



## DESCRIPTION

The ES689 is a single, highly integrated, high-performance, and economical wavetable music synthesizer chip for personal computers, delivering superior acoustic sound comparable to expensive professional synthesizers. With its embedded microcontroller, the ES689 directly supports a General MIDI instrument set of 128 melodic instruments and can play back 32 voices of 16-bit data at a sampling rate of 44.1 kHz. Music is produced in high fidelity with the realism of a live symphony orchestra.

The ES689 is used with the ES981 wavetable ROM chip and a DAC to provide a complete wavetable solution. The ES981 provides digitally recorded sound samples of musical instruments, encoded in a ROM size of 512K x 16-bit.

No external DAC is required when the ES689 and the ES981 companion wavetable ROM chip are used with one of the ES1xxx ESS *AudioDrive*® chips. The ES689 Wavetable Music Synthesizer interfaces with the music DAC of the ES1xxx via the third serial port of the host chip, providing a cost-effective implementation of a complete wavetable music synthesizer. The ES689 also supports power-up and power-down.

The ES689 is available in an industry-standard 100-pin Plastic Quad Flat Pack (PQFP) package.

## APPLICATIONS

- Multimedia PCs
- PC Games
- Music Synthesis
- Consumer Audio Equipment
- Karaoke Systems

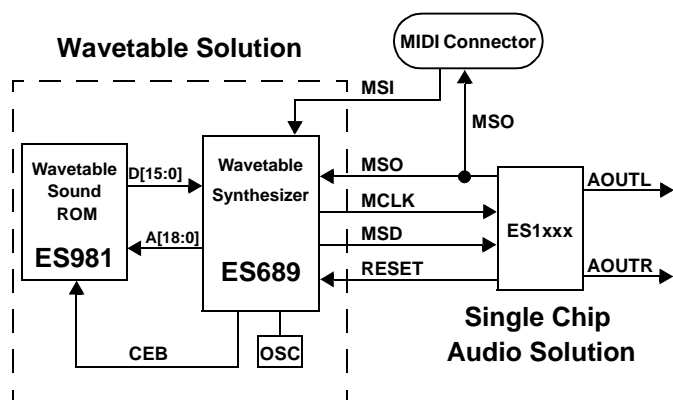
## FEATURES

- Single chip, high-performance wavetable music synthesizer
- Playback of 16-bit data at 44.1 kHz via the ES1xxx DAC
- No DAC required when used with an ES1xxx chip
- Stereo pan for each voice
- 32-voice polyphony
- MIDI serial port compatible with MPU-401 serial port of the ES1xxx
- General MIDI instrument set – 128 melodic and 47 rhythm instruments
- Digital serial interface with the ES1xxx or external stereo DAC
- Glueless interface with external wavetable ROM, 512K x 16-bit
- Supports power-up and power-down
- 100-pin PQFP package

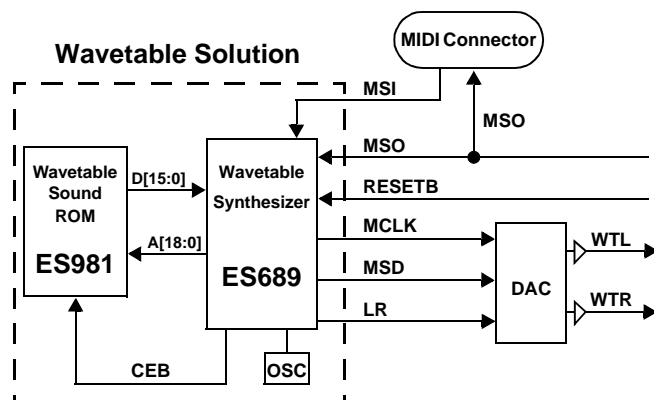
## IMPLEMENTATION PLATFORMS

- Desktop PCs
- Notebooks
- Multifunction Cards
- Sound Cards
- Combination Audio-Fax/Modem Cards

## TYPICAL APPLICATION



ES689 wavetable solution with ES1xxx



ES689 wavetable solution only



## ES981 DESCRIPTION

The ES981 wavetable sound ROM is 16-bit mask Read-Only-Memory, designed to be a companion chip to the ES689 and ES690 wavetable music synthesizer chips. The ES981 is organized as 512K x 16-bit memory, with an access time of 150 ns.

The ROM offers automatic power-down, controlled by the chip enable (CEB) input. When CEB deselects the ROM, the ROM powers down automatically and remains in a low-power standby mode.

The ES981 is available in an industry-standard 44-pin Small Outline Package (SOP).

## ES981 FEATURES

- 512K x 16-bit CMOS wavetable mask ROM
- General MIDI instrument set – 128 melodic and 47 rhythm instruments
- 150 ns fast access time
- Total static operation
- Single +5 V power supply requirement
- Operating current of 60 mA
- Standby current of 100  $\mu$ A
- 44-pin Small Outline Package (SOP)

## ES981 PIN DESCRIPTION

Name	Number	I/O	Description
A[18:0]	2:3,34:42, 4:11	I	ROM address. (Word addresses).
CEB	12	I	Active-low chip enable.
GND	13	I	Ground.
OEB	14	I	Active-low output enable.
D[15:0]	31,29,27,25, 22,20,18,16, 30,28,26,24, 21,19,17,15	O	ROM data.
BYTEB	33	I	Word address selection. Connect to VCC.
VCC	23	I	Power supply voltage (4.5 to 5.5 V).
NC	1,43:44		No connection.

## ES689 PIN DESCRIPTION

Name	Number	I/O	Description
MSO	12	I	MIDI serial output for two-way connection to ES1xxx <i>AudioDrive</i> <sup>®</sup> controller.
MERGE	13	O	Input with pull-up. For one-way MIDI connection, this pin is left no-connect. For two-way MIDI connection, this pin is external MIDI input. Normally, this pin is internally connected to MSO pin.
VCC	14,57,89	I	Power supply voltage (4.5 to 5.5 V).
GND	15,25,48,88	I	Ground.
XO	16	I	Oscillator output. Connect to 33.0 MHz crystal.
XI	17	O	Oscillator input. Connect to 33.0 MHz crystal.
DS	18	O	Data format select for audio serial port: 0: 2-wire interface to ES1xxx 1: 3-wire interface to stereo DAC
LR	19	O	Left/right strobe for 3-wire interface to stereo DAC.
BC	20	O	Bit clock output of audio serial port.
SD	21	I	Shift data output of audio serial port.
MSI	22	I	MIDI serial input from ES1xxx <i>AudioDrive</i> <sup>®</sup> controller.
RSTB	23	O	Active-low reset input. This pin is AND'ed with inverted RSTP to produce the internal active-low reset. It has a pull-up device. If not used, tie this pin to VCC.
RSTP	24	I	Active-high reset input. This pin is inverted and AND'ed with RSTB to produce the internal active-low reset. It has a pull-down device. If not used, tie this pin to ground.
XTO	26	I	16.5 MHz clock output.
RSTO	27	I	Active-low reset output.
D[15:0]	46,42,38, 34:33,37,41, 45:44,40,36, 32,35,39,43, 47	O	External ROM data.
CEB	58	O	External ROM active-low chip enable.
A[22:0]	91:90,87:84, 59,61,63,65, 67,69,71,73, 83:82,72,70, 68,66,64,62, 60	O	External ROM address. (Word addresses).
NC	1:11,28:31, 49:56,74:81, 92:100	I	No connection.

## ES689 ELECTRICAL CHARACTERISTICS

Parameter	Symbol	Min	Max	Unit (conditions)
Operating voltage	VCC	4.5	5.5	volts
Input low voltage	VIL		0.8	volts (VCC = 5 V)
Input high voltage: all inputs except XI	VIH	2.0		volts (VCC = 5 V)
Output low voltage: all outputs except XO	VOL		0.4	volts (IOL = 4 mA)
Output high voltage: all outputs except XO	VOH	2.4		volts (IOH = -3 mA)
Operating current	ICC		75	milliamps (VCC = 5 V)
Input leakage current high: all inputs except RSTP	IILH1	0	10	microamps (VCC = 5 V, VIN = 5 V)
Input leakage current high: RSTP	IILH2	50	150	microamps (VCC = 5 V, VIN = 5 V)
Input leakage current low: all inputs except XI, RSTB, MERGE	IILL1		10	microamps (VCC = 5 V, VIN = 5 V)
Input leakage current low: XI, RSTB, MERGE	IILL2	25	100	microamps (VCC = 5 V, VIN = 5 V)

## ES689 MAXIMUM RATINGS

Rating	Symbol	Value	Units
Power supply voltage	VCC	-0.3 to 7.0	V
Voltage range on any pin	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 AND SUPPORT

- Evaluation Kit
- Manufacturing Kit
- Reference Design

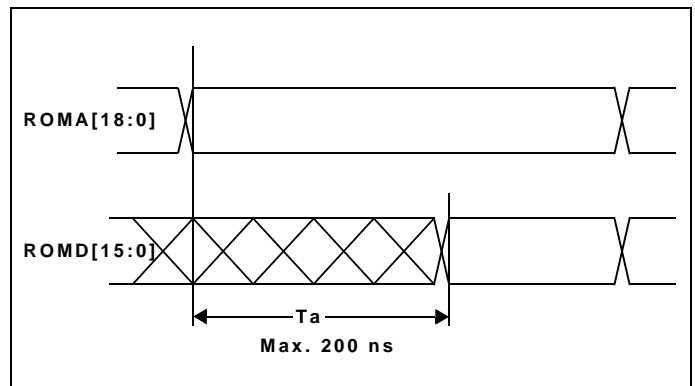
## ES981 ELECTRICAL CHARACTERISTICS

Parameter	Symbol	Min	Max	Unit (conditions)
Operating voltage	VCC	4.5	5.5	volts
Input low voltage	VIL		0.8	volts (VCC = 5 V)
Input high voltage	VIH	2.2		volts (VCC = 5 V)
Output low voltage	VOL		0.4	volts (IOL = 2.1 mA)
Output high voltage	VOH	2.4		volts (IOH = 1.0 mA)
Operating current	ICC		60	milliamps (VCC = 5 V)
Power-down supply current	ICCP		100	microamps (VCC = 5 V, VIN = 0 V)
Input leakage current	IIL	0	10	microamps (VCC = 5 V, VIN = 0 V)

## ES981 MAXIMUM RATINGS

Rating	Symbol	Value	Units
Power supply voltage	VCC	-0.3 to 7.0	V
Voltage range on any pin	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

## ES981 ROM ACCESS TIMING



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(P) U.S. Patent 4,214,125 and others, other patents pending.  
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