## DESCRIPTION

The ES1888 *AudioDrive*® is a single mixed-signal chip for adding 16-bit stereo audio and 20-voice FM music synthesis to personal computers. The ES1888 *AudioDrive* can record, compress, and playback voice, sound and music with built-in 7 channel mixer controls. It supports full duplex operation for simultaneous record and playback using 2 DMA channels. 1 channel supports bidirectional 8-bit programmed I/O or DMA data transfers, the other channel supports 8-bit or 16-bit DMA playback.

The ES1888 AudioDrive consists of an embedded microcontroller, 20-voice high-quality ESFM™ music synthesizer, 16-bit stereo wave A/D and D/A, 16-bit stereo music D/A, MPU401 UART mode serial port, two serial port interfaces to external DSP and external wavetable music synthesizer, DMA control logic with FIFO, and ISA bus interface logic. The AudioDrive® ESFM™ synthesizer is backward-compatible to the OPL™3 and has enhanced capabilities for superior sound quality with ESFM™ music synthesis. A serial port interface to an external DSP allows the DSP to control the ES1888 full-duplex analog resources for audio effects, compression/decompression, or telephony applications. The MPU401 serial port can be used to interface the host to an external wavetable synthesizer. The ES1888 music D/A can be utilized by an external wavetable synthesizer by using a third ES1888 serial port. The PC speaker volume can be modified by software. Two software address selection modes allow for motherboard plug-and-play configuration. Advanced power management features include suspend/resume from disk or host independent self-timed power down and auto-wakeup. It has three stereo inputs (typically LINE, CD-ROM, and TV) and a mono input for a microphone.

ESFM™ music synthesis provides high-fidelity music and greater realism for every instrument. ESFM™ produces deeper instrument timbre, with layering capabilities for chorusing.

The ES1888 is available in an industry standard 100-pin PQFP package.

BLOCK DIAGRAM
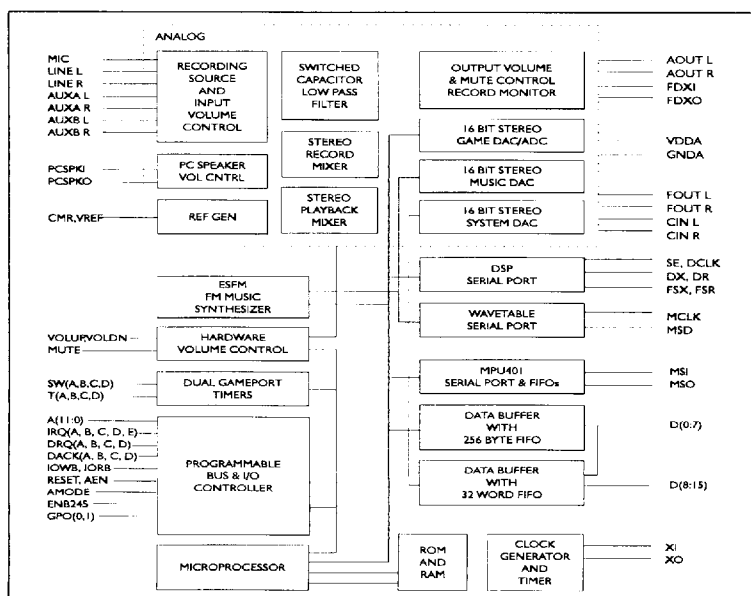
FEATURES

- Single, mixed-signal, 16-bit stereo VLSI chip
- Record, compress, and playback voice, sound and music
- High-quality 20-voice ESFM™ music synthesizer, patents pending
- Full duplex operation: record and playback simultaneously using two DMA channels
- 2 independent analog mixers: 7 channel playback mixer and 4 channel record mixer with stereo inputs for LINE-IN, CD-ROM, TV and a mono input for microphone
- 3 stereo D/A with independent sample rate and filter control for simultaneous game, music and system playback digital data streams
- 6-bit (64 steps) master volume control
- 3 button hardware volume control for up, down, and mute
- Dual game port
- Programmable sample rate from 4 KHz to 44.1 KHz for record and playback
- MPU401 (UART mode), Sound Blaster MIDI interface for wavetable synthesizers and MIDI devices
- Serial Port interface to external DSP
- Separate wavetable serial port interface for access to the music DAC
- Single transfer or demand transfer DMA
- PC speaker I/O with volume control
- Software address mapping, and DMA and IRQ selections for motherboard plug-and-play
- Advanced power management with self-timed power-down, auto-wakeup, and suspend/resume to and from disk
- Patented ESPCM™ compression
- Supports 3.3 volt or 5.0 volt operation
- Supports Microsoft® Windows™, Windows NT™, Windows for Work Groups, Windows 95 and Windows Sound System
- Supports IBM OS/2®
- Supports PC games and applications for Sound Blaster™ and Sound Blaster Pro™ modes
- Supports FM music synthesis in OPL™ 3 mode

APPLICATIONS

- PC Audio
- Business Audio
- Multimedia PC
- PC Games
- Music Synthesis

IMPLEMENTATION PLATFORMS

- Desktop Systems
- Notebooks
- Motherboards
- Sound Cards
- Multifunction Cards
- Voice/Fax/Modem Cards

ESS Technology, Inc.

DIGITAL PIN DESCRIPTION

VDDD	I	Digital Supply Voltage (3.0V to 5.5V)
GNDD	I	Digital Ground
VOLDN	I	Active low volume decrease button input.
VOLUP	I	Active low volume increase button input.
MUTE	I	Active low mute toggle button input.
GPO0	O	Output that is set low by external reset and thereafter controlled by bit 0 of port 2x7H. Available to system software for power management or other applications.
GPO1	O	Output that is set high by external reset and thereafter controlled by bit 1 of port 2x7H. Available to system software for power management or other applications.
MSI	I	MIDI serial input. Either MPU401 or Sound Blaster formats. Schmitt trigger input with internal pull-up resistor.
MSO	O	MIDI serial data output.
RESET	I	Active high reset from ISA bus.
XO	O	Crystal oscillator output.
XI	I	Crystal oscillator input.
IORB	I	Active low read strobe from ISA bus.
IOWB	I	Active low write strobe from ISA bus.
A0-A9	I	Address inputs from ISA bus.
A10-A11	I	Address inputs from ISA bus. The ES1888 requires these pins to be low for all address decodes.
AEN	I	Active low address enable from ISA bus
D0-D7	I/O	Bi-directional data bus. These pins have weak pullup devices to prevent these inputs from floating when not driven.
D8-D15	I	High byte input data bus. This is used for the system D/A when the 16 bit DMA transfer mode is selected.
ENB245	O	Active low output when ES1888 is being read or written to. Intended to be connected to the enable control of an external 74LS245.
SWA,B,C,D	I	Active low joystick switch setting inputs, These SW pins have a 2K pull-up resistor which is pulled to ground by the switch on each Joystick. The joystick port is at address 201.
TA,B,C,D	I/O	Joystick timer pins. These pins connect to the XY positioning variable resistors on the two joysticks.
AMODE	I	Input pin with pull-down device. The ES1888 is disabled following a hardware reset and must be configured by one of two methods (optioned by AMODE) of software address selection: 0: Read-Sequence-Key method 1: System-Control-Register method

|		
IRQ A,B,C,D	O	Active high interrupt request to ISA bus. Unselected IRQ outputs are high impedance. IRQs are software configurable.
IRQE	O	Active high interrupt request to ISA bus. Reserved for MPU401 use or hardware volume control.
DRQ A,B,C	O	Active high DMA request to ISA bus. Unselected DRQ outputs are high impedance. When DMA is not active, the selected DRQ output has a pulldown device that holds the DRQ line inactive, unless another device that shares the same DRQ line can source enough current to make the DRQ line active. DRQs are software configurable.
DACKB A,B,C	I	Active low DMA acknowledge inputs from ISA bus
DRQD	O	DMA request for the system DAC. This can be selected to be either 8 bit or 16 bit DMA transfers.
DACKBD	I	Active low DMA acknowledge for the system DAC.
PCSPKI	I	Normally low digital PC speaker signal input. This signal is converted to an analog signal with volume control and appears on analog output PCSPKO.
FSR	I	Input with internal pull-down. Frame Sync for Receive data from external DSP. Programmable for active high or active low.
FSX	I	Input with internal pull-down. Frame Sync for Transmit request from external DSP. Programmable for active high or active low.
DCLK	I	Input with internal pull-down. Serial data clock from external DSP. Typically 2.048 MHz.
DR	I	Input with internal pull-down. Data receive pin from external DSP.
DX	O	Tri-state output. Data Transmit to external DSP. High impedance when not transmitting.
MSD	I	Input with internal pull-down. Music Serial Data from external ES689 Wavetable Music Synthesizer.
MCLK	I	Input with internal pull-down. Music Serial Clock from external ES689 Wavetable Music Synthesizer.
SE	I	Input with internal pull-down. Active high to enable serial mode, i.e., enables an external DSP to control analog resources of the ES1888 through the DSP serial interface.

ANALOG PIN DESCRIPTION

VDDA	I	Analog supply voltage (4.5V to 5.5V). Should be greater than or equal to VDDD-0.3V.
GNDA	I	Analog Ground.
MIC	I	Microphone input. MIC has an internal pullup resistor to CMR
LINE L,R	I	Line input left, right. LINE L,R have internal pullup resistors to CMR.
AUXA L,R	I	Auxiliary input left, right. AUXA L,R have internal pullup resistors to CMR. Normally intended for connection to an internal or external CD-ROM analog output.
AUXB L,R	I	Auxiliary input left, right. AUXB L,R have internal pullup resistors to CMR. Normally intended for connection to an external music synthesizer or other line level music source. These pins are selectable with the FDXI, FDXO functions (see below).
FDXO	O	Normally connected to CMR via an internal resistor. Can be programmed to connect internal to FOUT R pin during DSP serial mode. This function is shared with the AUXB R input pin.
FDXI	I	Input with internal pullup to CMR. Alternate input to left channel filter stage in DSP serial mode. This function is shared with the AUXB L input pin.
FOUT L,R	O	Filter outputs left, right. A.C. coupled externally to CIN L,R in order to remove DC offsets. These outputs have internal series resistors of about 5K ohms. Capacitors to analog ground on these pins can be used to create a lowpass filter pole that removes switching noise introduced by the switched-capacitor filters.
CIN L,R	I	Capacitive coupled inputs left, right. These inputs have internal pullup resistors to CMR of approximately 50K ohms.
VREF	O	Reference generator resistor divider output. Should be bypassed to analog ground with 0.1 uf capacitor.
CMR	O	Buffered reference output. Should be bypassed to analog ground with a 47 uf electrolytic capacitor, with a 0.1 uf capacitor in parallel.
AOUT L,R	O	Line level stereo outputs, left, right
PCSPKO	O	Analog output of PCSPKI with volume control.

TYPICAL CIRCUIT DIAGRAM
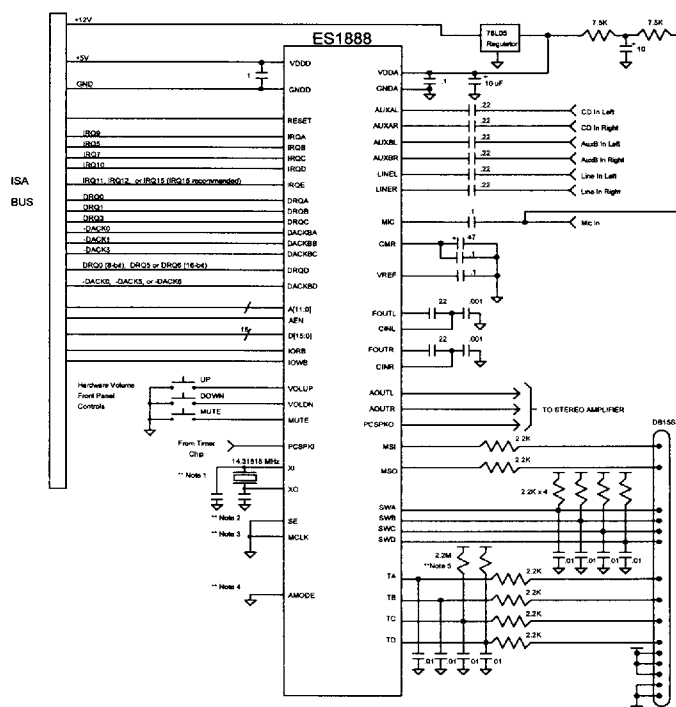
**Note 1: Use a crystal for the ES1888 if the accuracy of the ISA bus OSC signal is not sufficient. The XI pin can be driven by an external clock if the clock has CMOS logic levels.
**Note 2: In designs where the DSP interface is not used, it is recommended to tie SE pin low.
**Note 3: In designs where the ES689 serial interface is not used, it is recommended to tie MCLK pin low.
**Note 4: AMODE selects one of the two software address configuration methods. In this example, the Read-Sequence-Key method is selected.
**Note 5: For power-management designs, 2 pullup resistors (2.2 megaohms each) should be connected to TC and

PINOUT

ES1888F AudioDrive®

3   03/95
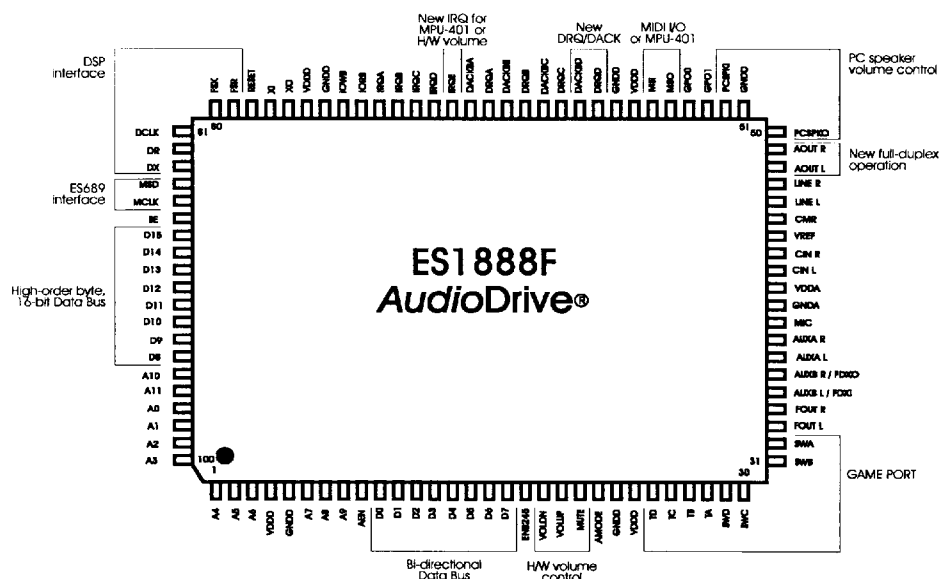
ANALOG CHARACTERISTICS

Parameter	Pins	Min	Typ	Max	Unit (conditions)
Reference Voltage	CMR, VREF		2.25		Volts (VDDA=5.0V)
Input Impedance	LINE L/R, AUXA L/R, AUXB L/R, MIC	30K		100K	Ohms
	CIN L/R	35K	50K	65K	Ohms
Output Impedance	FOUT L/R	3.5K	5K	6.5K	Ohms
	AOUT L/R max load for full-scale output range		5K		Ohms
Input Voltage Range	MIC	10		125	mVp-p
	LINE L/R, AUXA L/R, AUXB L/R	0.5		VDDA-0.5	Volts
Output Voltage Range	AOUT L/R full-scale output range	0.5		VDDA-1.0	Volts
Gain	Mic preamp		26		dB
I/O Range	Input Volume Range	0		22.5	dB
	Output Volume Range	-46.5		+10	dB

DIGITAL CHARACTERISTICS

Symbol	Parameter	Min	Max	Unit	Conditions
VIH1	Input High Voltage: All Except GPI1	2.0		V	VDDD=min
VIH2	Input High Voltage: GPI1	3.0		V	VDDD=min
VIL	Input Low Voltage		0.8	V	VDDD=max
VOL1	Output Low Voltage, All except D[7:0], DRQx, IRQx		0.4	V	IOL=4mA, VDDD=min
VOH1	Output High Voltage, All except D[7:0], DRQx, IRQx	2.4		V	IOH=-3mA, VDDD=max
VOL2	Output Low Voltage, D[7:0], DRQx, IRQx		0.4	V	IOL=16mA, VDDD=min
VOH2	Output High Voltage, D[7:0], DRQx, IRQx	2.4		V	IOH=-12mA, VDDD=max
VOL3	Output Low Voltage, Select DRQx when DMA inactive		0.4	V	IOL=0.8mA
ICC1	VDDD active		60	mA	VDDD=max osc. rate at 14.32 MHz
ICC2	VDDA active		60	mA	VDDA=max

MAXIMUM RATINGS

Ratings	Symbol	Value	Units
Analog Supply Voltage	VDDA	-0.3 to 7.0	V
Digital Supply Voltage	VDDD	-0.3 to 7.0	V
Input Voltage	VIN	-0.3 to 7.0	V
Operating Temperature Range	TA	0 to 70	Deg C
Storage Temperature Range	TSTG	-50 to 125	Deg C

SERVICE & SUPPORT

- Bundled Drivers:
    - Microsoft Windows
    - Microsoft Windows NT
    - Microsoft Windows Sound System
    - IBM® OS/2®
- Evaluation Kit
- Manufacturing Kit
- Bundled Audio Application Software
- Reference Design

BUNDLED SOFTWARE

- Audio Recorder
- Audio Reminder
- Audio Clip Library
- Chime
- Mixer
- Stopwatch
- Talking Calculator
- Talking Clock
- Timer

AudioDrive®

ESS Technology, Inc.
46107 Landing Parkway
Fremont, CA 94538
TEL: (510) 226-1088
FAX: (510) 226-8868

ESS Technology, Inc.

9006144 0000008 105

46298

03/95