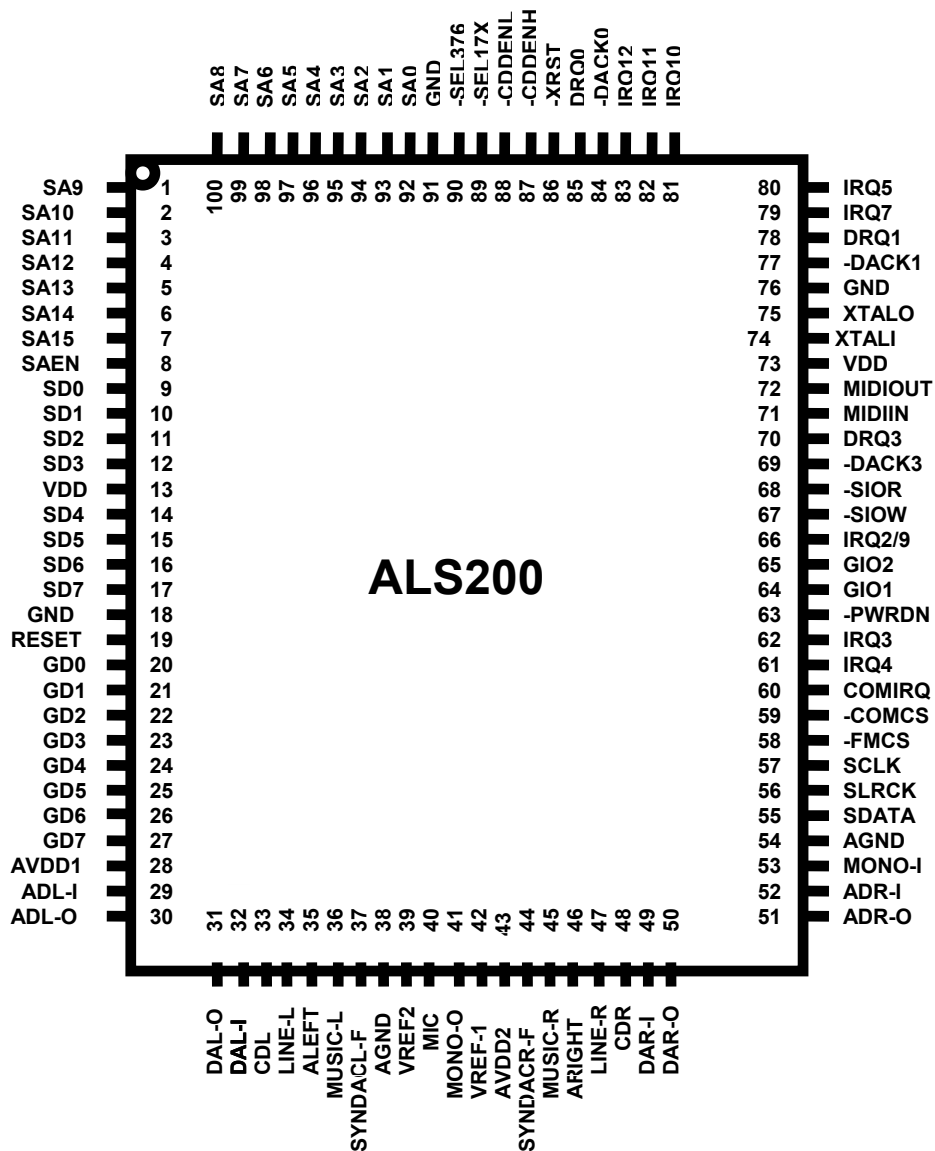
**EXTERNAL GAME PORT, CD-ROM, AND EXPANSION(CONT.)**

Item	Pin Name	Type	Pin No.	Description
87	-XRST	O	86	CD-ROM OR FM RESET
88	-FMCS	I/O	58	EXTERNAL FM SYNTHESIZER CHIP SELECT
89	-PWRDN/ -BIOR	I/O	63	POWER DOWN/ BUFFERED SYSTEM I/O READ STROBE
90	GIO1	I/O	64	GENERAL PURPOSE I/O SIGNAL 1
91	GIO2	I/O	65	GENERAL PURPOSE I/O SIGNAL 2

**POWER**

Item	Pin Name	Type	Pin No.	Description
92	VDD	P	13	DIGITAL VCC, 5 OR 3.3 VOLT
93	VDD	P	73	DIGITAL VCC, 5 OR 3.3 VOLT
94	AVDD1	P	28	ANALOG VCC, 5 OR 3.3 VOLT
95	AVDD2	P	43	ANALOG VCC, 5 OR 3.3 VOLT
96	GND	P	18	DIGITAL GROUND
97	GND	P	91	DIGITAL GROUND
98	GND	P	76	DIGITAL GROUND
99	AGND	P	54	ANALOG GROUND
100	AGND	P	38	ANALOG GROUND

FIGURE 3.1 ALS200 PIN DIAGRAM



## 4.0 Electrical Specification

### Analog Characteristics

Assumptions:

- Ambient temperature (TA) -----25°C
- Voltage, Analog (VA) ----- +5.0
- Voltage, Digital (VD) -----+5.0
- Voltage, Filtered Digital (VFD) ----- +5.0
- Input levels:
  - Logical 0 -----0 V
  - Logical 1 -----VD
- Input signal -----1kHz sine wave
- Sample frequency (FS1) ----- 48kHz
- Sample frequency (FS2) ----- 8kHz
- Measurement bandwidth ( 16-bit linear coding ) 20Hz to 20kHz

Parameter	Min.	Type	Max.	Units		
<b>Analog Input Characteristics-Minimum Gain Setting(0 dB);unless otherwise specified</b>						
ADC Resolution	-	16	-	Bits		
Instantaneous Dynamic Range (IDR)	-	80	-	dB		
Total Harmonic Distortion (THD)	-	0.04	-	%		
Inter-Channel Isolation	-	70	-	dB		
Left/Right Channel Separation	-	76	-	dB		
Inter-Channel Gain Mismatch		Line Inputs	-	0.5	dB	
		Mic		0.5	dB	
Inputs						
Programmable Input Gain Span	21.5	22.5	-	dB		
Gain Step Size ( 32 levels )	1.3	1.5	1.7	dB		
ADC Offset Error	-	10	100	LSB		
Full Scale Input Voltage	(MGE=1)	Mic Inputs	0.26	0.28	0.31	Vpp

(MGE=0)Mic Inputs	2.6	2.8	3.1	Vpp
Line, CD-Audio, Music Inputs	2.6	2.8	3.1	Vpp
<b>(Table continued form previous page.)</b>				
Gain Drift	-	100	-	ppm/°C
Input Resistance	47	-	-	kΩ
Input Capacitance	-	-	15	pF
<b>Analog output Characteristics-Minimum attenuation(1 dB);unless otherwise specified</b>				
DAC Resolution	16	-	-	Bits
Total Dynamic Range(TDR) All Outputs	-	95	-	dB
Instantaneous Dynamic Range(IDR) All Outputs	-	80	-	dB
Total Harmonic Distortion(THD)	-	0.04	-	%
Inter-Channel Isolation Line Out	-	70	-	dB
Inter-Channel Gain Mismatch Line Out	-	-	0.2	dB
Voltage Reference Output-VREF	-	2.00	-	V
Voltage Reference Output Current-VREF	-	500	-	μA
DAC Programmable Attenuation Span	93	94.5	-	dB
DAC Attenuation Step Size 0dB to -81dB	1.3	1.5	1.7	dB
-82.5dB to -94.5dB	1.0	1.5	2.0	dB
DAC Offset Voltage	-	10	30	mV
Full Scale Output Voltage OLB=0	1.8	2.0	2.25	Vpp
OLB=1 OUT, MOUT	2.6	2.9	3.2	Vpp
Gain Drift	-	100	-	ppm/°C
Deviation From Linear Phase	-	-	1	degrees
Mute Attenuation(0 dB)	-	80	-	dB
Total Out-of-Band Energy 0.6xFS1 to 100kHz	-	-	-45	dB
Audible Out-of-Band Energy 0.6xFS2 to 22kHz	-	-	-70	dB
Signal To Noise Ratio	70	-	-	dB
Output Power Rating-Main Out(4Ω speakers)	-	-	2	W/chnl
<b>Power Supply</b>				
Power Supply Current Digital ,	-	61	110	mA

Operating	-	41	60	mA
Analog, Operating	-	102	170	mA
Total	-	100	300	$\mu$ A
Digital, Power Off	-	100	300	$\mu$ A
Analog, Power Off	-			
Power Supply Rejection	1kHz	40		dB

Note: These values are based on characterizations, not on production testing.

### Mixers

Assumptions:

- Ambient temperature (  $T_A$  ) ----- 25°C
- Voltage, Analog (  $V_A$  ) ----- +5.0
- Voltage, Digital (  $V_D$  ) -----+5.0
- Voltage, Filtered Digital (  $V_{FD}$  ) ----- +5.0
- Input levels:
  - Logical 0 ----- 0 V
  - Logical 1 -----  $V_D$
- Input signal -----1kHz sine wave

Parameter		Min.	Type	Max.	Units
Mixer Gain Range Span	Line, CD-ROM, Music	45	46.5	-	dB
	Monaural	42	45	-	dB
	Master	26	30	-	dB
Step Size	Line, CD-ROM, Music	1.3	1.5	1.7	dB
	Monaural	2.3	3.0	3.4	dB
	Master	1.6	2.0	2.4	dB

Note: These values are based on characterizations, not on production testing.



**Maximum Ratings**

Assumptions:

- Analog Ground ( AGND ) -----0 V
- Digital Ground ( DGND ) -----0 V
- Signal Ground ( SGND ) -----0 V
- All voltages measured with respect to:-----0 V

Parameter	Min.	Max.	Units
Power supplies			
Digital(VD)	-0.3	6.0	V
Filtered Digital(VFD)	-0.3	6.0	V
Analog(VA)	-0.3	6.0	V
Total Power Dissipation (Supplies, Inputs, Outputs)	-	1.0	W
Input Current per Pin (Except Supply Pins)	-10.0	+10.0	mA
Output Current per Pin (Except Supply Pins)	-50	+50	mA
Analog Input Voltage	-0.3	VA+0.3	V
Digital Input Voltage	-0.3	VD+0.3	V
Operating Temperature Range	0	+70	°C
Storage Temperature	-50	+125	°C
Electrostatic Protection (ESD) <sub>c=100pf, R=1.5KΩ</sub>	2000	-	V

Warning: Operation beyond these limits may result in permanent damage to the ASIC normal operation is not guaranteed at these extremes.

**Timing Parameters**

Assumptions:

- Ambient temperature (TA) ----- 25°C
- Voltage, Analog (VA) ----- +5.0
- Voltage, Digital (VD) ----- +5.0
- Input levels:
- Logical 0 ----- 0 V
- Logical 1 ----- VD
- Outputs loaded with: ----- 30pF

Parameter	Symbol	Min.	Max.	Units
OSC(14.31 MHz) Frequency	tOSCP	14.000	14.500	MHz
OSC High Width	tOSCH	32	40	ns
OSC Low Width	tOSCL	32	40	ns
SYSCLK Frequency	-	8	9	MHz
SYSCLK High Width	-	50	70	ns
SYSCLK Low Width	-	55	70	ns
-IOR/-IOW Command Width	tCMD	120	-	ns
Write Data Setup To -IOW Rising	tWDS	30	-	ns
Write Data Hold From -IOW Rising	tWDH	15	-	ns
Read Access Time	tRAC	20	50	ns
Address Setup To -IOR/-IOW Falling	tAS	50	-	ns
Address Hold From -IOR/-IOW Rising	tAH	30	-	ns
-DACK Setup To -IOR/-IOW Falling	tDKS	40	-	ns
-DACK Hold From -IOR/-IOW Rising	tDKH	160	-	ns
SD Hold Form -IOR Rising	tDH	0	20	ns
XTAL Frequency	-	-	14.318	MHz
XTAL High Time	-	18	-	ns
XTAL Low Time	-	18	-	ns

Sample Frequency	-	3.918	50	kHz
DRQ Hold Form -IOR/ -IOW Falling	tDRH	0	25	ns

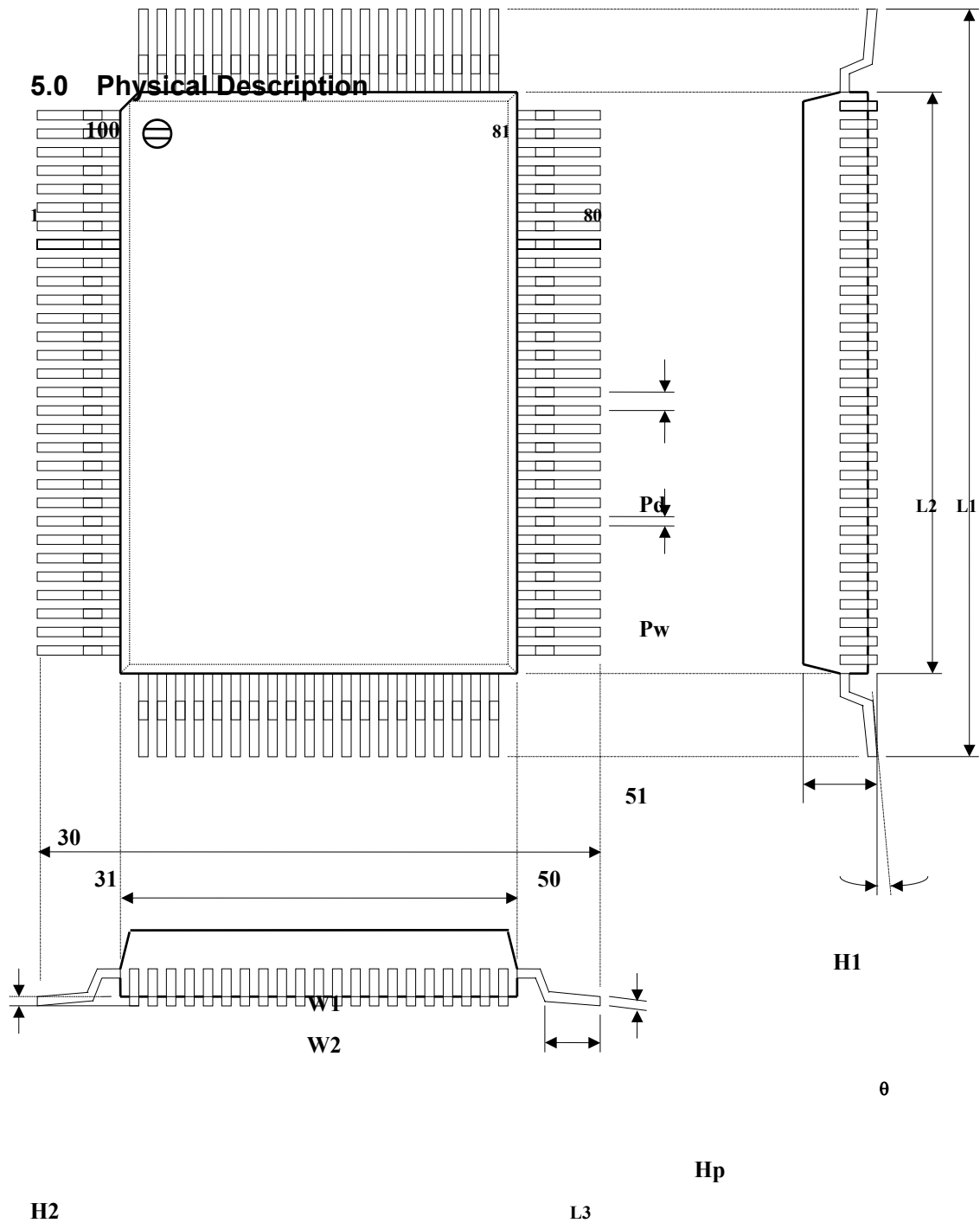
Note: These values are based on characterizations, not on production testing.

### Operating Environment

Assumptions:

- Analog Ground ( AGND ) ----- 0 V
- Digital Ground ( DGND ) ----- 0 V
- Signal Ground ( SGND ) ----- 0 V
- All voltages measured with respect to: ----- 0 V

Parameter	Min.	Type	Max.	Units
Power supplies				
Digital(VD)	4.75	5.0	5.25	V
Filtered Digital(VFD)	4.75	5.0	5.25	V
Analog(VA)	4.75	5.0	5.25	V
Operating Ambient Temperature(TA)	0	25	70	°C

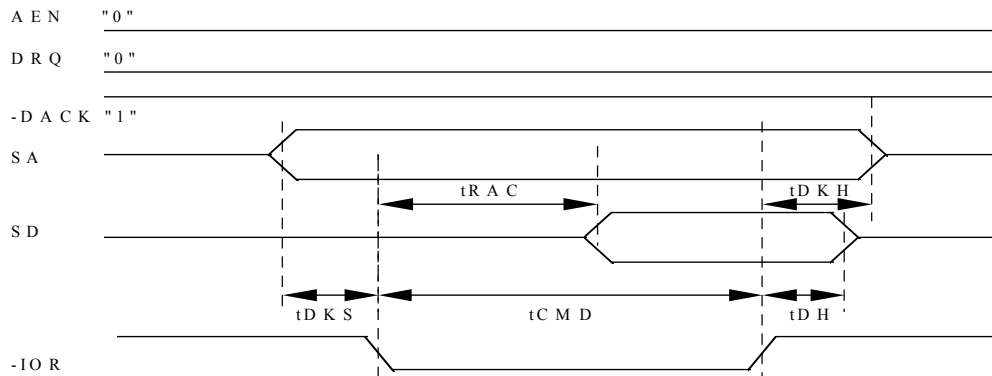


Unit: mm

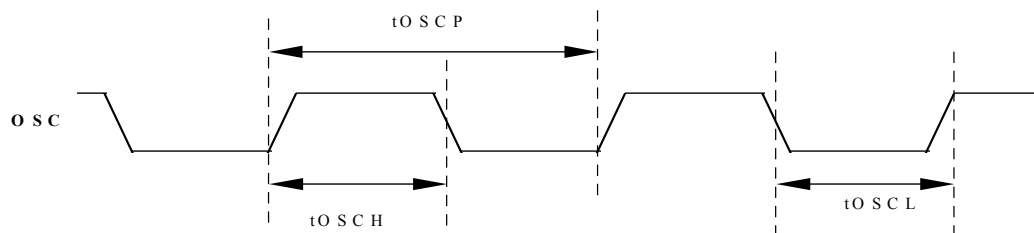
<b>Symbol</b>	<b>Min</b>	<b>Tvne</b>	<b>Max</b>
<b>L1</b>	<b>24.45</b>	<b>24.80</b>	<b>25.12</b>
<b>L2</b>	<b>19.75</b>	<b>20.00</b>	<b>20.25</b>
<b>L3</b>	<b>1.00</b>	<b>1.20</b>	<b>1.40</b>
<b>W1</b>	<b>18.45</b>	<b>18.80</b>	<b>19.15</b>
<b>W2</b>	<b>13.75</b>	<b>14.00</b>	<b>14.25</b>
<b>H1</b>	<b>2.70</b>	<b>3.00</b>	<b>3.30</b>
<b>H2</b>	<b>0.11</b>	<b>0.51</b>	<b>0.91</b>
<b>Hp</b>	<b>0.04</b>	<b>0.15</b>	<b>0.26</b>
<b>Pw</b>	<b>0.50</b>	<b>0.65</b>	<b>0.80</b>
<b>Pd</b>	<b>0.18</b>	<b>0.30</b>	<b>0.42</b>
<b>θ</b>	<b>0°</b>	<b>5°</b>	<b>10°</b>

**Timing Characteristics**

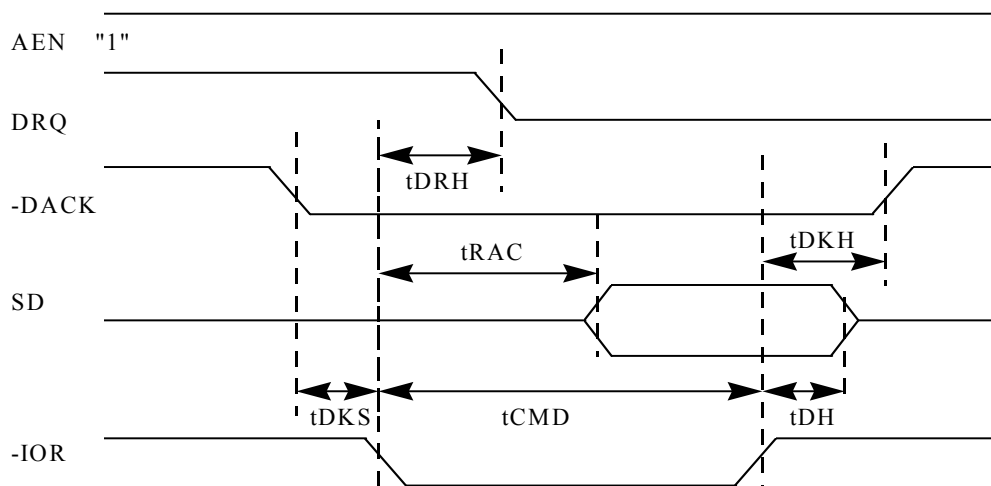
**Register/CD/FM/Mixer/Sound/Port I/O Read Cycle**



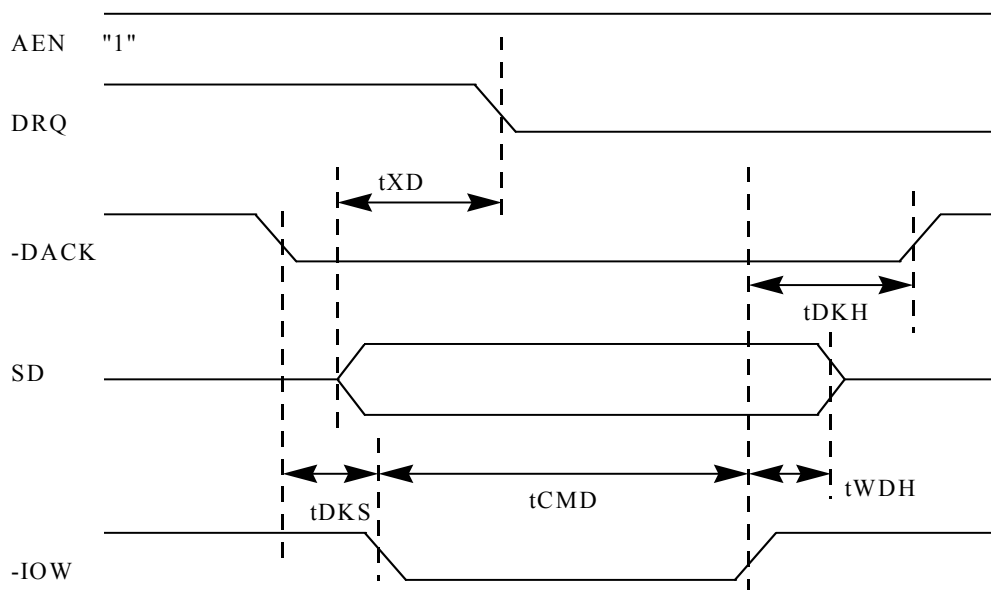
**Clock Timing**



**DMA Read/Capture**



**DMA Write/Playback Cycle**



## 6.0 Design Example

ALS200 ISA SOUND w/ IDE CD INTERFACE    Revised: January 9, 1997  
 AS9650 (1553)                                    Revision: C  
 Bill Of Materials                                January 9, 1997                                8:32:12

Item	Quantity	Reference	Part	
1	1	CN1	DB15	D-SUB 15PIN FEMALE
2	5	C1	10u	10UF 16V TANT CAP
		C37	10u	10UF 16V TANT CAP
		C49	10u	10UF 16V TANT CAP
		C53	10u	10UF 16V TANT CAP
		C54	10u	10UF 16V TANT CAP
3	1	C21	100P	100PF 0805 SMD CAP
4	19	C2	.1U	.1UF 0805 SMD CAP
		C3	.1U	.1UF 0805 SMD CAP
		C4	.1U	.1UF 0805 SMD CAP
		C5	.1U	.1UF 0805 SMD CAP
		C6	.1U	.1UF 0805 SMD CAP
		C8	.1U	.1UF 0805 SMD CAP
		C15	.1U	.1UF 0805 SMD CAP
		C22	.1U	.1UF 0805 SMD CAP
		C24	.1U	.1UF 0805 SMD CAP
		C30	.1U	.1UF 0805 SMD CAP
		C31	.1U	.1UF 0805 SMD CAP
		C32	.1U	.1UF 0805 SMD CAP
		C33	.1U	.1UF 0805 SMD CAP
		C39	.1U	.1UF 0805 SMD CAP
		C40	.1U	.1UF 0805 SMD CAP
		C42	.1U	.1UF 0805 SMD CAP
		C43	.1U	.1UF 0805 SMD CAP
		C47	.1U	.1UF 0805 SMD CAP
		C56	.1U	.1UF 0805 SMD CAP
5	10	C7	100U	100UF 16V TANT CAP
		C28	100U	100UF 16V TANT CAP
		C29	100U	100UF 16V TANT CAP
		C36	100U	100UF 16V TANT CAP
		C38	100U	100UF 16V TANT CAP
		C41	100U	100UF 16V TANT CAP
		C45	100U	100UF 16V TANT CAP
		C48	100U	100UF 16V TANT CAP
		C50	100U	100UF 16V TANT CAP
		C63	100U	100UF 16V TANT CAP



6	3	C9	.22U	.22UF 0805 SMD CAP
		C51	.22U	.22UF 0805 SMD CAP
		C52	.22U	.22UF 0805 SMD CAP
7	2	C10	4.7P	4.7PF 0805 SMD CAP
		C11	4.7P	4.7PF 0805 SMD CAP
8	10	C14	1000P	1000PF 0805 SMD CAP
		C16	1000P	1000PF 0805 SMD CAP
		C17	1000P	1000PF 0805 SMD CAP
		C18	1000P	1000PF 0805 SMD CAP
		C19	1000P	1000PF 0805 SMD CAP
		C20	1000P	1000PF 0805 SMD CAP
		C23	1000P	1000PF 0805 SMD CAP
		C25	1000P	1000PF 0805 SMD CAP
		C26	1000P	1000PF 0805 SMD CAP
		C27	1000P	1000PF 0805 SMD CAP
9	3	C46	470U	470UF 16V RAD ELECT CAP
		C64	470U	470UF 16V RAD ELECT CAP
		C65	470U	470UF 16V RAD ELECT CAP
10	7	C55	.01U	.01UF 0805 SMD CAP
		C57	.01U	.01UF 0805 SMD CAP
		C58	.01U	.01UF 0805 SMD CAP
		C59	.01U	.01UF 0805 SMD CAP
		C60	.01U	.01UF 0805 SMD CAP
		**C61	.01U	.01UF 0805 SMD CAP
		**C62	.01U	.01UF 0805 SMD CAP
				**C61 & C62 are optional
11	1	JP1	MITSUMI	4PIN 2MM AUDIO HEADER
12	1	JP2	IDE	4PIN 0.1" AUDIO HEADER
13	1	JP3	2X1	2X1 HEADER
14	1	J1	20X2	20X2 DUAL ROW HEADER
15	1	J2	13X2	13X2 DUAL ROW HEADER
16	2	L1	1MH	1MH EPOXY THRU-HOLE IND
		L2	1MH	1MH EPOXY THRU-HOLE IND
17	4	PH1	PHONEJACK	SJ-100 5PIN PHONEJACK
		PH2	PHONEJACK	SJ-100 5PIN PHONEJACK
		PH3	PHONEJACK	SJ-100 5PIN PHONEJACK
		PH4	PHONEJACK	SJ-100 5PIN PHONEJACK

18	1	RN1	2.2KX4	2.2K OHM 8-PIN ISO SIP RES NET
19	6	R1 R2 R3 R4 R8 R9	4.7K 4.7K 4.7K 4.7K 4.7K 4.7K	4.7K OHM 0805 SMD RES 4.7K OHM 0805 SMD RES 4.7K OHM 0805 SMD RES 4.7K OHM 0805 SMD RES 4.7K OHM 0805 SMD RES 4.7K OHM 0805 SMD RES
20	2	**R17	10K	10K OHM 0805 SMD RES **DO NOT MOUNT IF USING 6502
EMULATION		**R5	10K	10K OHM 0805 SMD RES **DO NOT MOUNT IF USING EXTERNAL OPL3
21	1	R6	33	33 OHM 0805 SMD RES
22	9	R7 R10 R12 R18 R22 R23 R39 R55 R56	47 47 47 47 47 47 47 47 47	47 OHM 0805 SMD RES 47 OHM 0805 SMD RES 47 OHM 0805 SMD RES 47 OHM 0805 SMD RES 47 OHM 0805 SMD RES 47 OHM 0805 SMD RES 47 OHM 0805 SMD RES 47 OHM 0805 SMD RES 47 OHM 0805 SMD RES
23	3	R11 R48 R49	100 100 100	100 OHM 0805 SMD RES 100 OHM 0805 SMD RES 100 OHM 0805 SMD RES
24	1	R13	1K	1K OHM 0805 SMD RES
25	1	R14	1.8M	1.8M OHM 0805 SMD RES
26	7	R40 R41 R43 R44 R52 R53 R54	1.2K 1.2K 1.2K 1.2K 1.2K 1.2K 1.2K	1.2K OHM 0805 SMD RES 1.2K OHM 0805 SMD RES 1.2K OHM 0805 SMD RES 1.2K OHM 0805 SMD RES 1.2K OHM 0805 SMD RES 1.2K OHM 0805 SMD RES 1.2K OHM 0805 SMD RES
27	11	R16 R21 R24 R27	100K 100K 100K 100K	100K OHM 0805 SMD RES 100K OHM 0805 SMD RES 100K OHM 0805 SMD RES 100K OHM 0805 SMD RES

		R28	100K	100K OHM 0805 SMD RES
		R29	100K	100K OHM 0805 SMD RES
		R31	100K	100K OHM 0805 SMD RES
		R46	100K	100K OHM 0805 SMD RES
		R47	100K	100K OHM 0805 SMD RES
		R50	100K	100K OHM 0805 SMD RES
		R51	100K	100K OHM 0805 SMD RES
28	1	**R19	33	33 OHM 0805 SMD RES **DO NOT MOUNT IF USING CRYSTAL(Y1)
29	2	R32	68K	68K OHM 0805 SMD RES
		R35	68K	68K OHM 0805 SMD RES
30	2	R33	75K	75K OHM 0805 SMD RES
		R36	75K	75K OHM 0805 SMD RES
31	2	R42	2K	2K OHM 0805 SMD RES
		R45	2K	2K OHM 0805 SMD RES
32	2	**R34		**RESERVED
		**R37		**RESERVED
33	1	**U1	YMF262	OPL 3 ** DO NOT MOUNT IF USING INTERNAL OPL3
34	3	**U2	74LS245	20PIN SOIC **DO NOT MOUNT IF USING INTERNAL OPL3
		U3	74LS245	20PIN SOIC
		U4	74LS245	20PIN SOIC
35	1	U5	ALS200S	AVANCE SOUND CHIP
36	1	U6	LM7809CT	TO-220 9V VOLTAGE REGULATOR
37	1	U7	LM7805CT	TO-220 5V VOLTAGE REGULATOR
38	1	U8	TEA2025B	14PIN DIP
39	1	**Y1	14.318MHz	14.31818MHZ SERIES CRYSTAL **DO NOT MOUNT IF USING MOTHERBOARD OSC

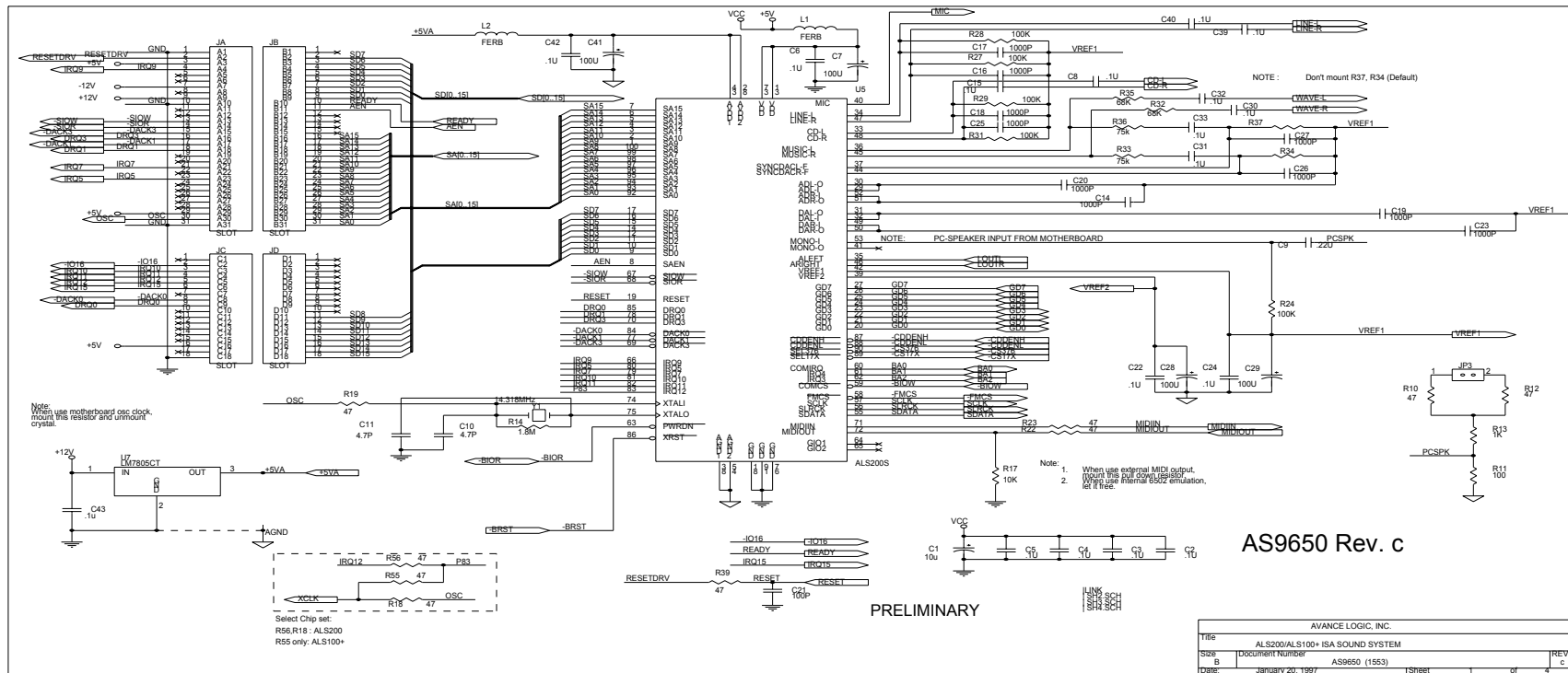


Figure 6.1

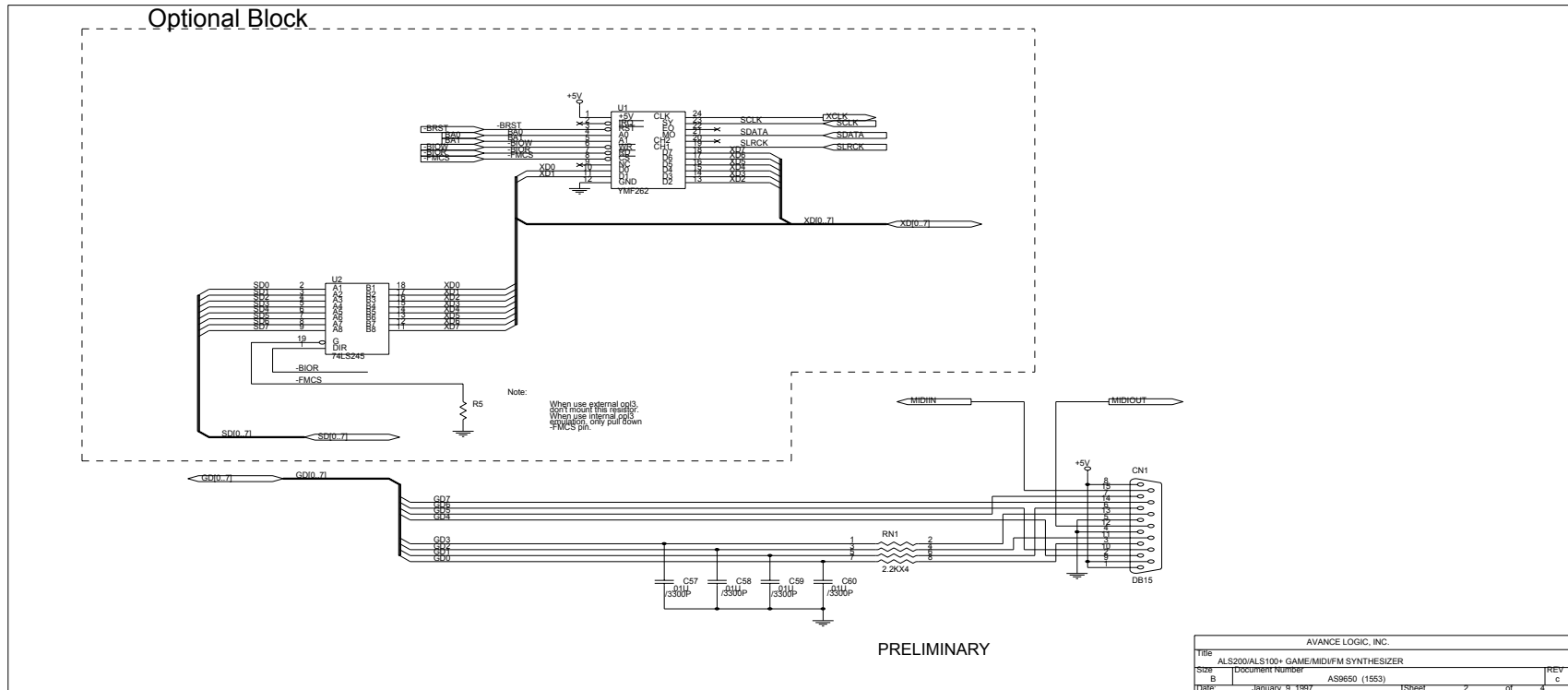


Figure 6.2

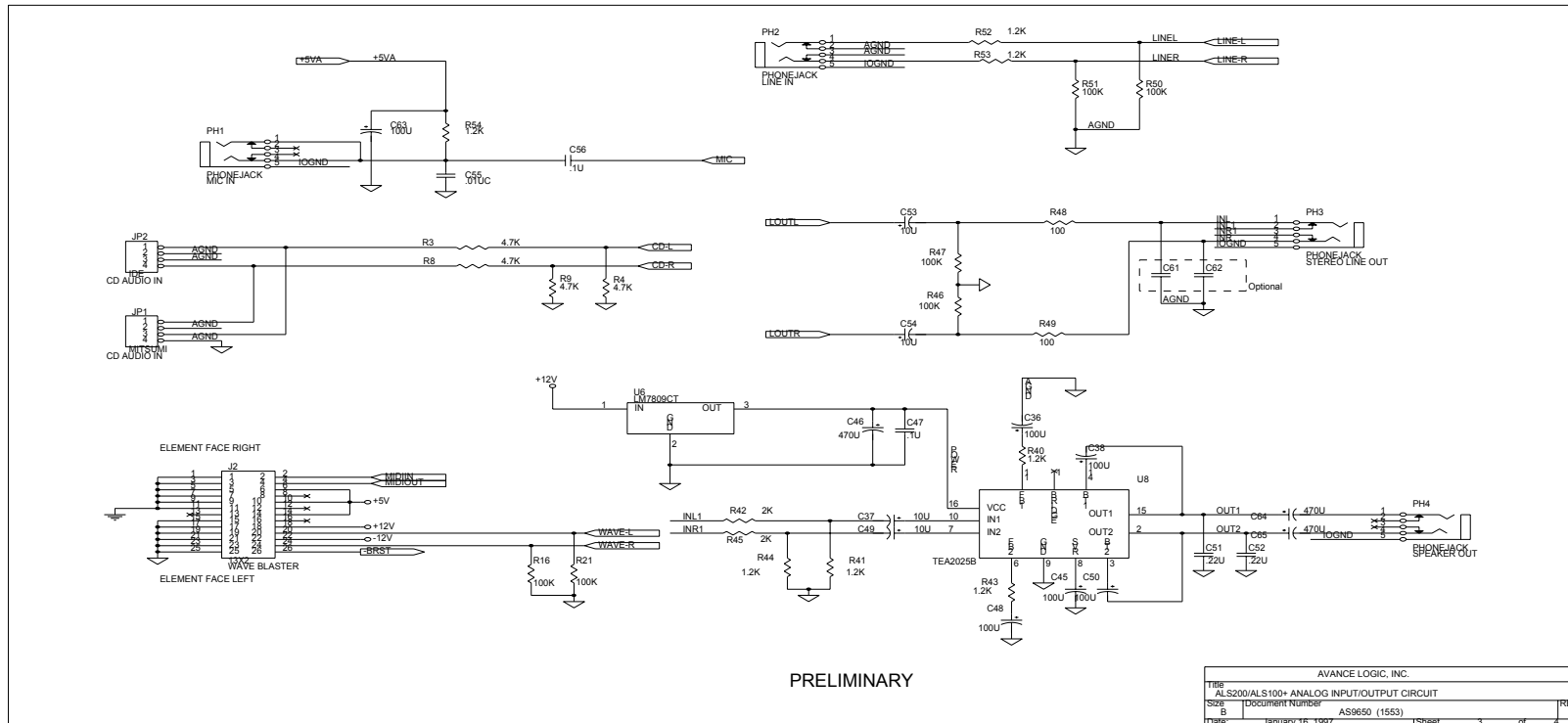


Figure 6.3

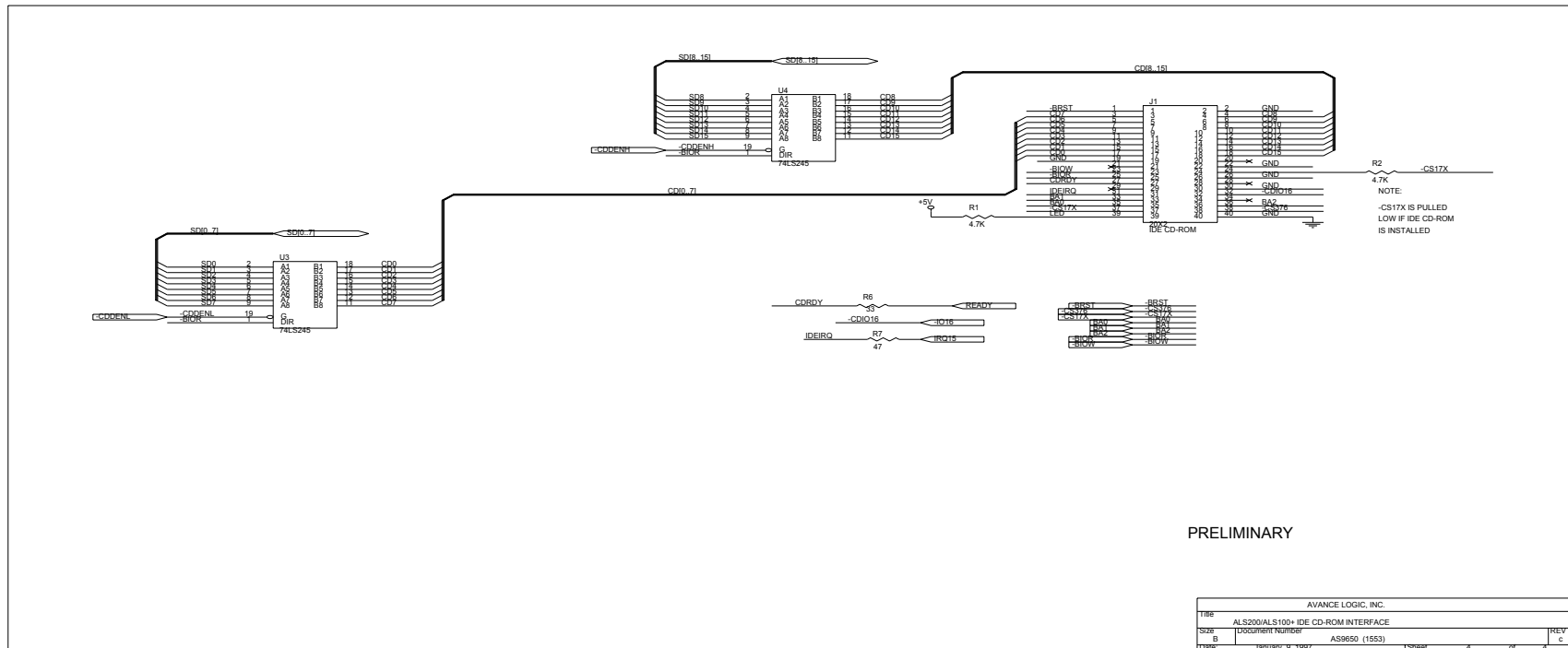


Figure 6.4