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8-CHANNEL HIGH DEFINITION AUDIO CODEC STAC9227/9228/9228D

Description

The STAC9227/9228/9228D are a family of Theater Quality 8-channel audio CODECs that enable systems with 7.1 audio or 5.1 audio playing simultaneously with VoIP or another stereo audio stream. SigmaTel's proprietary ΣΔ technology provides high fidelity with an estimated DAC SNR up to 105dB. Up to four digital microphones are supported enabling high quality voice input for increased usability of voice applications.

Features

- **High performance HD Audio CODEC provides Theater Quality Audio**
- **High performance ΣΔ technology**
  - 105dB DAC SNR
  - 90dB ADC SNR
- **Four Stereo DACs and three stereo ADCs**
  - Supports 7.1 audio or 5.1 audio with simultaneous Real Time Communication (RTC) channel such as VoIP or separate stereo audio stream
- **24-bit resolution with up to 192 KHz sample rates**
- **Digital Microphone Interface (STAC9228X/D only)**
  - Direct interface up to four Digital Microphones
- **Analog Stereo Microphone**
  - Microphone Boost 0, 10, 20, 30, 40dB
  - Six adjustable Vref outputs for microphone bias
- **Integrated Headphone Amps (3).**
- **S/PDIF In and Out**
- **Volume Up/Down Control**
- **Jack Insertion Detect and Impedance Sensing Supports Jack Retasking and Universal Jacks**
- **Digital PC Beep to all outputs**
- **+3.3 V to +5 V analog power supply options**
- **Environmental 48-pin LQFP package option**

Software Support

- **SKPI (Kernel Processing Interface)**
  - Enables plug-ins that can operate globally on all audio streams of the system
- **12 band parametric equalizer SKPI plug-in**
  - Constant, system-level effects tuned to optimize a particular platform can be combined with user-mode “presets” tailored for specific acoustical environments and applications
  - System-level effects automatically disabled when external connections made
- **Dynamics Processing SKPI plug-in**
  - Enables improved voice articulation
  - Compressor/limiter allows higher average noise level without resonances
- **Dolby Home Theatre (STAC9228D)**
- **Dolby Technologies**
  - Dolby Headphone™, Dolby Virtual Speaker™
  - Dolby ProLogic II™, Dolby ProLogic IIx™
  - Dolby Digital Live™
- **Intel Audio Studio™ from Sonic Focus**
- **Maxx Player™ from Waves**
- **Microphone Beam Forming, Acoustic Echo Cancellation, & Noise Suppression from Knowles™**

TABLE OF CONTENTS

List of Figures

List of Tables

1. DESCRIPTION

The STAC9227/9228/9228D are high fidelity, 8-channel audio CODECs compatible with the Intel High Definition (HD) Audio Interface. The STAC9227/9228/9228D CODECs provide high quality, HD Audio capability to notebook and cost sensitive desktop PC applications.

The STAC9227/9228/9228D incorporate SigmaTel's proprietary technology to achieve a DAC SNR in excess of 100 dB. The higher performance and quality of SigmaTel's audio solutions brings consumer electronics level performance to the notebook, desktop and media center PC.

The STAC9227/9228/9228D provide stereo 24-bit, full duplex resolution supporting sample rates up to 192 KHz by the DAC and ADC. The STAC9227/9228/9228D SPDIF In/Out support sample rates of 96 KHz, 48 KHz and 44.1 KHz plus SPDIF OUT supports 88.2 KHz. Additional sample rates are supported by the driver software.

The STAC9227/9228/9228D support all desired eight channel configurations, including switchable Headphone Out, and Universal JacksTM functionality for jack detection and re-tasking. The SPDIF interface provides connectivity to Consumer Electronic equipment like Dolby Digital decoders, powered speakers, mini disk drives or to a home entertainment system. All analog I/O pairs support LINE_IN, LINE_OUT and MIC.

MIC inputs can be programmed with 0/10/20/30/40dB boost. For more advanced configurations, the STAC9227/9228/9228D has up to four General Purpose I/O (GPIO) pin. The STAC9227/9228/9228D also provide a single ended CD input for compatibility with DRM solutions and to support legacy OS issues.

The STAC9227/9228/9228D integrate a headphone amplifier which is available on Ports A, B and D. The headphone amplifier is dedicated to these three outputs for increased flexibility, enhanced user experience, and reduced implementation costs.

The Universal Jack capabilities allow the CODECs to detect when audio devices are connected to the CODEC, and to allow the CODECs to be reconfigured to support these devices regardless of which port they are plugged into the system. SPDIF input sensing is also supported. The fully parametric SigmaTel SoftEQ can be initiated upon headphone jack insertion and removal for protection of notebook speakers. Note: The Jack Detect circuit and component selection are critical for accurate detection of audio jacks on individual ports. Please see the reference design for circuit implementation details.

The STAC9227/9228/9228D operate with a 3.3 V digital supply and a 3.3 V to 5 V analog supply.

The STAC9227/9228/9228D are available in a 48-pin LQFP Environmental (ROHS) package.

2. CHARACTERISTICS

2.1. Audio Fidelity

DAC SNR:	105dB	A-Weighted	5.0 V +/- 5%
ADC SNR:	90dB	A-Weighted	5.0 V +/- 5%

2.2. Electrical Specifications

2.2.1. Absolute Maximum Ratings

Stresses above the ratings listed below can cause permanent damage to the STAC9227/9228/9228D. These ratings, which are standard values for IDT commercially rated parts, are stress ratings only. Functional operation of the device at these or any other conditions above those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods can affect product reliability. Electrical parameters are guaranteed only over the recommended operating temperature range.

Item	Pin	Maximum Rating
Analog maximum supply voltage	AVdd	6 Volts
Digital maximum supply voltage	DVdd	5.5 Volts
VREFOUT output current		5 mA
Voltage on any pin relative to ground		Vss - 0.3 V to Vdd + 0.3 V
Operating temperature		0^{o}C to +70^{o}C
Storage temperature		-55 ^{o}C to +125 ^{o}C
Soldering temperature		260 ^{o}C for 10 seconds * Soldering temperature information for all available packages begins on page 228.

2.2.2. Recommended Operation Conditions

Parameter		Min.	Typ.	Max.	Units
Power Supply Voltage	Digital - 3.3 V	3.135	3.3	3.465	V
	Analog - 3.3 V	3.135	3.3	3.465	V
(Note: With Supply Override Enable Bit set to force 5 V operation.)	Analog - 4 V	3.8	4	4.2	V
	Analog - 4.5 V	4.275	4.5	4.725	V
	Analog - 5 V	4.75	5	5.25	V
Ambient Operating Temperature		0		+70	°C
Case Temperature	T_{case} (48-LQFP)			+90	°C

ESD: The STAC9227/9228/9228D is an ESD (electrostatic discharge) sensitive device. The human body and test equipment can accumulate and discharge electrostatic charges up to 4000 Volts without detection. Even though the STAC9227/9228/9228D implements internal ESD protection circuitry, proper ESD precautions should be followed to avoid damaging the functionality or performance.

2.3. STAC9227/9228/9228D 5V, 4.5V, 4.0V, and 3.3V Analog Performance Characteristics

($T_{ambient}$ = 25 ºC, AVdd = Supply ± 5%, DVdd = 3.3 V ± 5%, AVss = DVss = 0 V; 1 KHz input sine wave; Sample Frequency = 48 KHz; 0 dB = 1 VRMS, 10 KΩ/50 pF load, Testbench Characterization BW: 20 Hz – 20 KHz, 0 dB settings on all gain stages)

Parameter	Conditions	AVdd	Min	Typ	Max	Unit
Digital to Analog Converters						
Resolution		All		24		Bits
SNR - DAC to All Line-Out Ports (Note 4)	Analog Mixer Disabled, PCM data	5 V 4.5 V 4.0 V 3.3 V		105 101 100 98		dB
THD+N - DAC to All Line-Out Ports (Note 3)	Analog Mixer Disabled, -3dB Signal, PCM data	5 V 4.5 V 4.0 V 3.3 V		90 88 86 84		dB
SNR - DAC to All Line-Out Ports (Note 4)	Analog Mixer Enabled, PCM data	5 V 4.5 V 4.0 V 3.3 V		90 88 87 85		dB
THD+N - DAC to All Line-Out Ports (Note 3)	Analog Mixer Enabled, -3dB Signal, PCM data	5 V 4.5 V 4.0 V 3.3 V		80 78 77 75		dB
Dynamic Range: DAC to All Line Out Ports (Note2)	-60dB signal level	5 V 4.5 V 4.0 V 3.3 V	-	95 93 92 90	-	dB
SNR - DAC to All Headphone Ports (Note 4)	Analog Mixer Disabled, 10 KΩ load, PCM data	5 V 4.5 V 4.0 V 3.3 V		105 101 100 98		dB
THD+N - DAC to All Headphone Ports (Note 3)	Analog Mixer Disabled, -3dB Signal, 10 KΩ load, PCM data	5 V 4.5 V 4.0 V 3.3 V		85 83 82 80		dB
SNR - DAC to All Headphone Ports with 2 Headphone Outputs Operating (Note 4)	Analog Mixer Disabled, 32 Ω load, PCM data	5 V 4.5 V 4.0 V 3.3 V		100 98 97 95		dB
THD+N - DAC to All Headphone Ports with 2 Headphone Outputs Operating (Note 3)	Analog Mixer Disabled, -3dB Signal, 32 Ω load, PCM data	5 V 4.5 V 4.0 V 3.3 V		82 80 79 77		dB
SNR - DAC to All Headphone Ports (Note 4)	Analog Mixer Disabled, 32 Ω load, PCM data	5 V 4.5 V 4.0 V 3.3 V		100 98 97 95		dB

Parameter	Conditions	AVdd	Min	Typ	Max	Unit
THD+N - DAC to All Headphone Ports (Note 3)	Analog Mixer Disabled, -3dB Signal, 32 Ω load, PCM data	5 V 4.5 V 4.0 V 3.3 V		85 83 82 80		dB
SNR - DAC to All Headphone Ports (Note 4)	Analog Mixer Enabled, 10 KΩ load, PCM data	5 V 4.5 V 4.0 V 3.3 V		90 88 87 85		dB
THD+N - DAC to All Headphone Ports (Note 3)	Analog Mixer Enabled, -3dB Signal, 10kΩ load, PCM data	5 V 4.5 V 4.0 V 3.3 V		79 77 76 74		dB
SNR - DAC to All Headphone Ports (Note 4)	Analog Mixer Enabled, 32 Ω load, PCM data	5 V 4.5 V 4.0 V 3.3 V		87 85 84 82		dB
THD+N - DAC to All Headphone Ports (Note 3)	Analog Mixer Enabled, -3dB Signal, 32 Ω load, PCM data	5 V 4.5 V 4.0 V 3.3 V		74 72 71 69		dB
Any Analog Input to DAC Crosstalk	10 KHz Signal Frequency	All	-	-85	-	dB
Any Analog Input to DAC Crosstalk	1 KHz Signal Frequency	All	-	-80	-	dB
Gain Error	Analog Mixer Disabled	All			0.5	dB
Interchannel Gain Mismatch	Analog Mixer Disabled	All			0.5	dB
D/A Digital Filter Pass Band (Note 5)		All	20	-	19,200	Hz
D/A Digital Filter Transition Band		All	19,200	-	28,800	Hz
D/A Digital Filter Stop Band		All	28,800	-	-	Hz
D/A Digital Filter Stop Band Rejcn (Note 6)		All	-100	-	-	dB
D/A Out-of-Band Rejection (Note 7)		All	-55	-	-	dB
Group Delay (48 KHz sample rate)		All	-	-	1	ms
Attenuation, Gain Step Size DIGITAL		All	-	0.75	-	dB
Gain Drift		All	-	100	-	ppm/ºC
DAC Offset Voltage		All	-	100	20	mV
Deviation from Linear Phase		All	-	1	10	degrees
Analog Outputs						

Parameter	Conditions	AVdd	Min	Typ	Max	Unit
Full Scale All Line-Outs	DAC PCM Data	5 V 4.5 V 4.0 V 3.3 V	1.00 1.00 1.00 0.70	-	-	Vrms
Full Scale All Line-Outs	DAC PCM Data	All	2.83	-	-	Vp-p
All Headphone Capable Outputs	32 Ω load	All	31	50	-	mW peak
Analog inputs						
Full Scale Input Voltage	0dB Boost @ 4.75 V	All	1.00	-	-	Vrms
All Analog Inputs with boost	10dB Boost	All	0.31	-	-	Vrms
All Analog Inputs with boost	20dB Boost	All	0.10	-	-	Vrms
All Analog Inputs with boost	30dB Boost	All	0.03	-	-	Vrms
All Analog Inputs with boost	40dB Boost	All	0.01	-	-	Vrms
Input Impedance		All	-	50	-	KΩ
Input Capacitance		All	-	15	-	pF
Analog Mixer						
SNR - CD to Ports A,B, & D Line-Out (Note 4)		All		90		dB
THD+N - CD to Ports A,B, & D Line-Out (Note 3)	-3dB Input	All		70		dB
SNR - All Line-In to A,B, & D Line-Out (Note 4)		All		90		dB
THD+N - All Line-In to A,B, & D Line-Out (Note 3)	-3dB Input	All		70		dB
SNR - Analog PC Beep to Ports A,B, & D Line-Out (Note 4)		All		85		dB
THD+N - Analog PC Beep to Ports A,B, & D Line-Out (Note 3)	-3dB Input	All		70		dB
Analog to Digital Converter						
Resolution		All		24		Bits
Dynamic Range, All Analog Inputs to A/D (Note 1)	High Pass Filer Enabled, 1 Vrms Input, No boost	All	88	90		dB
SNR All Analog Inputs to A/D (Note 4)	High Pass Filter enabled	All	88	90		dB
THD+N All Analog Inputs to A/D (Note 3)	High Pass Filter enabled, -3dBV input Level	All		85		dB
Analog Frequency Response (Note 2)		All	10	-	30,000	Hz
A/D Digital Filter Pass Band (Note 5)		All	20	-	19,200	Hz
A/D Digital Filter Transition Band		All	19,200	-	28,800	Hz