CMI-8338/PCI C3D*X*
PCI-Based HRTF 3D extension Positional Audio Chip

Features

- ✓ **HRTF-based 3D positional audio, supports Microsoft® DirectSound® 3D and Aureal® A3D® interface**
- ✓ **Supports rear side speakers,C3D*X* positional audio in 4 CH speaker mode**
- ✓ **Legacy audio SB16™ compatible**
- ✓ **DLS-based wavetable music synthesizer, supports Direct Music®**
- ✓ **Professional digital audio interface that supports 24-bit SPDIF IN and OUT**
- ✓ **Built-in 32ohm Earphone buffer**
- ● **Driver supports WIN95®, WIN®98, NT®4.0.**
- ● **MPU-401 port**
- ● **Dual game port**
- ● **16-bitsfull duplex CODEC**
- ● **4 CH 16-bit DAC**
- ● **32-bit PCI bus master**
- ● **Cost effective**
- ● **Single chip design, +5V, 100 pins QFP**

With high speed PCI V2.1 bus controller and legacy audio SB16® DSPemulator, CMI8338 is designed for PC add-on cards and all-in-one motherboards.

There is no need for external CODEC in CMI8338: CMI-8338 supports the legacy audio – SB16™, FM emulator/DLS wavetable music synthesis, and HRTF 3D positional audio functions.

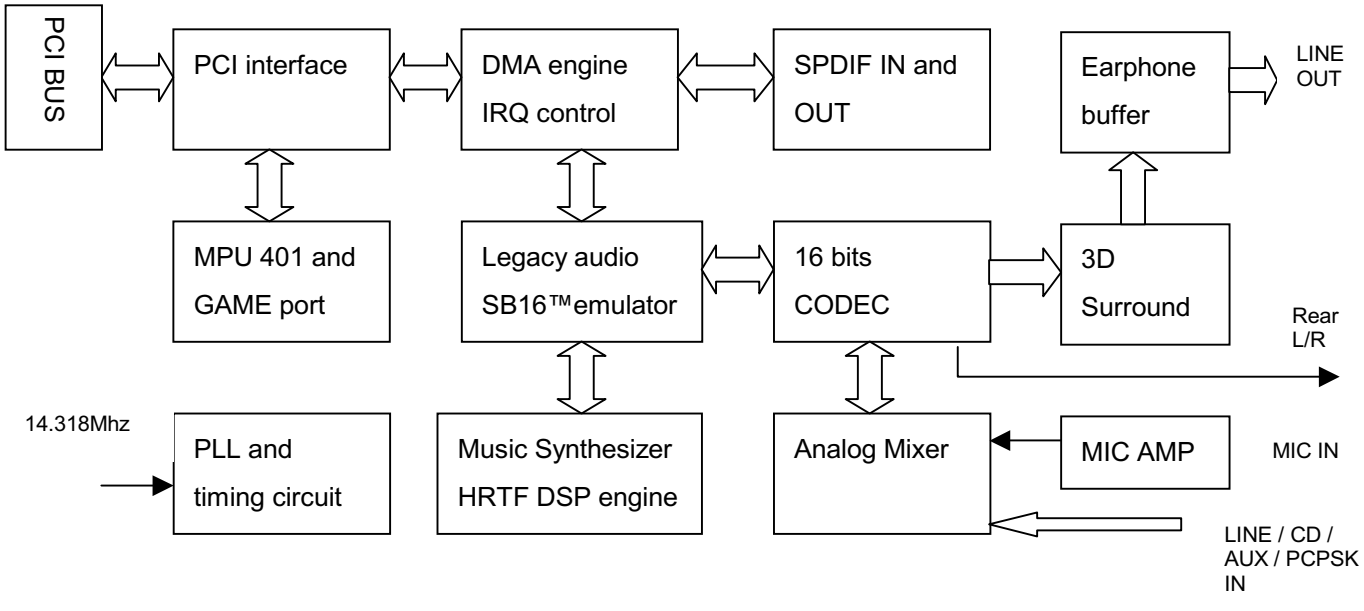
Besides, this 3D positional audio interface is compatible with A3D® and DirectSound® 3D. CMI8338 meets PC98® requirements, and supports professional digital audio interface as 24-bit SPDIF IN (0.5V ~ 5V)and OUT.

3D positional audio assumes the user's site as the sweet spot to design crosstalk-cancellation circuit; therefore,if the user wants to have the 3D positional audio effect,he can't move his head out of the spot,or freely turn his head.To remedy this, CMI8338 uses HRTF 3D extension technology to enhance traditional HRTF 3D positional audio from two speakers system to four speakers. It supports additional 2CH 16-bit DAC to provide rear side audio. It improves HRTF 3D positional audio quality and removes the sweet spot limitation. Users can enjoy the real 3D audio gaming effect, and don't have to worry about the limitation any more.

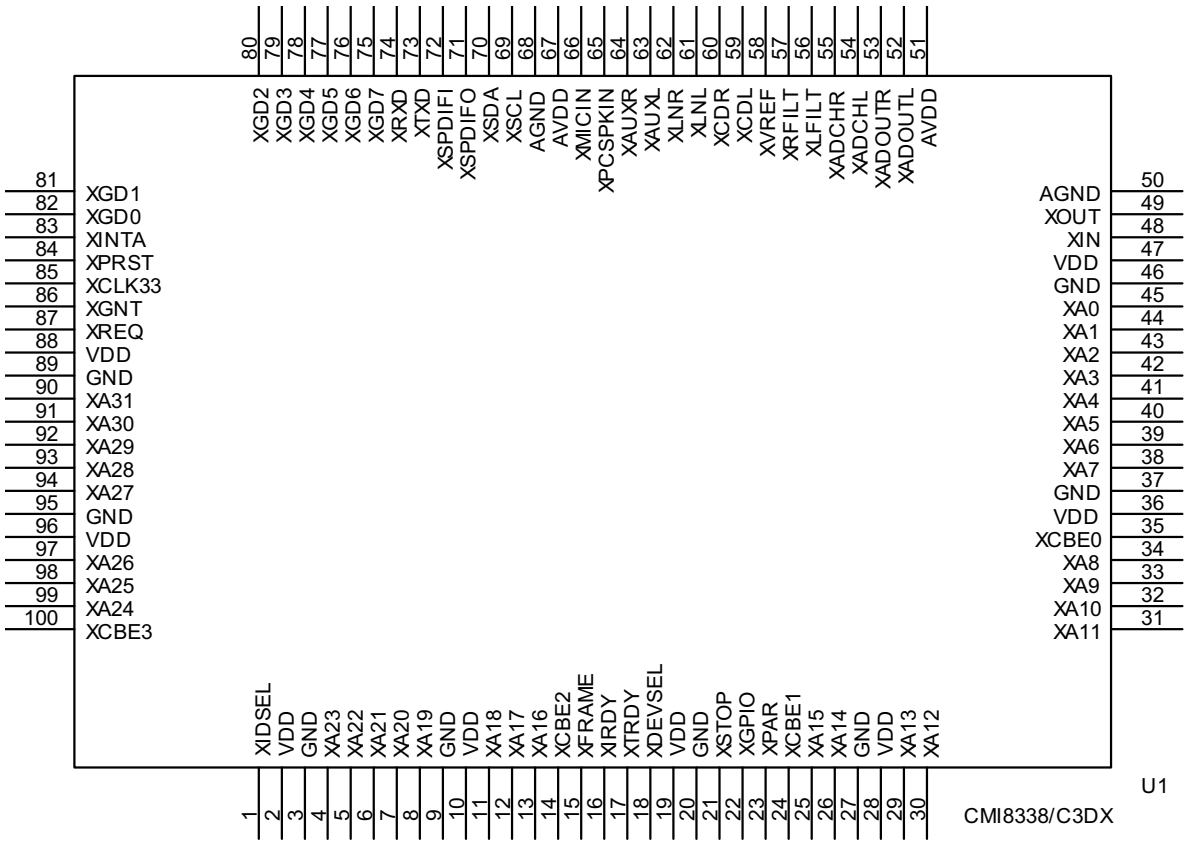
Being outstanding for its full audio functions, competitive price, and power management, CMI-8338 is the best choice for people seeking for optimum use of the PC applications.

C-Media's HRTF 3D library is licensed from Central Research Lab (CRL®), U.K, which presents one of the world's best HRTF libraries (CRL® also licensed its audio technology to YAMAHA®, ESS®, and other name-brand sound chip makers).

CMI-8338/PCI Block Diagram



PINOUT



CMI8338/PCI C3DX AUDIO CHIP
QFP 100 PINS

DIGITAL PIN DESCRIPTION

Name	Number	PIN Type	Definition
XA31-XA0	90-94,97-99,4-8,11-13,25-26,29-34,38-45	I/O	PCI bus address and data lines
XINTA	83	O	Interrupt request , active-low.
XPRST	84	I	Reset
XCLK33	85	I	PCI bus clock.
XGNT	86	I	Bus master grant, active-low.
XREQ	87	O	Bus master request, tri-state output, active-low.
XIDSEL	1	I	ID select, active-high.
XFRAME	15	I/O	Cycle frame, active-low.
XIRDY	16	I/O	Initiator ready, active-low. The bus master device is ready to transmit or receive data
XTRDY	17	I/O	Target ready, active-low. The target device is ready to transmit or receive data
XDEVSEL	18	I/O	Device select, active-low. The target device has decoded the address of the current transaction as its own chip select range.
XSTOP	21	I/O	Stop transaction, active-low. The target device request to the master to stop the current transaction.
XGPIO	22	I	General purpose Input pin.
XPAR	23	I/O	Parity. The pin indicates even parity across XA31-XA9 and XCBE3-0 for both address and data phases.
XCBE3,2,1,0	100,14,24,35	I/O	Multiplexed command/byte enable. These pins indicate cycle type during the address phase of a transaction.
DVDD	2,10,19,28,36,47,88,96	+5V	Digital and PCI I/O power pin
DGND	3,9,20,27,37,46,89,95	GND	Digital and PCI I/O ground
XIN	48	I	14.318Mhz crystal, or external clock input
XOUT	49	O	14.318Mhz crystal
XGD7-XGD4	75-78	I	Game port switch input pin. Switch D to switch A
XGD4-XGD7	79-82	I/O	Game port resistor input pin. RC3 to RC0
XTXD	73	O	MIDI transmit data
XRXD	74	I	MIDI receive data
XSPDIFO	71	O	44.1kHZ SPDIF output
XSPDIFI	72	I*	44.1kHZ SPDIF input
XSCL	69	O	General purpose output
XSDA	70	I/O	General purpose I/O

ANALOG PIN DESCRIPTION

AVDD	**51,67**	**+5V**	**Analog power**
AGND	**50,68**	**GND**	**Analog ground**
XADOUTL-R	**52,53**	**AO1**	**Line out**
XADCHL-R	**54,55**	**AI/O**	**ADC filter**
XLFILT	**56**	**AI/O**	**Left channel DAC filter**
XRFILT	**57**	**AI/O**	**Right channel DAC filter**
XVREF	**58**	**AI**	**Reference Voltage**
XCDL-R	**59,60**	**AI**	**CD audio differential input**
XLNL-R	**61,62**	**AI**	**Line in or Rear speaker out**
XAUXL-R	**63,64**	**AI**	**Aux. Line in**
XPCSPKIN	**65**	**AI**	**PC beep signal**
XMICIN	**66**	**AI**	**Microphone in**

ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings

Ratings	Symbol	Value	Units
Digital power voltage	VDD	VDD±5%	V
Analog power voltage	AVDD	AVDD±5%	V
Operating temperature range	TO	0 to 70	°C
Storage temperature range	TST	-40 to 125	°C
Maximum power dissipation	PDMAX	300	MW

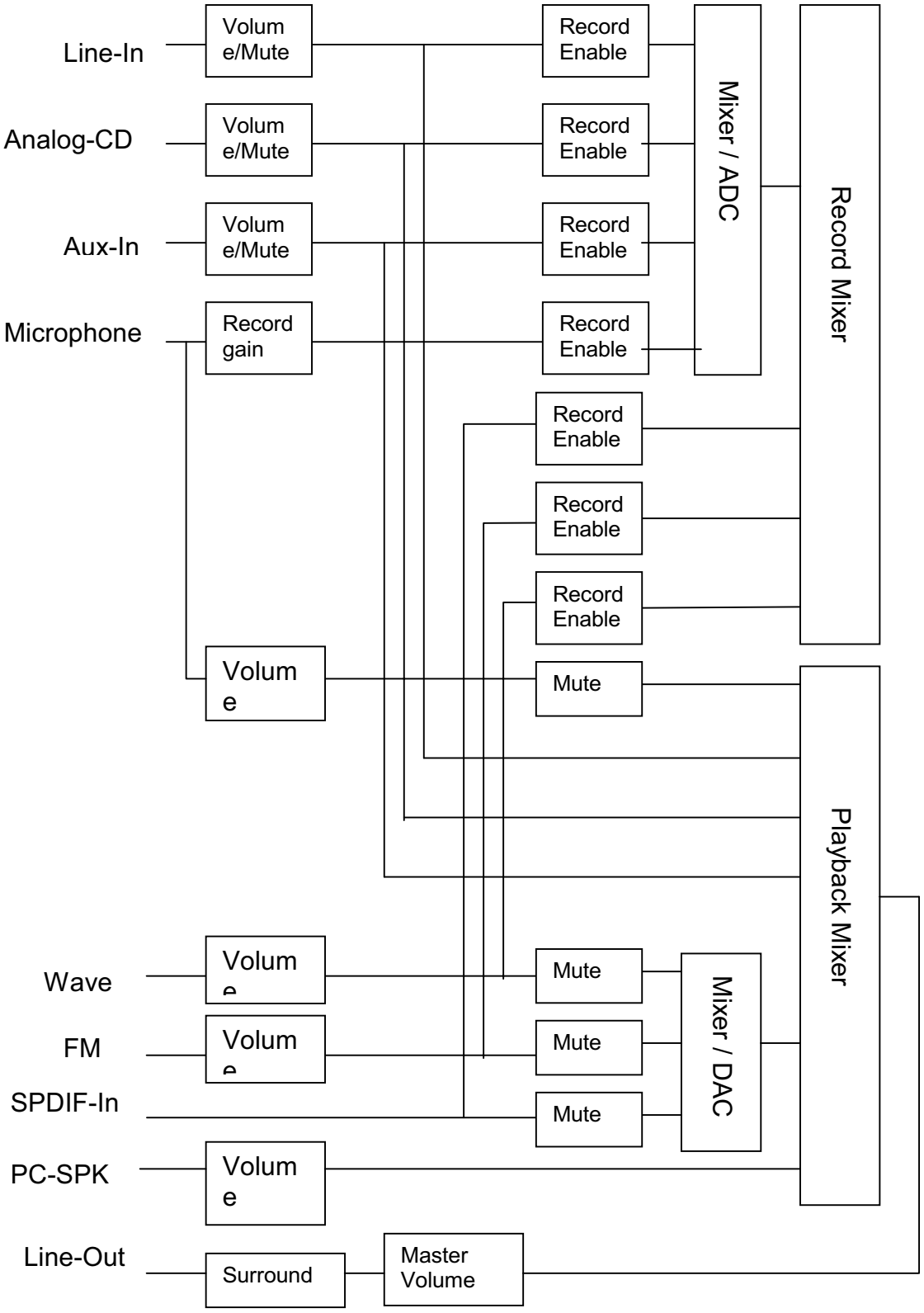
Digital Characteristics

PARAMETER	Symbol	Min	Typ	Max	Unit
Input high voltage(PCI I/O)	VIH	2.		VDD+0.5	V
Input low voltage (PCI I/O)	VIL	-0.5		0.8	V
Output high voltage	VOH	2.4		VDD	V
Output low voltage	VOL	0.0	0.2	0.4	V
SPDIF IN input high voltage	VIH1		2.6		V
SPDIF IN input low voltage	VIL1		2.4		V
SPDIF output high voltage	VOH1		VDD		V
SPDIF output low voltage	VOL1		VSS		V
Output buffer current			5		mA

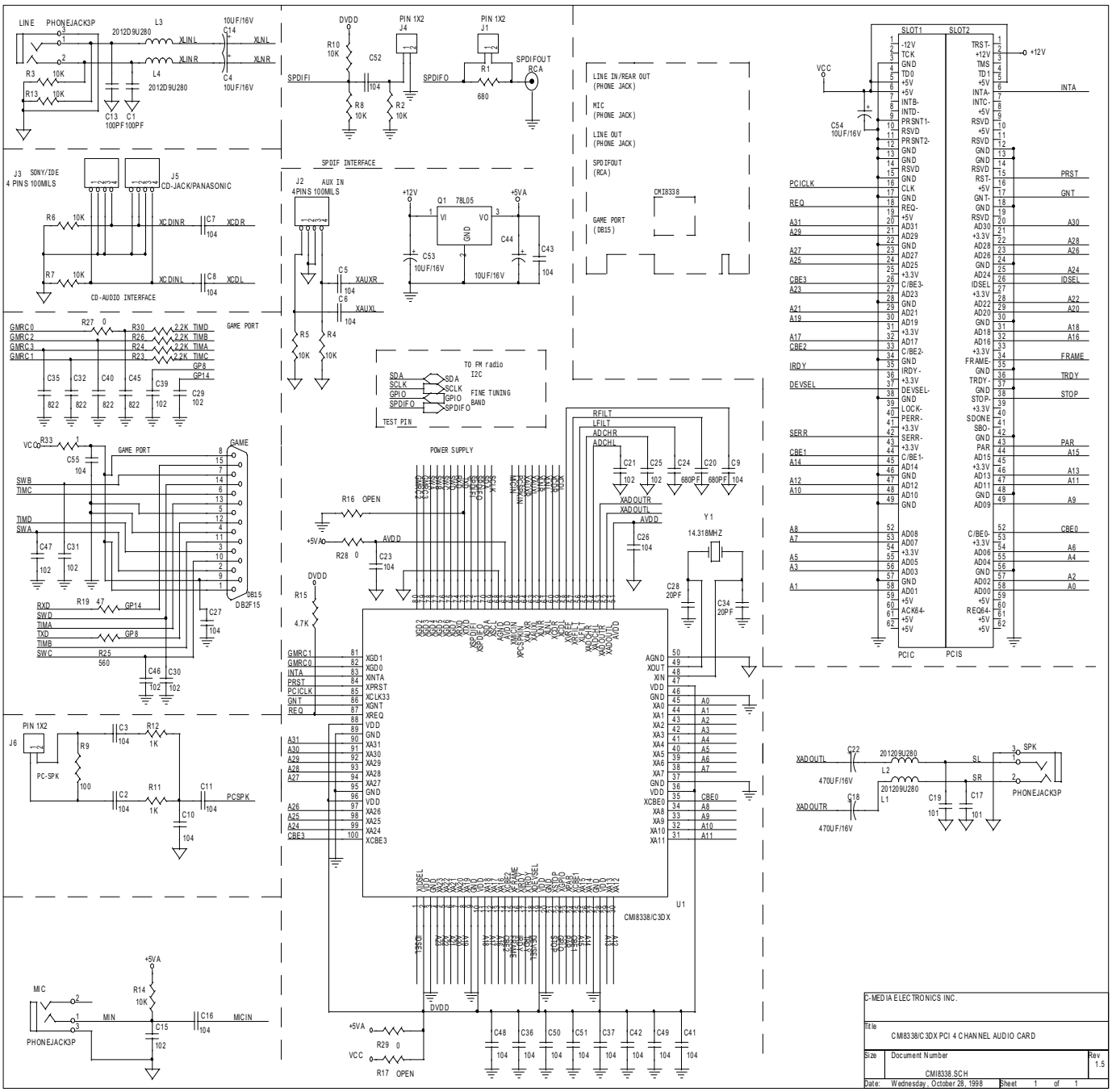
Audio Characteristics

PARAMETER	Symbol	Min	Typ	Max	Unit
Analog input voltage	Avin		1.1		VRms
Analog output voltage	Avout		1.1		VRms
A-A S/N ratio			85		db
A-A THD			0.09		
ADC S/N ratio			80		db
ADC THD			0.1	0.2	%
DAC S/N ratio			80		db
DAC THD			0.1	0.2	%
SPDIF IN/OUT S/N ratio			120		db
SPDIF IN/OUT THD			0		%
Microphone input level		20		200	mv
Microphone booster				20	db

🗁Mixer Block Diagram :



Application circuit:



CMI8338/C3DX PCI 4 CHANNEL AUDIO CARD Revised: Oct. 16, 1998

CMI8338.SCH Revision: 1.5

Item	Quantity	Reference	Part
1	4	C1,C13,C17,C19	100PF
2	22	C2,C3,C5,C6,C7,C8,C9,C10, C16,C23,C26,C36,C37,C41, C42,C43,C48,C49,C50,C51, C52,C55,C27,C11	104 (0.1uf)
3	5	C4,C14,C44,C53,C54	10UF/16V
4	1	R15	4.7K
5	9	C15,C21,C25,C29,C30,C31, C39,C46,C47	102 (1000PF)
6	2	C18,C22	470UF/16V
7	2	C20,C24	680PF
8	5	C32,C35,C40,C45	822 (0.82uf)
9	2	C28,C34	20PF
10	1	GAME	DB2F15
11	3	J1,J4,J6	PIN 1X2
12	2	J2,J3	4 PINS 100MILS
13	1	J5	CD-JACK/PANASONIC
14	4	L1,L2,L3,L4	201209U280(EMI)
15	3	LINE,MIC,SPK	PHONEJACK3P
16	1	Q1	78L05
17	3	R1,R25,R27	560PF
18	10	R2,R3,R4,R5,R6,R7,R8,R10, R13,R14	10K
19	1	R9	100 ohm
20	2	R11,R12	1K
21	1	R19	47 ohm
22	4	R23,R24,R26,R30	2.2K
23	2	R28,R29	0 ohm
24	1	R33	1 ohm
25	1	SPDIFOUT	RCA Jack(for SPDIF out)
26	1	U1	CMI8338/C3DX
27	1	Y1	14.318MHZ

CMI8338 PCI configuration spaces

00h 13F6 : (Vender ID) read only
02h 0100 : (Device ID) read only
04h 0006 : Command (State after #RST all is "0")
0 (bit 9) Fast back-to-back enable
0 (bit 8) #SERR enable (R/W)
0 (bit 7) Wait cycle control
0 (bit 6) Parity error response
0 (bit 5) VGA palette snoop
0 (bit 4) Memory write and invalidate enable
0 (bit 3) Special cycles
1 (bit 2) Bus master (R/W)
0 (bit 1) Memory space
1 (bit 0) I/O space (R/W)
06h 0280 : Status
0 (bit 15) Detected Parity Error
0 (bit 14) Signaled System Error
0 (bit 13) Received Master Abort
0 (bit 12) Received Target Abort
0 (bit 11) Signaled Target Abort
01 (bits 10-9) DEVSEL timing 00-fast, 01-medium, 10-slow
0 (bit 8) Data Parity Error Detected
1 (bit 7) Fast Back-to-Back Capable
0 (bit 6) UDF Supported
0 (bit 5) 0-33MHz ,1-66MHZ Capable
00000 (bits 4-0) Reserved
08h 10 : Revision ID
09h 040100 : Audio device
0Ch 00 : Cache Line Size
0Dh 20 : Latency Timer
0Eh 00 : Header Type
0Fh 00 : BIST

10h 0000d401 : I/O of length : -65280(ffff0100h) : First Base Address register
14h 00000000 : Uninitialized : Second Base Address register
18h 00000000 : Uninitialized : Third Base Address register
1Ch 00000000 : Uninitialized : Fourth Base Address register
20h 00000000 : Uninitialized : Fifth Base Address register
24h 00000000 : Uninitialized : Sixth Base Address register
28h 00000000 : Cardbus CIS Pointer
2Ch 13f6 : (SubSystem Vender ID) This Vender ID was unknown to Microsoft as of April 95
2Eh ffff : SubSystem ID
30h 00000000 : Expansion ROM Base Address
34h 00000000 : Reserved
38h 00000000 : Reserved
3Ch 05 : Interrupt Line
3Dh 01 : Interrupt Pin
3Eh 02 : Min_Gnt
3Fh 18 : Max_Lat

DMA Slave Configuration Register(R/W)

PCI Configuration address **40**H

Bit(s)	Function
31:16	Reserved
15:4	Reserved
3	Non legacy Extended Addressing 0 = disabled 1 = enabled
2:1	Transfer Size 00 = 8 bit transfer 01 = 16 bit transfer 10 = 32 bit transfer, non legacy 11 = Reserved
0	Channel Enable 0 = disabled 1 = enabled

Internal Register Mapping

Function Control Register 0

Address **00**H

Bit(s)	R/W	Name	Description
31:20			Reserved.
19		**RST_CH1**	**Channel1, 1->Reset (Default 0)**
18		**RST_CH0**	**Channel0, 1->Reset (Default 0)**
17		CHEN1	Channel1, 1->Enabled, 0->Disabled.
16		CHEN0	Channel0, 1->Enabled, 0->Disabled.
15-2		Reserved	
3		PAUSE1	Channel1, 1->Pause if channel1 is enabled.
2		PAUSE0	Channel0, 1->Pause if channel0 is enabled.
1		CHADC1	Channel 1 , 1->Recording, 0->Playback
0		CHADC0	Channel 0, 1->Recording, 0->Playback

Function Control Register 1

Address **04**H

Bit(s)	R/W	Name			Description
31-16		Reserved			
15:13		DSFC[2:0]			**DAC** Sampling Frequency Select,
		0	0	0	5.512 K
		0	0	1	11.025 K
		0	1	0	22.05 K
		0	1	1	44.1 K
		1	0	0	8 K
		1	0	1	16 K
		1	1	0	32 K
		1	1	1	48 K
12:10		ASFC[2:0]			**ADC** Sampling Frequency Select,
		0	0	0	5.512 K
		0	0	1	11.025 K
		0	1	0	22.05 K
		0	1	1	44.1 K
		1	0	0	8 K
		1	0	1	16 K
		1	1	0	32 K
		1	1	1	48 K
9		SPDF_0			SPDIF IN/OUT at Channel B at 44.1K double-words/sec.
8		SPDF_1			SPDIF OUT only at Channel A at 44.1K double-words/sec.
7		SPDFLOOP			Loop data from PIN SPDIF-IN to PIN SPDIF-OUT..

6 SPDO2DAC SPDF_OUT can be heard from DAC.

5 INTRM Interrupt Mask bit for MCB (Master control block) module interrupt.
0 MCB interrupt disabled.
1 MCB interrupt enabled.

4 BREQ If this bit is set low it will prevent the MCB and DAC/ADC block from accessing the memory.
0 Bus Master request disabled(power on state)
1 Bus Master request enabled.

3 VOICE_EN This bit enables Legacy Voice device(SB16,FM).
0 Legacy Voice disabled on channel 0.
1 Legacy Voice enabled on channel 0.

2 UART_EN This bit enables Legacy UART device.
0 UART disabled
1 UART enabled

1 JYSTK_EN This bit enables Legacy Joystick device.
0 Joystick disabled
1 Joystick enabled

0 SERR_TRAP PCI signal SERR used for Legacy I/O Trapping.
0 Disabled.
1 Enabled.

Channel Format Register

Address **08**H

Bit(s)	R/W	Name	Description
31:4		Reserved	
3:2		CH1FMT[1:0]	Data format of channel 1
		00	8 bit Mono mode
		01	8 bit Stereo mode
		10	16 bit Mono mode
		11	16 bit Stereo mode
1:0		CH0FMT[1:0]	Data format of channel0
		00	8 bit Mono mode
		01	8 bit Stereo mode
		10	16bit Mono mode
		11	16 bit Stereo mode

Interrupt Hold/Clear Register

Address **0C**H

Bit(s)	R/W	Name	Description
31:19		Reserved	
18		**TDMA_INT_EN**	**Interrupt hold/clear bits for updating TDMA position** **0 Interrupt Clear** **1 Interrupt Hold if exist.**
17		CH1_INT_EN	Interrupt hold/clear bits for the Channel 1. 0 Interrupt Clear 1 Interrupt Hold if exist.
16		CH0_INT_EN	Interrupt hold/clear bits for the Channel 0. 0 Interrupt Clear 1 Interrupt Hold if exist.
15:0		Reserved	

Interrupt Register

Address **10**H

Bit(s)	R/W	Name	Description
31	R	INTR	Interrupt reflected from any sources. 0 No interrupt 1 Interrupt pending
30:27		Reserved	
26	R	MCBint	Abort conditions occur during PCI Bus Target/Master Access. 0 No interrupt 0 Interrupt pending
25:17		Reserved	
16	R	UARTint	This bit is the UART interrupt bit. 0 No UART interrupt 1 UART interrupt pending
15:	R	LTDMAINT	Interrupt for updating Low Channel TDMA position. 0 No interrupt 1 Interrupt pending
14	R	HTDMAINT	Interrupt for updation High Channel TDMA position. 0 No interrupt. 1 Interrupt pending.
13:7		Reserved	
6	R	LHBTOG	High/Low status from DMA CTRL register.
5	R	LegHDMA	Legacy is in High DMA channel.
4	R	LegStereo	Legacy is in Stereo mode.
3	R	Ch1Busy	Channel B Busy.
2	R	Ch0Busy	Channel A Busy.
1	R	Chint1	Channel B Interrupt. 0 No interrupt 1 Interrupt pending
0	R	Chint0	Channel A Interrupt.

0 No interrupt
1 Interrupt pending

Legacy Control/Status Register

Address **14**H

Bit(s)	R/W	Name	Description
31		VSB	The address range for SB16/FM access. 0 Address range : 220h – 22fh,388h – 38Bh 1 Address range : 240h – 24fh,388h – 38Bh
30:29		VMPU [1:0]	Base address for MPU401 access 00 Base address : 300h 01 Base address : 310h 10 Base address : 320h 11 Base address : 330h
28		FIRQ	Setting high forces interrupt on pin INTA#.
27:26		Reserved	
25		MDMA	Event captures for the system DMA controller address (00h - 0F\h). 0 Disables event capture 1 Enables event capture
24		MPIC	Event captures for the system Interrupt controller address (20h – 21H). 0 Disables event capture 1 Enables event capture
23		Fm cap	Event captures for the FM registers. (288h – 38Bh) 0 Disables event capture 1 Enables event capture
22		Reserved	
21		MPU cap	Event captures for the MPU401 Base addresses. The decoded address range is

			decided by VMPU [1:0].
			0 Disables event capture
			1 Enables event capture
20		Reserved	
		19:18 R	Reserved
17:14	R	Acap [3:0]	The four LSB of I/O address during the event captured.
13		Reserved	
12	R	W_R	Read/Write status of the event captured.
			0 – Event captured was a Read
			1 – Event captured was a Write
11:4	R	Dcap [7:0]	valid when current captured event is on a Write cycle.
3:0		Reserved	

Miscellaneous Control Register

Address 18H

Bit(s)	R/W	Name	Description
31		PWD	Power Down Mode enabled..
30		**RESET**	**Reset Bus Master/DSP Engine.**
29:28			**Monitor Internal signal.**
27		Reserved	
26:24		Reserved	
23		**ENDBDAC**	**Default low, High will enable Double DAC structure.**
22		**XCHGDAC**	**Default low, 0 CH0 > Front SPKR, CH1 > Back SPKR. 1 CH0 > Back SPKR, CH1 > Front SPKR.**
21		**SPD32SEL**	
20		**SPDFLOOPI**	
19		**FM_EN**	**Legacy FM enabled.**
18		**WTRAP**	**Enable DMA registers' write trap. (default 0).**
17		**Reserved**	**default 0**
16		**VIDWPDSB**	**Sub ID write protect disabled. (default 0)**
15		**Reserved**	**Default 0**
14:4		Reserved.	
3:2		**UPDDMA[1:0]**	**For every the number of samples to notify updating TDMA position.**
1:0		**TWAIT[1:0]**	**For controlling the length of legacy BUS cycle.**

DMA Position

Address **1CH**

Bit(s)	R/W	Name	Description
31:16	**R**	**TDMACNT**	**Current Byte/Word Count of DMA channel.**
15:0	**R**	**TDMAADR**	**Current Address of DMA channel.**

Mixer Control / Device Configure Register (can be accessed only by **BYTE** instruction)

Address **20**H

Bit(s)	R/W	Name	Description
7:0	W	SBVR[7:0]	Programmable SB16 version No.
	R	DEV[7:0]	Hardwire device version No.

Address **21**H

Bit(s)	R/W	Name	Description
7		TST_SBADC	Test Mode only
6		DISIP	When high, it disable PCM interpolation function block.
5:4		C_ADSPEED[1:0]	ADC recording speed.(Don't care by programmer)
3	Reserved		
2		X_ADPCM	SB16 ADPCM enable,default disabled.
1		PROINV	SBPro Left/Right channel switching.
0		X_SB16	Indicate device active as SB16 compatible, default SB16

Address **22**H

Bit(s)	R/W	Name	Description
7:0		IDXdata	Mapping SB16 mixer INDEX register data port(A2x5h)

* The legacy SB16 mixer mapping detail info, please refer to page 27.

Address **23**H

Bit(s)	R/W	Name	Description
7:0		IDXaddr	Mapping SB16 mixer INDEX register address port(A2x4h)

* The legacy SB16 mixer mapping detail info, please refer to page 27.

Address **24**H

Bit(s)	R/W	Name	Description
7		Fmmute	Mute FM
6		Wsmute	Mute Wave stream
5:4	Reserved		
3		Waveinl	Digital Wave recording Left channel
2		Waveinr	Digital Wave recording Right channel
1		X3DEN	3D surround enable.
0		Cdplay	SPDIF/IN PCM to DAC enable

Address **25**H

Bit(s)	R/W	Name	Description
7		RAUXREN	Recording source select R-Aux
6		RAUXLEN	Recording source select L_Aux
5		VAUXRM	R-AUX mute control
4		VAUXLM	L-AUX mute control
3:1		VADMIC[2:0]	Recording MIC volume control
0		MICGAINZ	MIC gain control,default high

Address **26**H

Bit(s)	R/W	Name	Description
7:4		VAUXL[3:0]	L-AUX volume control
3:0		VAUXR[3:0]	R-AUX volume control

Address **27**H

Bit(s)	R/W	Name	Description
0		DMAUTO	SB16 Low/High DMA Auto detect enabled ,When high.
1		SPDVALID	SPDIF/IN valid bit detect enabled, When high.
2:7	Reserved		Keep all bits to Low.

* In test mode these bits are for analog ADC testing.

Extension Index Register

Index address **F0**H

Bit(s)	R/W	Name	Description
7:5		VPHONE[2:0]	Phone volume control
4		VPHOM	Phone mute control
3		VSPKM	Speaker mute control,default high
2		RLOOPREN	Recording R-channel enable
1		RLOOPLEN	Recording L-channel enable
0	Reserved		

Index address **F8-FF**H

These 8 registers is used to programming M/N counter by clock generator

External CODEC Interface Register

Address **28-2B**H reserved

Bit(s)	R/W	Name	Description

Channel 0 Frame Register 1

Address **80**H

Bit(s)	R/W	Name	Description
31:0	W	BASADDR0	Base address of channel 0.
	R	CURADDR0	Current address of channel 0.

Channel 0 Frame Register 2

Address **84**H

Bit(s)	R/W	Name	Description
31:16	W	BASCNT0	Base count of samples at Codec.
15:0	W	BASCNT0	Base count of samples at Bus Master.
31:16	R	CURCNT0	Current count of samples at Codec.
15:0	R	CURCNT0	Current count of samples at Bus Master.

Channel 1 Frame Register 1

Address **88**H

Bit(s)	R/W	Name	Description
31:0	W	BASADDR1	Base address of channel 0.
	R	CURADDR1	Current address of channel 0.

Channel 1 Frame Register 2

Address **8C**H

Bit(s)	R/W	Name	Description
31:16	W	BASCNT1	Base count of samples at Codec.

15:0	W	BASCNT1	Base count of samples at Bus Master.
31:16	R	CURCNT1	Current count of samples at Codec.
15:0	R	CURCNT1	Current count of samples at Bus Master.

Legacy SB16 mixer

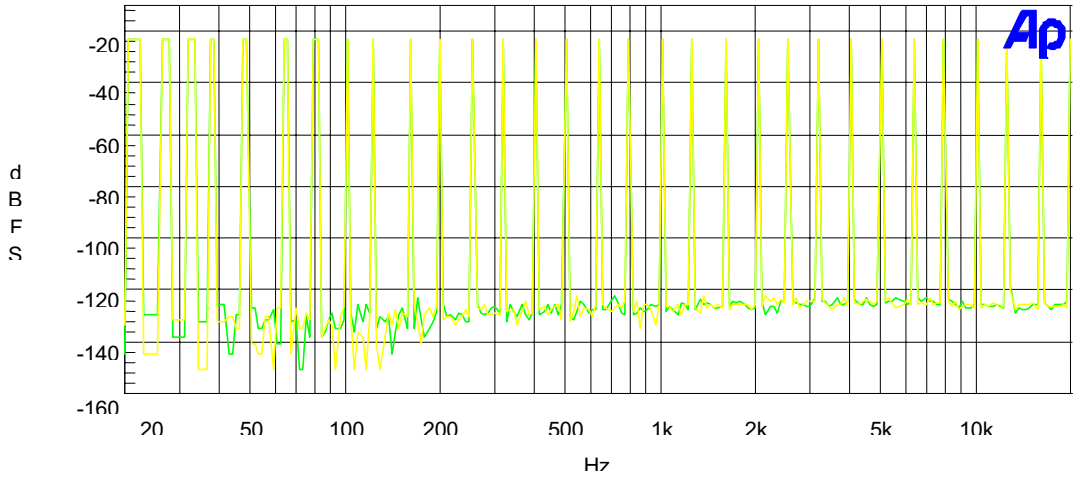
Index	D7	D6	D5	D4	D3	D2	D1	D0
0x00	Reserved							
0x04	Wave volume left channel				Wave volume right channel			
0x0A						Mic volume		
0x22	Master volume left channel				Master volume right channel			
0x26	FM volume left channel				FM volume right channel			
0x28	Analog-CD volume left channel				Analog-CD volume right channel			
0x2E	Line-in volume left channel				Line-in volume right channel			
0x30	Reserved							
0x31	Reserved							
0x32	Reserved							
0x33	Reserved							
0x34	Reserved							
0x35	Reserved							
0x36	Reserved							
0x37	Reserved							
0x38	Reserved							
0x39	Reserved							
0x3A	Reserved							
0x3B	PC spk volume							
0x3C				Output muting controls				
				Line L	Line R	CD L	CD R	Mic
0x3D		Recording left channel controls						
		FM L	FM R	Line L	Line R	CD L	CD R	Mic
0x3E		Recording right channel controls						
		FM L	FM R	Line L	Line R	CD L	CD R	Mic
0x3F	Reserved							
0x40	Reserved							
0x41	Reserved							
0x42	Reserved							
0x43	Reserved							
0x44	Reserved							
0x45	Reserved							
0x46	Reserved							
0x47	Reserved							

0x80					IRQ channel (read only)			
					IRQ10	IRQ7	IRQ5	IRQ2(9)
0x81	16 bit DMA channel (read only)				8 bit DMA channel (read only)			
	DMA 7		DMA 5		DMA 3		DMA 1	DMA 0
0x82						Interrupt status (read only)		
						MPU-401	16bit DMA	8bit DMA

* Please do not write any values into reserved registers

CMI8338 SPDIF IN/OUT Test Report

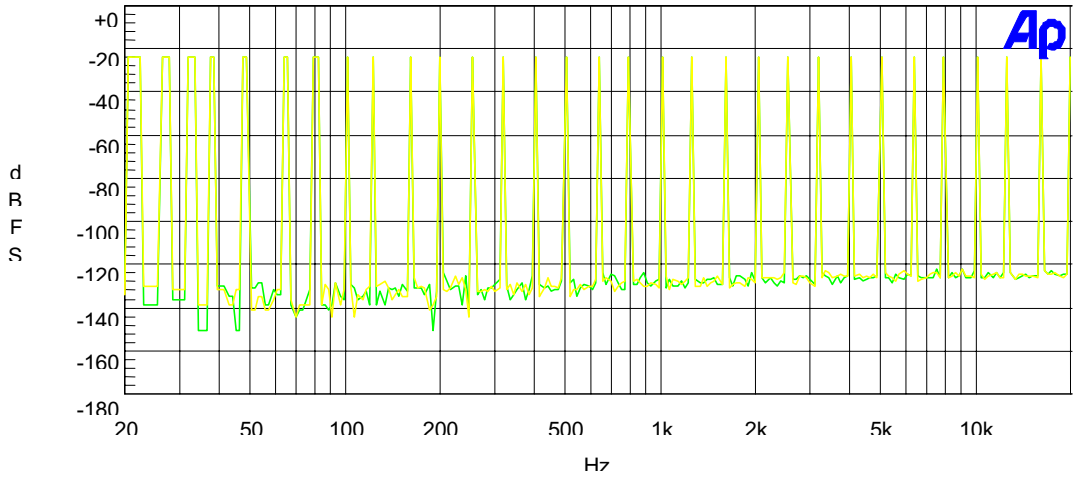
CMI8338 SPDIF-out Frequency, Distortion Noise Response 05/18/98 16:18:46



Color	Line Style	Thick	Data	Axis
Green	Solid	1	Fasttest Ch 1 Ampl	Left
Yellow	Solid	1	Fasttest Ch 2 Ampl	Left

PC-SPDIF-MEET.at2

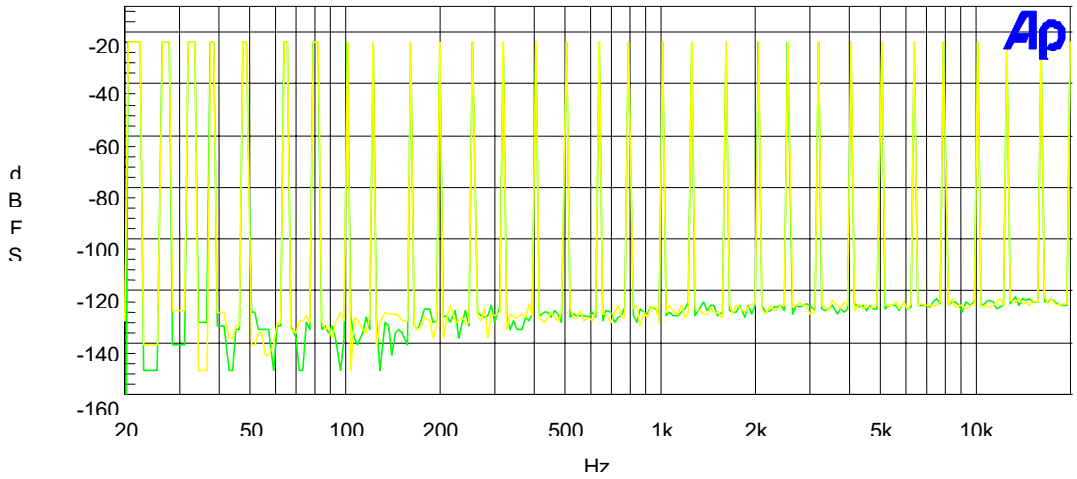
CMI8338 SPDIF-in Frequency, Distortion Noise Response 05/15/98 16:31:38



Color	Line Style	Thick	Data	Axis
Green	Solid	1	Fasttest Ch 1 Ampl	Left
Yellow	Solid	1	Fasttest Ch 2 Ampl	Left

SPDIF- PC-

CMI8338 SPDIF-thru Frequency, Distortion Response Noise 05/15/98 15:56:48



Color	Line Style	Thick	Data	Axis
Green	Solid	1	Fasttest Ch 1 Ampl	Left
Yellow	Solid	1	Fasttest Ch 2 Ampl	Left

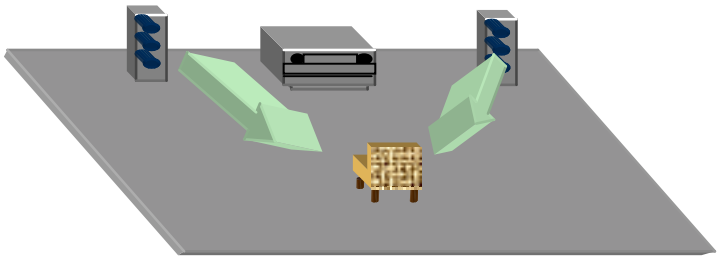
PC-SPDIF-MEET.at2

1. **SPDIF OUT (playback)= 120db**
2. **SPDIF IN (recording)= 120db**
3. **SPDIF through mode (bypass)= 120db**

* This report is generated by Audio Precision using multi-tone mode.

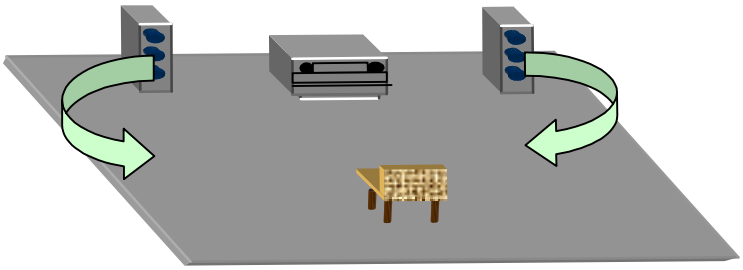
1. Stereo

It is only one-dimensional, as sounds come flatly from (left /right) the physical location of speakers.



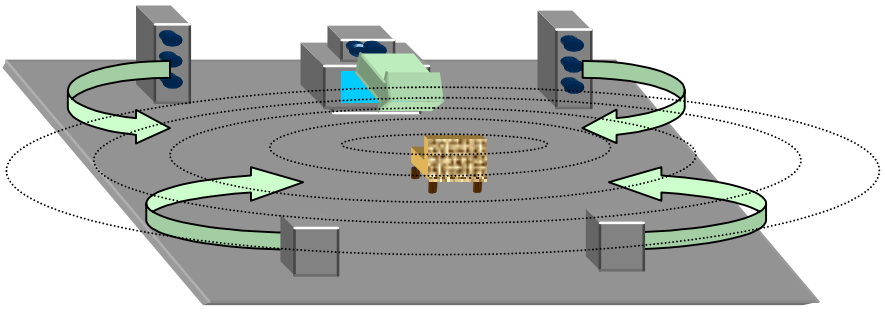
2. Surround (Stereo Expander)

It filters the existing stereo signal to make the sounds fill in the area around speakers and in front of the listener. Hence, it appears to come from outside the physical locations of the speakers.



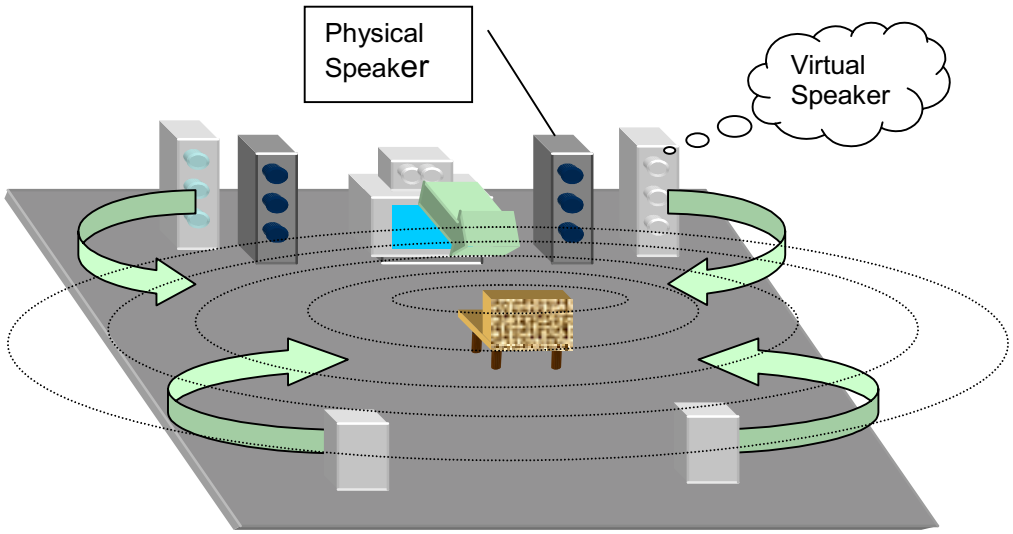
3. Multi-Speaker Surround (Dolby Pro Logic or Digital AC-3)

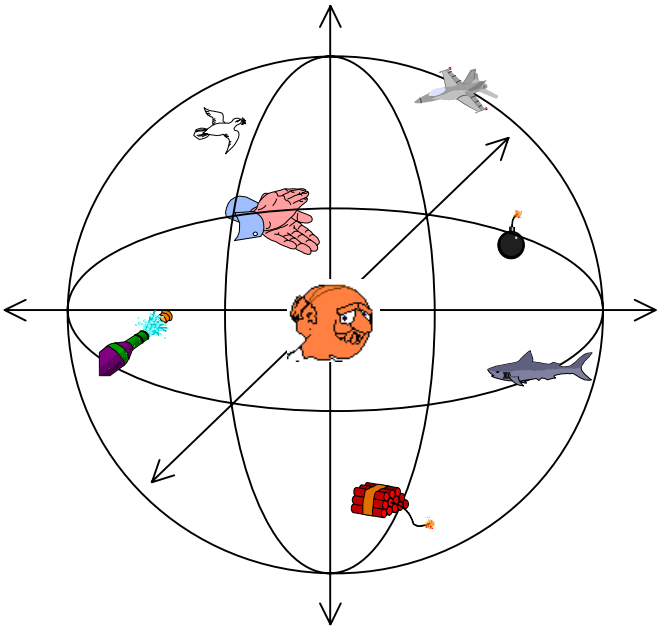
It uses five instead of two speakers to surround the listener. Sounds come from five directions and creates a very engaging audio experience. This surround sound effect has to be pre-recorded, and it dose not support interactive environment.



4. HRTF 3D Positional 3D (C-Media 3D)

Only can this sound processing be called real 3D, since 3D generally refers to the three dimensions of X, Y and Z. It allows the user to pin-point the location of sound in the real world (up/down, left/right, front/back) using only two speakers or a pair of headphones. This technology also supports interactive 3D applications to get a real-time placement of sounds via API (application programming interface) such as Microsoft DirectSound3D™. We can likewise use this technology to simulate Multi-speaker Surround with two physical speakers to deliver five "virtual speakers" into the air to surround the listener, creating home theater effect. This is the most economical and the easiest solution to everyone who would like to get high performance surround sound but doesn't want to spend extra money in adding other speakers.

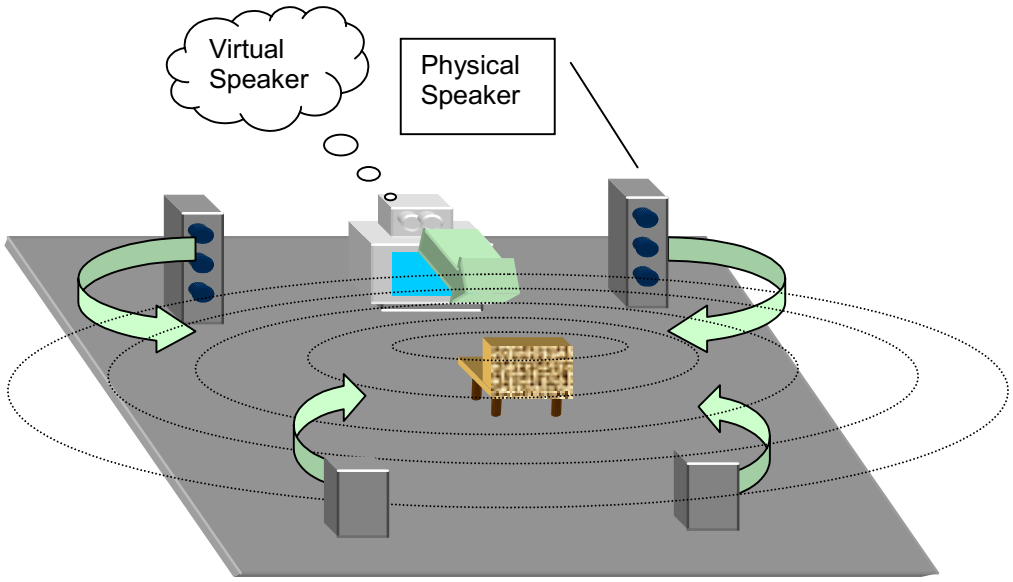




5. HRTF 3D Extension Positional (C-Media 3DX)

3D positional audio system assumes the user's site as the sweet spot to design crosstalk-cancellation circuit; therefore, if the user wants to have the 3D positional audio experience, he can't move his head or position out of sweet spot. Another 3D illusion fails because half the population are compulsive "head-turners" who will never get 3D audio from two speakers .

To remedy this, C-Media uses HRTF 3D extension technology (C3DX) to enhance traditional HRTF 3D positional audio by substituting the two-speaker system with the four-speaker one. Only one or two speakers are needed to place behind the listener's head for compelling realistic sound. It greatly improves HRTF 3D positional audio quality, and successfully eliminates the sweet spot limitation.



C3D HRTF Positional Audio Technology

The technology of C3D is licensed from CRL (Central Research Lab.) using an audio filter called Head Related Transfer Functions (HRTFs). The basic concept of C3D is, since we can hear sound three dimensionally in the real world using two ears, it must be possible to regenerate the same sound effect from two loud speakers.

What is HRTF ?

HRTF (Head Related Transfer Functions) is a set of audio filters which vary locations of sound effects (spatial hearing cues) in three-dimension measured from listener's eardrum.

Using this technology and special digital signal processing to re-create spatial hearing cues can make our ears hear realistic and three-dimensional sounds coming from a pairs of loud speakers or headphones.

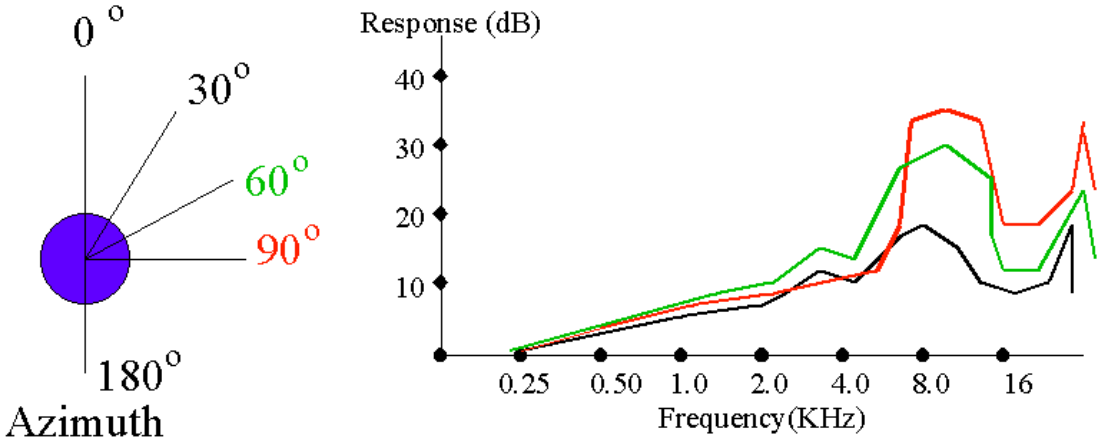
There are several listening cues that allow us to hear sounds three-dimensionally :

(I). Spatial hearing : Primary 3D-cues

1. IAD

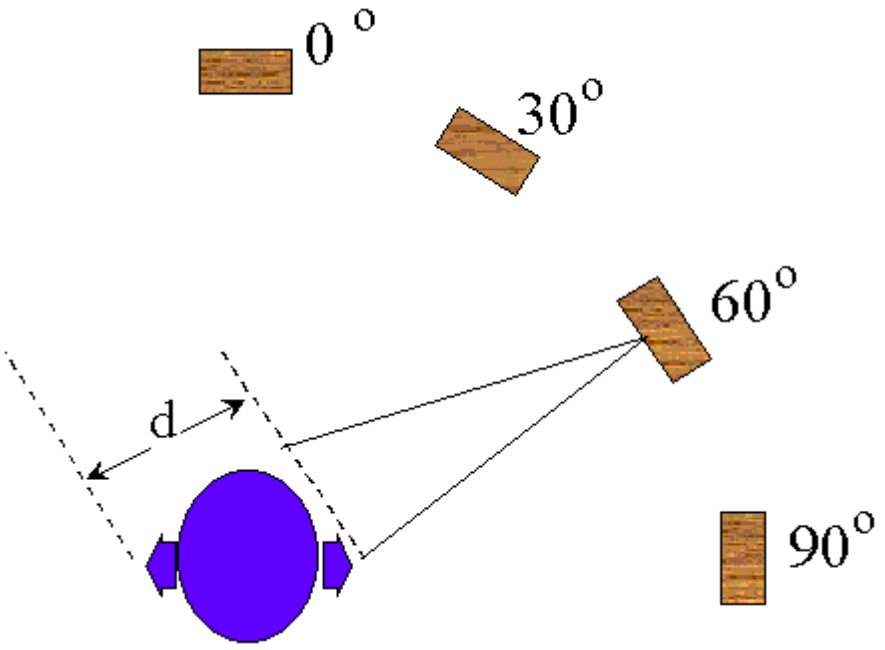
   The head shadowing effect creates differences in the amplitudes of the sound signals arriving at each ear from the source. The effects of diffraction are most noticeable in the range between about 700 Hz to 8 KHz, where the A and S functions periodically converge and diverge gently.

This Inter-aural Amplitude difference (IAD) is one of the primary 3D sound cues.



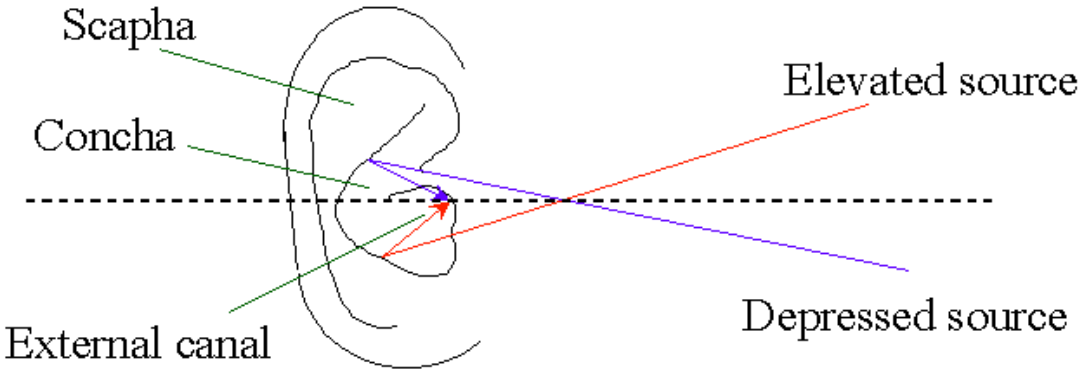
2. ITD

In addition to the IAD, there will be a time-of-arrival difference between the left and right ears, unless the sound source is in one of the pole positions (i.e. directly in front, behind, above and below). This is known as the Inter-aural Time Delay (ITD).



3. Pinna effects

It has been supposed by several researchers that the convolutions of the pinna create the spectral features which constitute the 'height' cues. In practical experiments by Gardner, in which different parts of the pinna were occluded, and then the ability of a number of subjects to identify sound source positions at different heights was tested, it was shown that the different features all contributed by different amounts. For example, if the fossa is excluded, then height localization capability is impaired, but not totally extinguished. It would be reasonable to conclude that it is the combined effect of the pinna convolutions which create the various localization cues, and it is not valid - or logical - to attempt to assign particular spatial capabilities with individual physical features.



(II). Spatial hearing : Secondary 3D-cues (shoulder & local reflections)

In addition to the 'primary' 3D sound cues (IAD, ITD and pinna effects), there are several additional cues which do contribute to the localization capability; these will be referred to here as 'secondary' cue, and include should/torso reflections, local room reflections, and psychological cues.

1. Shoulder / Torso reflections

The presence of a torso attached to an artificial head has the effect of increasing the pressure in the vicinity of the ear up to frequencies of around 2 kHz. The effect is greater for frontal sources than lateral sources. In the experience, the presence of the torso does not appear to contribute much to spatial accuracy. However, the shoulder are located

very close to the ears, and their effect is greater, this time, in respect of lateral sounds. If one listens to an artificial head first without - and then with - shoulder fitments, then it is clear that the shoulders do contribute to spatial effects in certain positions. The shoulders provide a strong reflection from lateral sources, with a short path-length of around 10 cm between direct sound and reflection. The effects are most important for side-positioned sources, especially for "height" effects, where the shoulders tend to mask sources which move below about 30 degrees depression.

2. Local, Room reflections

In simulations, it is clear that the incorporation of first-order simulated room reflections can help in the creation of sound images which have a "solid" nature. However, the effects - if accurately simulated - are relatively slight. Experience has shown that it is primarily the quality of the HRTFs themselves which determine the quality and solidity of the sound image. The furter addition of second-order reflections does not help significantly, because in reality, there is a great number of reflections in the average room. A method which does help to recreate the acoustic experience of a room, however, is to use approximate simulations of lateral reverb, using either 2 or 4 laterally placed "virtual" sources at, say, +-70 degrees and 80 degrees azimuth.

- The quality of the sound image relates to the HRTFs used.
- The quality of the room image relates to addition of reflections and reverb.

3. Psychological cues

There are clearly psychological cues present in everyday life which work together with the audio cues to tell us about the world around us. For example, if you hear the sound of a helicopter flying, you expect it to be up in the air, and not downwards. If a dog is to bark nearby, you would expect it to be downwards.

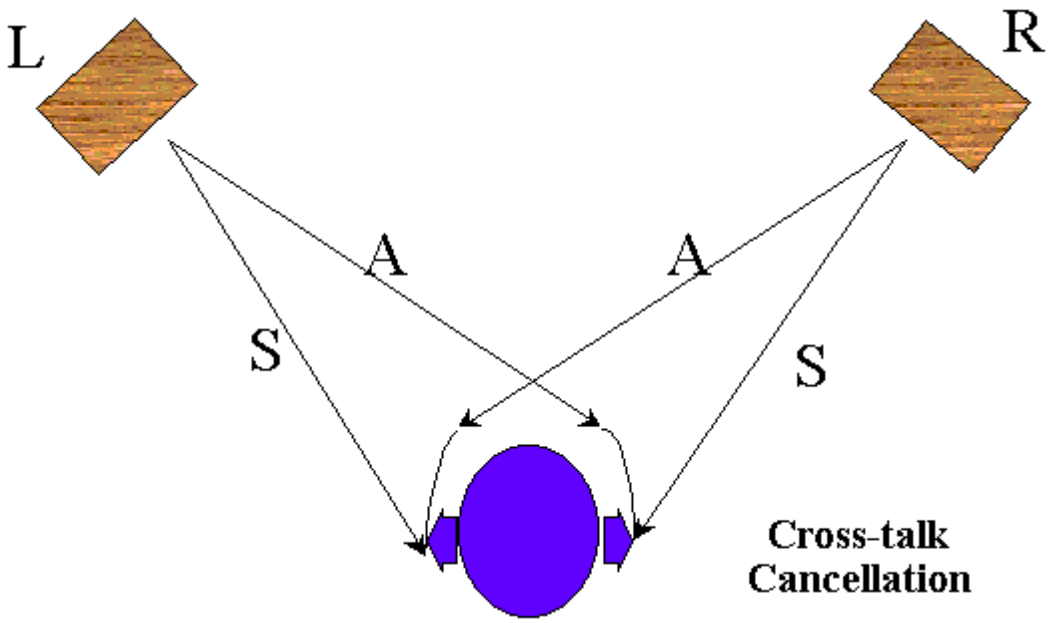
How to listen to C3D sound correctly and properly?

1. Use headphones to have much better effect

When you use headphones in listening, there will less interference such as outside voices or room reflections comparing to using speakers.

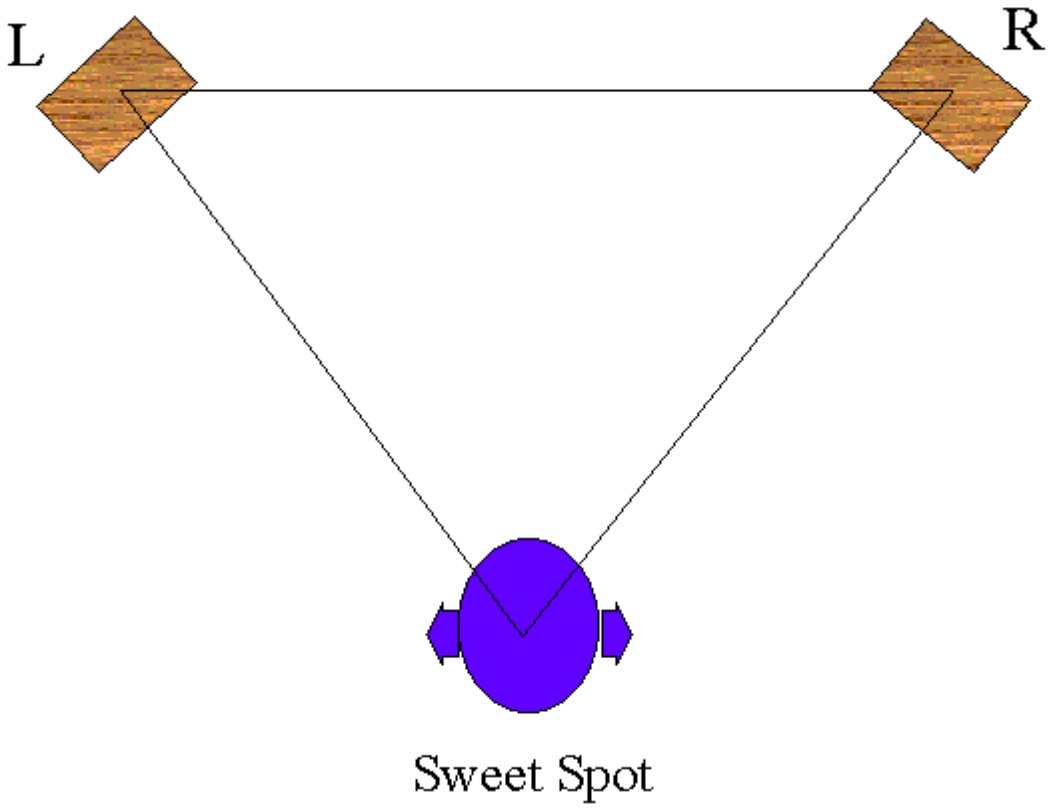
2. Choose correct output devices

Choose the correct output devices in the options of demo program in accordance with what listening devices you want to listen to. Because listening through speakers must be proceeded by crosstalk cancellation, if you choose the wrong output devices, there won't be any 3D positional audio effect..



3. Location of speakers

If you listen through speakers, please do not inverse the left and right speakers. They must be in equal distance from the listener. That means the listener, the left, and the right speaker must be in the topmost of a right triangle. The point of the listener is called “sweet spot”. In addition, the height of the listener’s ears must be equal to that of the speakers.

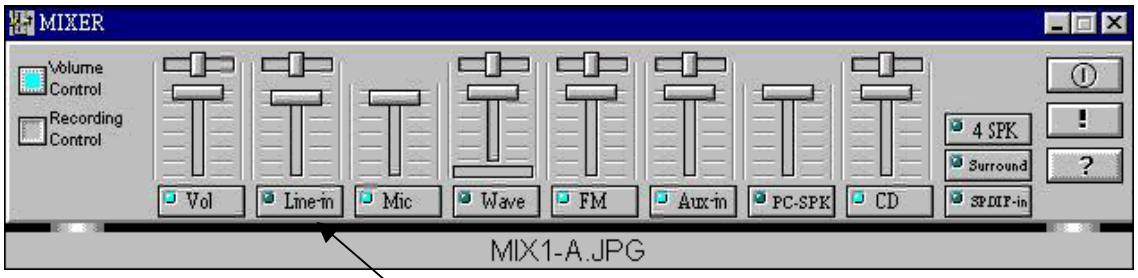


4. Turn surround sound functions off

When the surround sound effect is enabled, it will cause confusion with C3D sound, and make positional sound effect invalid.

Audio Rack Panel

Two Speakers System :



Line-In becomes
Rear Speakers Output

4 Speakers
system Enable

Four Speakers System :