ESS Technology, Inc.

DESCRIPTION

The ES1688 *Audio*Drive® is a mixed-signal single-chip solution that adds 16-bit stereo sound and FM music synthesis to personal computers. It includes an embedded microprocessor, a 20-voice **ESFM**™ music synthesizer, 16-bit stereo wave ADC and DAC, 16-bit stereo music DAC, MPU-401 UART mode serial port, two serial port interfaces to external DSP and external wavetable music synthesizer, DMA control logic with FIFO, and ISA bus inferface logic. There are three stereo inputs (typically line, CD Audio, and auxiliary line) and a mono microphone input to an internal preamp. All of this on a single chip that can be designed into a motherboard, add-on card, or integrated into other peripheral cards such as Fax/Modem, VGA, LAN, I/O, etc.

The ES1688 *Audio*Drive® can record, compress, and play back voice, sound, and music with built-in 6-channel mixer controls. Using two high-performance DMA channels, the ES1688 supports full-duplex analog operation for simultaneous record and playback. The **ESFM**™ synthesizer has extended capabilities within native mode operation providing superior sound and power-down capabilities. The ES1688 is register compatible to OPL3™.

The MPU-401 serial port is for interfacing with an external MIDI device. The PC speaker volume can be modified by software. Two software address selection modes allow for motherboard Plug and Play configuration.

A DSP serial interface allows an external DSP to take over DAC or ADC resources. A wavetable serial port allows the ES1688 to interface with either the ES689 or ES690 wavetables. I/O address, DMA, and interrupt selection can be controlled through system software or by jumper.

Advanced power management features include suspend/resume from disk or host-independent self-timed power-down and automatic wake-up.

The ES1688 *Audio*Drive® is available in an industry-standard 100-pin Plastic Quad Flat Pack (PQFP) package.

APPLICATIONS

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

SERVICE AND SUPPORT

- Evaluation Kit
- Manufacturing Kit
- Reference Design

FEATURE HIGHLIGHTS

- Single, high-performance, mixed-signal, 16-bit stereo VLSI chip for digital audio
- High-quality, 20-voice **ESFM**™ music synthesizer; patents pending
- Patented **ESPCM**® compression

Record and Playback Features

- Record, compress, and play back voice, sound, and music
- Programmable sample rate from 4 kHz to 44.1 kHz for record and playback
- Mixer controlled record and playback with programmable logarithmic volume controls

Inputs and Outputs

- MIDI serial port compatible with MPU-401 UART mode
- Address decode for joystick
- Programmed I/O and demand transfer DMA
- Software address mapping, DMA and IRQ selections for motherboard Plug and Play
- Wavetable serial port interface to ES689/ES690 for direct access to the music DAC
- PC speaker input/output with volume control
- Serial port interface to external DSP optionally controls full-duplex analog operation

Mixer Features

- 6-channel stereo mixer inputs for line, auxiliary A (CD audio), auxiliary B, digital audio (wave files), music synthesizer, plus a mono channel mixer input for microphone
- 4-channel record mixer with stereo inputs for line, auxiliary A (CD audio), auxiliary B, plus a mono input for microphone
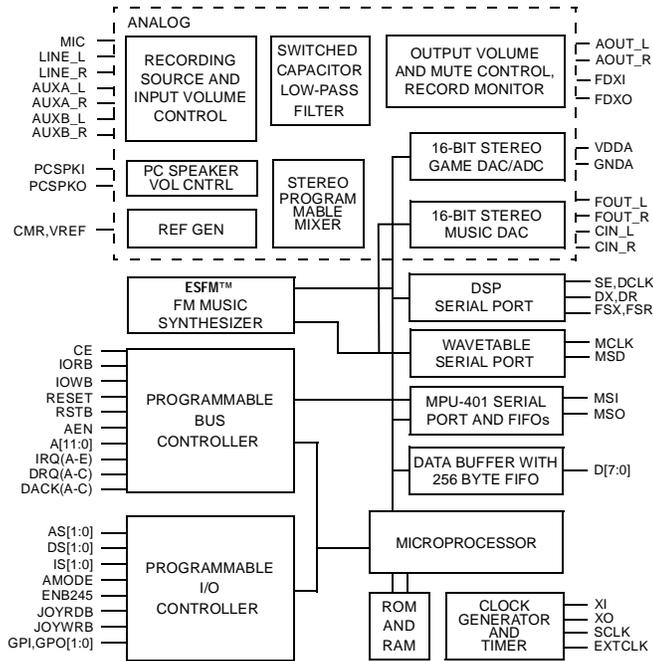
Power

- Advanced power management with self-timed power-down, automatic wake-up, and suspend/resume to and from disk
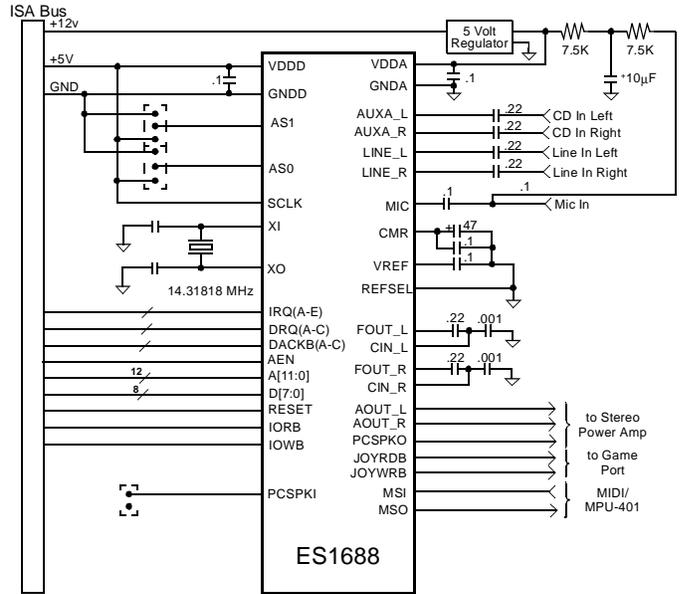- Supports 3.3 or 5.0 V operation

Compatibility

- Supports PC games in Sound Blaster™ and Sound Blaster™ Pro modes
- Supports FM music synthesis in OPL3 FM mode
- Supports Microsoft® Windows™, Windows NT™, Windows for Workgroups™, Windows®95 and Windows Sound System®
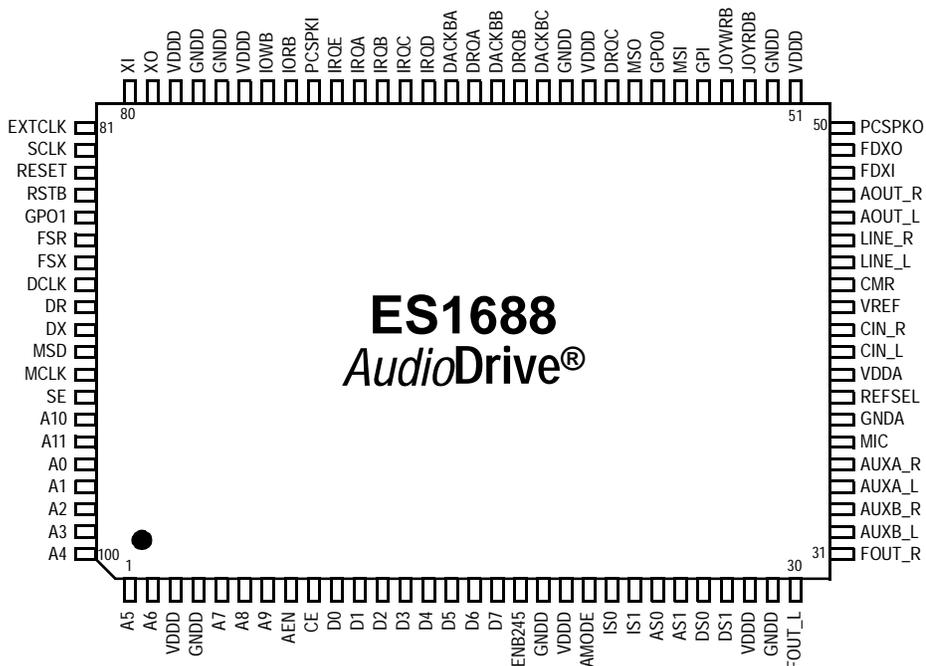- Supports IBM® OS/2®

ESS Technology, Inc.

BLOCK DIAGRAM

TYPICAL APPLICATION

PINOUT

ES1688
AudioDrive®

DIGITAL PIN DESCRIPTIONS

Name	I/O	Description
VDDD	I	Digital supply voltage (3.0V to 5.5V).
GNDD	I	Digital ground.
JOYRDB	O	Active-low decode for joystick, read from port 201h.
JOYWRB	O	Active-low decode for joystick, write to port 201h.
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 MPU-401 or SoundBlaster formats. Schmitt trigger input with internal pull-up resistor.
MSO	O	MIDI serial data output.
GPI	I	Reserved general-purpose input with internal pull-down. Currently no function is assigned to this pin and any connection is acceptable.
RESET	I	Active-high reset from ISA bus.
RSTB	O	Inverted RESET output.
SCLK	I	Clock selection output: 0: Clock from EXTCLK input 1: Clock from crystal connection to pins XI and XO
EXTCLK	I	14.32 MHz clock input from ISA bus. Duty cycle must be 40%-60%. No connection if SCLK=1.
XO	O	Crystal oscillator output.
XI	I	Crystal oscillator input.
CE	I	Input with internal pull-up. Active-high chip enable. When low, all IRQ and DRQ outputs become high impedance, and AEN is forced high internally, thereby disabling the I/O activity to/from the ES1688. Outputs JOYRDB and JOYWRB become inactive high. Leave unconnected or connect to VDD for normal operation.
IORB	I	Active-low read strobe from ISA bus.
IOWB	I	Active-low write strobe from ISA bus.
A[9:0]	I	Address inputs from ISA bus.
A[11:10]	I	Address inputs from ISA bus. The ES1688 requires these pins to be low for all address decodes. These pins have an internal pull-down device enabled when input signal AMODE=0. In this case they can float (ES688 compatible designs).
AEN	I	Active-low address enable from ISA bus.
D[7:0]	I/O	Bidirectional data bus. These pins have weak pull-up devices to prevent these inputs from floating when not driven.
ENB245	O	Active-low output when the ES1688 is being read or written to. Intended to be connected to the enable control of an external 74LS245.
IRQ(A-D)	O	Four (A,B,C,D) active-high interrupt requests to the ISA bus. Unselected IRQ outputs are high impedance. IRQs are software configurable.
IRQE	O	Active-high interrupt request to the ISA bus. Reserved for MPU-401 or hardware volume control.
DRQ(A-C)	O	Three (A,B,C) active-high DMA requests to the ISA bus. Unselected DRQ outputs are high impedance. When DMA is not active, the selected DRQ output has a pull-down 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-C)	I	Three (A,B,C) active-low DMA acknowledge inputs from the ISA bus.
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.

| Name	I/O	Description
DS0, DS1	I	Inputs with internal pull-down devices. These inputs select the DMA channel selected after external reset: | DS1	DS0	DRQx/DACKBx	Recommended ISA DRQ/DACK
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0	0	No DRQ or DACK	-----
0	1	DRQA, DACKBA	DRQ0/-DACK0
1	0	DRQB, DACKBB	DRQ1/-DACK1
1	1	DRQC, DACKBC	DRQ3/-DACK3	 DS1=0 and DS0=0 is a special case: no DMA request or interrupt request pin is selected after external reset. Software configuration of interrupt and DMA channels are required.
IS0, IS1	I	Inputs with internal pull-down devices. These inputs select the default interrupt request pin after external reset (unless DS1=0 and DS0=0): | IS1	IS0	IRQx	Recommended ISA IRQ
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0	0	IRQA	IRQ9
0	1	IRQB	IRQ5
1	0	IRQC	IRQ7
1	1	IRQD	IRQ10	
AMODE	I	Input pin with pull-down device. The ES1688 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
AS0, AS1	I	Inputs with internal pull-down devices. Along with AMODE, these inputs select the I/O address bank or the software address selection technique. They should be jumpered to VDDD or GNDD: | AMODE	AS1	AS0	Function
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0	0	0	220 base address
0	0	1	230 base address
0	1	0	240 base address
0	1	1	250 base address
1	0	0	220 base address
1	0	1	Read-Sequence-Key address selection
1	1	0	240 base address
1	1	1	System-Control-Register address selection	 DS1=0 and DS0=0 is a special case: no DMA request or interrupt request pin is selected after external reset. Software configuration of interrupt and DMA channels are required.
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 or ES690 Wavetable Music Synthesizer.
MCLK	I	Input with internal pull-down. Music serial clock from external ES689 or ES690 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 ES1688 through the DSP serial interface.

ANALOG PIN DESCRIPTIONS

Name	I/O	Description
VDDA	I	Analog supply voltage (4.5 to 5.5 V). Should be greater than or equal to VDDD-0.3 V.
GNDA	I	Analog ground.
MIC	I	Microphone input. MIC has an internal pullup resistor to CMR.
LINE_L, LINE_R	I	Line inputs left and right. LINE_L, LINE_R have internal pullup resistors to CMR.
AUXA_L, AUXA_R	I	Auxiliary inputs left and right. AUXA_L, AUXA_R have internal pullup resistors to CMR. Normally intended for connection to an internal or external CD-ROM analog output.
AUXB_L, AUXB_R	I	Auxiliary inputs left and right. AUXB_L, AUXB_R have internal pullup resistors to CMR. Normally intended for connection to an external music synthesizer or other line-level music source.
FDXO	O	Normally connected to CMR via an internal resistor. Can be programmed to connect internal to FOUT_R pin during DSP serial mode.
FDXI	I	Input with internal pullup to CMR. Alternate input to left channel filter stage in DSP serial mode.
FOUT_L, FOUT_R	O	Filter outputs left and right. AC-coupled externally to CIN_L, CIN_R 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 low-pass filter pole that removes switching noise introduced by the switched-capacitor filters.
CIN_L, CIN_R	I	Capacitive coupled inputs left and right. These inputs have internal pull-up resistors to CMR of approximately 50k ohms.
VREF	O	Reference generator resistor divider output. Should be bypassed to analog ground with 0.1 μF capacitor.
CMR	O	Buffered reference output. Should be bypassed to analog ground with a 47 μF electrolytic capacitor with a 0.1 μF capacitor in parallel.
AOUT_L, AOUT_R	O	Line-level stereo outputs, left and right.
PCSPKO	O	Analog output of PCSPKI with volume control.
REFSEL	I	Option input: Analog GND: normal operation Analog VDD: reserved

MAXIMUM RATINGS

Rating	Symbol	Value
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 °C
Storage temperature range	TSTG	-50 to 125 °C

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AudioDrive®
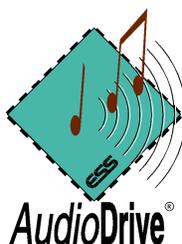
DIGITAL CHARACTERISTICS

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=4 mA, VDDD=min
VOH1	Output high voltage: All except D[7:0], DRQx, IRQx	2.4		V	IOH=-3 mA, VDDD=max
VOL2	Output low voltage: D[7:0], DRQx, IRQx		0.4	V	IOL=16 mA, VDDD=min
VOH2	Output high voltage: D[7:0], DRQx, IRQx	2.4		V	IOH=-12 mA, VDDD=max
VOL3	Output low voltage: Select DRQx when DMA inactive		0.4	V	IOL=0.8 mA
ICC1	VDDD active		60	mA	VDDD=max osc. rate at 14.32 MHz
ICC2	VDDA active		60	mA	VDDA=max

ANALOG CHARACTERISTICS

Parameter	Pins	Min	Typ	Max	Unit
Reference voltage	CMR, VREF		2.25		Volts (VDDA =5.0V)
Input impedance	LINE_L, LINE_R, AUXA_L, AUXA_R, AUXB_L, AUXB_R, MIC	30k		100k	Ohms
	CIN_L, CIN_R	35k	50k	65k	Ohms
Output impedance	FOUT_L, FOUT_R	3.5k	5k	6.5k	Ohms
	AOUT_L, AOUT_R max load for full-scale output range		5k		Ohms
Input voltage range	MIC	10		125	mVp-p
	LINE_L, LINE_R, AUXA_L, AUXA_R, AUXB_L, AUXB_R	0.5		VDDA -0.5	Volts
Output voltage range	AOUT_L, AOUT_R full-scale output range	0.5		VDDA -1.0	Volts
Gain	Mic preamp		26		dB

BUNDLED SOFTWARE AND DRIVERS

- *Audio*Rack™

- Bundled Drivers for:

    – Microsoft Windows 3.1
    – Microsoft Windows for Workgroups
    – Microsoft Windows NT
    – Microsoft Windows95
    – IBM OS/2