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19-3732; Rev 2; 7/07

EVALUATION KIT AVAILABLE

Stereo Audio CODECs with Microphone, DirectDrive Headphones, Speaker Amplifiers, or Line Outputs

General Description

The MAX9851/MAX9853 are single-chip, stereo audio CODECs designed to provide a complete audio solution for a GSM/GPRS/EDGE cell phone. The MAX9851/MAX9853 provide stereo DirectDrive™ headphone amplifiers, a mono receiver speaker amplifier, stereo Class D speaker amplifiers (MAX9851 only), stereo differential line outputs (MAX9853 only), microphone input amplifiers, plus flexible input selection and gain control. Two serial digital audio interfaces are included, one intended to accept voiceband data and the other accepting I²S data. The voiceband interface can be reconfigured as needed to act as a secondary I²S feed input—allowing multiple audio source mixing of ringer tones or other audio at different sample rates. A transducer/vibrator signal can be derived from digital audio.

The stereo digital-to-analog converter (DAC) path includes filtering and mixing, programmable-gain amplifiers (PGA), soft muting, and optional voiceband digital filtering. The MAX9851/MAX9853 accept up to two digital audio inputs at different sample rates. All analog inputs have PGAs on the front end, allowing dynamic range optimization with a wide range of input sources.

The stereo analog-to-digital converter (ADC) converts audio signals from either internal or external microphones or stereo line inputs. The microphone amplifiers have a programmable gain from 0 to 40dB to handle both amplified microphones and electret modules. In addition to a digital highpass filter to remove DC offset voltages, the ADC also features voiceband digital filtering.

The digital audio interfaces support a variety of serial audio formats. The secondary serial audio interface has an independent supply voltage to allow integration into multiple supply systems. Control for volume levels, signal mixing, and operating modes is done through the I²C 2-wire interface.

All circuitry is optimized for high PSRR. The MAX9851/MAX9853 use a thermally efficient, space-saving 48-pin thin QFN package (7mm x 7mm x 0.8mm) with an exposed pad.

Applications

GSM/GPRS/EDGE Cell Phones

PDAs/SmartPhones

Features

- **+1.7V to +3.3V (Digital) and +2.6V to +3.3V (Analog) Operation**
- **+2.6V to +5.5V Class D Speaker Amplifier Operation (Direct from Battery)**
- **Low 26mW Quiescent Power Consumption (Playback)**
- **High 98dB Power-Supply Rejection Ratio**
- **8kHz to 48kHz Sample Rate (Replay and Record)**
- **Stereo 18-Bit ADC and DAC**
- **Low-Noise Stereo Microphone Inputs and Stereo Line Inputs**
- **Dual Source Digital Mixing (DAC)**
- **Selectable Voiceband Filter for Recording/Playback Modes**
- **Digital Filtering, Soft Mute, and Volume Control**
- **Low-Noise, High-PSRR Microphone Bias Generator**
- **Stereo DirectDrive Headphone Amplifier (2 x 50mW)**
- **Mono DirectDrive Handset Receiver Amplifier (1 x 105mW)**
- **Stereo Class D, Ultra-Low-EMI, Filterless Speaker Amplifier with Active Emissions Limiting (2 x 1.25W, 8Ω) (MAX9851)**
- **Stereo Differential Line Output Amplifiers (MAX9853)**
- **Clickless/Popless Operation**
- **Flexible Shutdown Modes for Power Saving**
- **Comprehensive Headset Detection**
- **Ultra-Low Power Wake-Up on Headset Detection**

Ordering Information

PART	PIN-PACKAGE	PKG CODE
MAX9851ETM+	48 TQFN-EP* (7mm x 7mm x 0.8mm)	T4877-6
MAX9853ETM+	48 TQFN-EP* (7mm x 7mm x 0.8mm)	T4877-6

Note: *All devices specified over the -40°C to +85°C temperature range.*

+Denotes lead-free package.

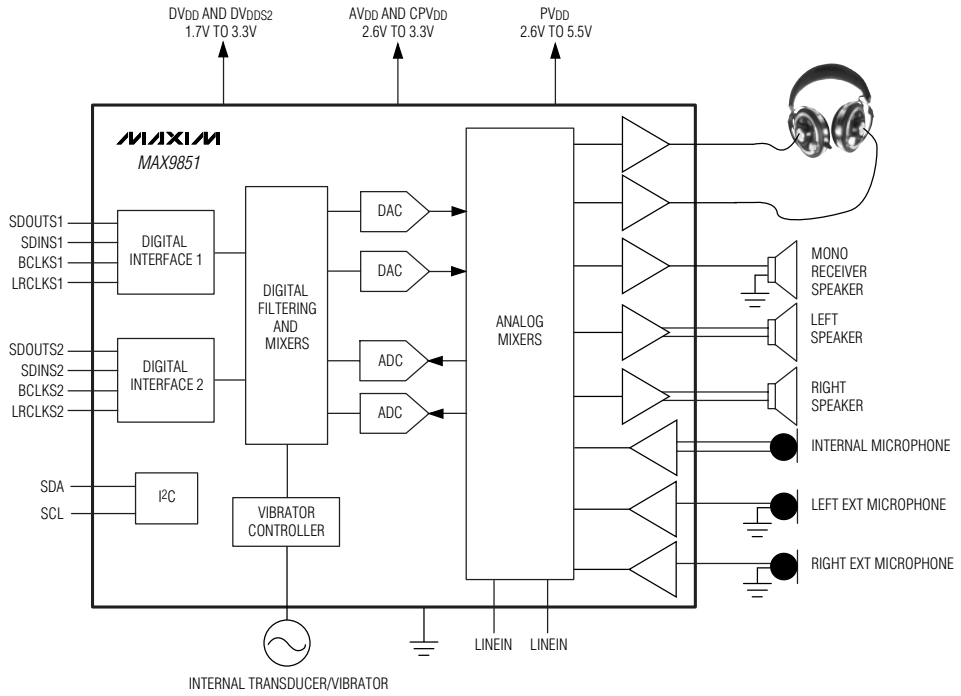
**EP = Exposed pad.*

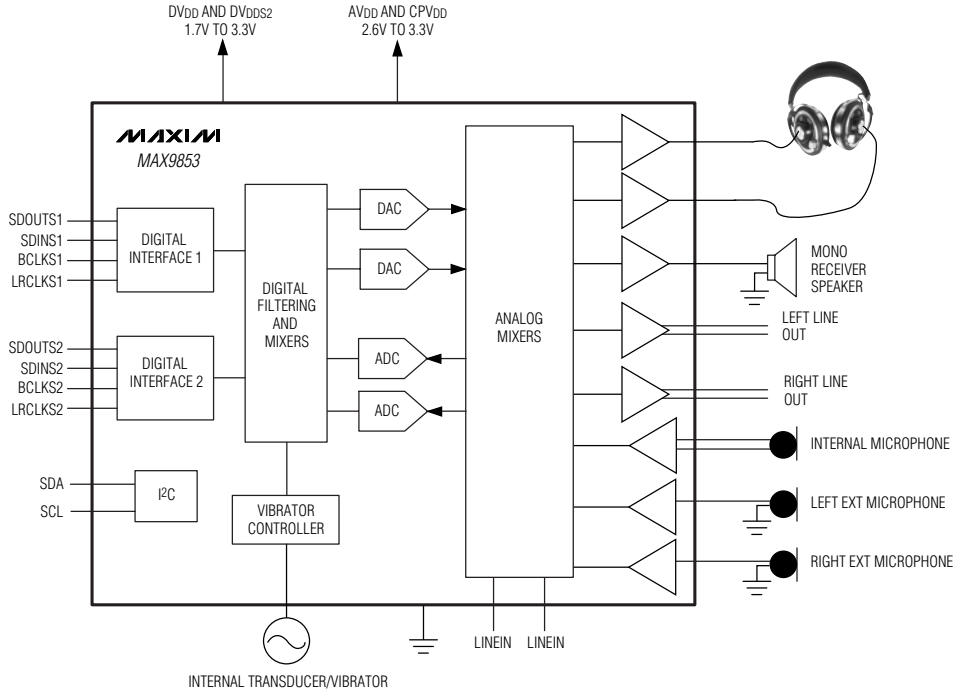
Pin Configurations and Selector Guide appear at end of data sheet.

For pricing, delivery, and ordering information, please contact Maxim Direct at 1-888-629-4642, or visit Maxim's website at www.maxim-ic.com.

Stereo Audio CODECs with Microphone, DirectDrive Headphones, Speaker Amplifiers, or Line Outputs

Simplified Block Diagrams





ABSOLUTE MAXIMUM RATINGS

(Voltages with respect to AGND)
AV_{DD}, DV_{DD}, DV_{DDS2}, CPV_{DD} .....-0.3V to +4V
PV_{SS}, SV_{SS} .....-4V to +0.3V
PV_{DD}.....-0.3V to +6V
AGND, DGND, CPGND, PGND.....-0.3V to +0.3V
HPL, HPR, REC .....(SV_{SS} - 0.3V) to (AV_{DD} + 0.3V)
LSPK+, LSPK-, RSPK+, RSPK- .....-0.3V to (PV_{DD} + 0.3V)
LINEIN1, LINEIN2.....-2V to +2V
EXTMICBIASL, EXTMICBIASR.....-0.3V to (AV_{DD} + 0.3V)
INTMICP, INTMICN, EXTMICL, EXTMICR.....-2V to +2V
EXTMICGND.....-0.3V to +0.3V
C1N.....(PV_{SS} - 0.3V) to (CPGND + 0.3V)
C1P.....(CPGND - 0.3V) to (CPV_{DD} + 0.3V)
PREG, REF, MBIAS, INTMICBIAS.....-0.3V to (AV_{DD} + 0.3V)
NREG.....+0.3V to (SV_{SS} - 0.3V)
OUTL+, OUTL-, OUTR+, OUTR-,
FAULTIN.....-0.3V to (AV_{CC} + 0.3V)
MCLK, $\overline{IRQ}$, $\overline{VIBE}$, SCL, SDA.....-0.3V to +4V
SHDNOUT .....-0.3V to +6V
LRCLKS1, BCLKS1, SDOUTS1,
SDINS1.....-0.3V to DV_{DD} + 0.3V
LRCLKS2, BCLKS2, SDOUTS2,
SDINS2 .....-0.3V to DV_{DDS2} + 0.3V
Short Circuit to AGND Duration:
HPL, HPR, REC .....Continuous
LSPK+, LSPK-, RSPK+,
RSPK- .....Subject to Maximum Package Power Dissipation
INTMICBIAS, EXTMICBIASL, EXTMICBIASR.....Continuous
Short Circuit to AV_{DD} Duration
EXTMICBIASL, EXTMICBIASR .....Continuous
Current Into/Out of Any Pin (unless otherwise noted).....100mA
Continuous Power Dissipation (T_A = +70°C)
48-Pin Thin QFN (derate 40mW/°C above +70°C) 3200mW
Junction Temperature.....+150°C
Operating Temperature Range .....-40°C to +85°C
Storage Temperature Range .....-65°C to +150°C
Lead Temperature (soldering, 10s) .....+300°C

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS

(AV_{DD} = CPV_{DD} = +3V, DV_{DD} = DV_{DDS2} = +1.8V, PV_{DD} = +3.3V, R_{HP} = 32Ω, Z_{SPK} = 8Ω + 10µH, R_{REC} = 32Ω, R_{OUTL+} to R_{OUTL-} = 10kΩ, R_{OUTR+} to R_{OUTR-} = 10kΩ, C1 = 0.22µF, C2 = C_{NREG} = C_{PREG} = $C_{INTMICBIAS}$, C_{MBIAS} = C_{REF} = 1µF, MCLK = 13MHz, all PGAs = 0dB, HP/REC volume = -20.0dB, SPK volume = -20.4dB, line output gain = -0.4dB, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (See *Functional Diagrams/Typical Operating Circuits*).

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Analog Supply Voltage	AV_{DD}, CPV_{DD}	AV_{DD} = CPV_{DD}, no load		2.6		3.3	V
Digital Supply Voltage	DV_{DD}, DV_{DDS2}	No load		1.7		3.3	V
Speaker Supply Voltage	PV_{DD}	No load		2.6		5.5	V
Analog Supply Current	AI_{DD}	DAC playback mode, no output loads (Note 1)	Stereo headphone		7.2		mA
			Stereo speaker (MAX9851)/line output (MAX9853)		6.5	8.5	
			Mono receiver		6.4		
		Line only playback mode, no output loads	Stereo headphone		5.0		
			Stereo speaker (MAX9851)/line output (MAX9853)		4.6		
			Mono receiver		4.4		
		DAC plus line input playback mode, no output loads (Note 1)	Stereo headphone		7.2		
			Stereo speaker (MAX9851)/line output (MAX9853)		6.4		
			Mono receiver		6.3		

Stereo Audio CODECs with Microphone, DirectDrive Headphones, Speaker Amplifiers, or Line Outputs

ELECTRICAL CHARACTERISTICS (continued)

(AV_{DD} = CPV_{DD} = +3V, DV_{DD} = DV_{DDS2} = +1.8V, PV_{DD} = +3.3V, R_{HP} = 32Ω, Z_{SPK} = 8Ω + 10µH, R_{REC} = 32Ω, R_{OUTL+} to R_{OUTL-} = 10kΩ, R_{OUTR+} to R_{OUTR-} = 10kΩ, C1 = 0.22µF, C2 = C_{NREG} = C_{PREG} = $C_{INTMICBIAS}$, C_{MBIAS} = C_{REF} = 1µF, MCLK = 13MHz, all PGAs = 0dB, HP/REC volume = -20.0dB, SPK volume = -20.4dB, line output gain = -0.4dB, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (See *Functional Diagrams/Typical Operating Circuits*).

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Analog Supply Current	AI_{DD}	Full-duplex voice mode, no output loads	Stereo headphone		11.9		mA
			Stereo speaker (MAX9851)/line output (MAX9853)		11.2		
			Mono receiver		11.1	14.5	
		Full-duplex voice mode plus DAC playback mode, no output loads (Notes 1, 2)	Stereo headphone		11.9		
			Stereo speaker (MAX9851)/line output (MAX9853)		11.2		
			Mono receiver		11.1		
		ADC record mode (Note 3)			12.2		
		ADC record mode plus DAC headphone playback mode (Notes 1, 3)			18.2	24.0	
Speaker Supply Current (Note 4)	PI_{DD}	Mono Class D speaker mode			5		mA
		Stereo Class D speaker mode			10	14	
		Sleep mode (MAX9851, MAX9853)			2	15	µA
Digital Supply Current	DI_{DD}	Playback operation (Note 1), no output loads			2.7	3.7	mA
		Full duplex voice operation (Note 2), no output loads, T_A = +25°C			6.2	7.8	
		Record operation (Notes 1, 3)			3.9	5.2	
Analog Shutdown Current	AI_{SHDN}	I_{AVDD} + I_{CPVDD}, T_A = +25°C			1.4	20	µA
Digital Shutdown Current	DI_{SHDN}	I_{DVDD} + I_{DVDDS2} , T_A = +25°C			0.5	10	µA
PV_{DD} Shutdown Current (Note 4)	PI_{SHDN}	I_{PVDD}, T_A = +25°C	MAX9851		1	20	µA
			MAX9853		0.1	5	
Shutdown to Full Operation	t_{ON}	ADC and DAC fully operational, master mode			70		ms
DAC PERFORMANCE (Note 5) (DAC in Master Mode)							
Gain Error					±1	±7	%
Channel Gain Matching					±1		%
Dynamic Range (Note 6)	DR	f_S = 8kHz (voice modes), headphone volume = +5.5dB			75.5		dB
		f_S = 8kHz and 48kHz (stereo audio modes), headphone volume = +5.5dB		84	87.5		

ELECTRICAL CHARACTERISTICS (continued)

(AV_{DD} = CPV_{DD} = +3V, DV_{DD} = DV_{DDS2} = +1.8V, PV_{DD} = +3.3V, R_{HP} = 32Ω, Z_{SPK} = 8Ω + 10µH, R_{REC} = 32Ω, R_{OUTL+} to R_{OUTL-} = 10kΩ, R_{OUTR+} to R_{OUTR-} = 10kΩ, C1 = 0.22µF, C2 = C_{NREG} = C_{PREG} = $C_{INTMICBIAS}$, C_{MBIAS} = C_{REF} = 1µF, MCLK = 13MHz, all PGAs = 0dB, HP/REC volume = -20.0dB, SPK volume = -20.4dB, line output gain = -0.4dB, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (See *Functional Diagrams/Typical Operating Circuits*).

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Total Harmonic Distortion Plus Noise	THD+N	f_{IN} = 1kHz, f_S = 8kHz, 0dBFS (voice mode master mode, ADC and headphone output enabled, no load), headphone volume = +2.5dB		-71.5		dB
		f_{IN} = 1kHz, f_S = 48kHz, 0dBFS (ADC and headphone output enabled, no load), headphone volume = +2.5dB		-84.5		
Signal-to-Noise Ratio (Note 7)	SNR	f_{IN} = 1kHz, f_S = 8kHz and 16kHz (voice modes), headphone volume = +2.5dB		75.5		dB
		f_{IN} = 1kHz, f_S = 8kHz to 48kHz (stereo audio modes), headphone volume = +2.5dB		88		
Crosstalk	XTALK	Driven channel at -1dBFS, f_{IN} = 1kHz, f_S = 8kHz, headphone output (no load)		-95		dB
Power-Supply Rejection Ratio	PSRR	f = 217Hz, V_{RIPPLE} = 100mV_{P-P}		95		dB
		f = 10kHz, V_{RIPPLE} = 100mV_{P-P}		68		
DAC DIGITAL FILTERS						
Passband Cutoff	f_{PD}		0.44			f_S
Passband Ripple		f < f_{PD}			±0.2	dB
Stopband Cutoff	f_{SD}				0.58	f_S
Stopband Attenuation		f > f_{SD}	60			dB
Attenuation at f_S / 2				-6.02		dB
DAC VOICEBAND HIGHPASS FILTER (S1 Mono Voice Input Path, f_S = 8kHz, Register 0x07 bit 4 = 1)						
Passband Cutoff	f_{PH}				175	Hz
Passband -3dB Cutoff	f_{P3_H}				130	Hz
Passband Ripple		f > f_{PH}			±0.2	dB
Stopband Cutoff	f_{SH}		77			Hz
Stopband Attenuation		f < f_{SH}	28			dB
DAC VOICEBAND HIGHPASS FILTER (S1 Mono Voice Input Path, f_S = 16kHz, Register 0x07, bit 4 = 1)						
Passband Cutoff	f_{PH}				350	Hz
Passband -3dB Cutoff	f_{P3_H}				260	Hz
Passband Ripple		f > f_{PH}			±0.2	dB
Stopband Cutoff	f_{SH}		154			Hz
Stopband Attenuation		f < f_{SH}	28			dB
DAC VOICEBAND LOWPASS FILTER (S1 Mono Voice Input Path, f_S = 8kHz)						
Passband Cutoff	f_{PL}		3500			Hz
Passband Ripple		f < f_{PL}			±0.05	dB
Stopband Cutoff	f_{SL}				3900	Hz
Stopband Attenuation		f > f_{SL}	75			dB

Stereo Audio CODECs with Microphone, DirectDrive Headphones, Speaker Amplifiers, or Line Outputs

ELECTRICAL CHARACTERISTICS (continued)

(AV_{DD} = CPV_{DD} = +3V, DV_{DD} = DV_{DDS2} = +1.8V, PV_{DD} = +3.3V, R_{HP} = 32Ω, Z_{SPK} = 8Ω + 10µH, R_{REC} = 32Ω, R_{OUTL+} to R_{OUTL-} = 10kΩ, R_{OUTR+} to R_{OUTR-} = 10kΩ, C1 = 0.22µF, C2 = C_{NREG} = C_{PREG} = $C_{INTMICBIAS}$, C_{MBIAS} = C_{REF} = 1µF, MCLK = 13MHz, all PGAs = 0dB, HP/REC volume = -20.0dB, SPK volume = -20.4dB, line output gain = -0.4dB, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (See *Functional Diagrams/Typical Operating Circuits*).

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
DAC VOICEBAND LOWPASS FILTER (S1 Mono Voice Audio Input Path, f_S = 16kHz)						
Stopband Cutoff	f_{PL}		7000			Hz
Passband Ripple		$f < f_{PL}$			±0.05	dB
Stopband Cutoff	f_{SL}				7800	Hz
Stopband Attenuation		$f > f_{SL}$	75			dB
DAC ADJUSTABLE HIGHPASS FILTER						
DC Attenuation	DC_{ATT}	Register 0x07 bits [3:0] = 0x5, 0xA, or 0xF		90		dB
Highpass Cutoff (-3dB)	f_P	Register 0x07 [3:0] = 0x5	55		91	Hz
		Register 0x07 [3:0] = 0xA	171		279	
		Register 0x07 [3:0] = 0xF	327		533	
DAC INPUT GAIN CONTROL (Register 0x0C and 0x0D)						
Gain Control Range		For both input data interfaces	-96		0	dB
ADC DC ACCURACY						
Gain Error				±1	±7	%
Full-Scale Conversion	0dBFS	f_{IN} = 1kHz, line input, PGA = 0dB		2.05		V_{P-P}
Channel Gain Matching				±1		%
ADC DYNAMIC SPECIFICATIONS (Note 8)						
Dynamic Range (Note 6)	DR	BW = 22Hz to f_S / 2 (8kHz voice modes)	73	75		dB
		BW = 22Hz to 20kHz (48kHz stereo audio modes, A-weighted), T_A = +25°C	77	82		
		BW = 22Hz to 20kHz (48kHz stereo audio modes, A-weighted), T_A = T_{MIN} to T_{MAX}	71			
		BW = 22Hz to f_S / 2 (8kHz audio mode)		-85.5		
Total Harmonic Distortion	THD	1kHz, 0dBFS, f_S = 8kHz (voice mode)		-85.5		dB
		1kHz, 0dBFS, f_S = 48kHz (stereo audio mode)		-85.5		
Signal-to-Noise Ratio	SNR	1kHz, 0dBFS, f_S = 8kHz (voice mode)		75		dB
		1kHz, 0dBFS, f_S = 48kHz (stereo audio mode, A-weighted)		81.5		
		1kHz, 0dBFS, f_S = 8kHz (stereo audio mode, A-weighted)		87.5		
Channel Crosstalk		Driven channel at -1dBFS, f_{IN} = 1kHz, f_S = 48kHz (from MICL to ADCR or MICR to ADCL)		-75		dB
Power-Supply Rejection Ratio (Note 9)	PSRR	AV_{DD} = 2.6V to 3.3V	48	63		dB
		f = 217Hz, V_{RIPPLE} = 100mV_{P-P}		63		
		f = 10kHz, V_{RIPPLE} = 100mV_{P-P}		50		

ELECTRICAL CHARACTERISTICS (continued)

(AV_{DD} = CPV_{DD} = +3V, DV_{DD} = DV_{DDS2} = +1.8V, PV_{DD} = +3.3V, R_{HP} = 32Ω, Z_{SPK} = 8Ω + 10µH, R_{REC} = 32Ω, R_{OUTL+} to R_{OUTL-} = 10kΩ, R_{OUTR+} to R_{OUTR-} = 10kΩ, C1 = 0.22µF, C2 = C_{NREG} = C_{PREG} = $C_{INTMICBIAS}$, C_{MBIAS} = C_{REF} = 1µF, MCLK = 13MHz, all PGAs = 0dB, HP/REC volume = -20.0dB, SPK volume = -20.4dB, line output gain = -0.4dB, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (See *Functional Diagrams/Typical Operating Circuits*).

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
ADC DIGITAL FILTER PATH (Stereo Audio Modes)						
Passband Cutoff	f_{PBL}		0.44			f_S
Passband Ripple		$f < f_{PBL}$			±0.5	dB
Stopband Cutoff	f_{SBL}				0.58	f_S
Stopband Attenuation		$f > f_{SBL}$	53			dB
Attenuation at $f_S/2$				-6.02		dB
ADC VOICEBAND HIGHPASS FILTER (S1 Mono Voice Input Path, f_S = 8kHz)						
Passband Cutoff	f_{PH}				175	Hz
Passband -3dB Cutoff	f_{P3_H}				130	Hz
Passband Ripple		$f > f_{PH}$			±0.2	dB
Stopband Cutoff	f_{SH}		77			Hz
Stopband Attenuation		$f < f_{SH}$	28			dB
ADC VOICEBAND HIGHPASS FILTER (S1 Mono Voice Input Path, f_S = 16kHz)						
Passband Cutoff	f_{PH}				350	Hz
Passband -3dB Cutoff	f_{P3_H}				260	Hz
Passband Ripple		$f > f_{PH}$			±0.2	dB
Stopband Cutoff	f_{SH}		154			Hz
Stopband Attenuation		$f < f_{SH}$	28			dB
ADC VOICEBAND LOWPASS FILTER (S1 Mono Voice Input Path, f_S = 8kHz)						
Passband Cutoff	f_{PL}		3500			Hz
Passband Ripple		$f < f_{PL}$			±0.05	dB
Stopband Cutoff	f_{SL}				3900	Hz
Stopband Attenuation		$f > f_{SL}$	75			dB
ADC VOICEBAND LOWPASS FILTER (S1 Mono Voice Input Path, f_S = 16kHz)						
Passband Cutoff	f_{PL}		7000			Hz
Passband Ripple		$f < f_{PL}$			±0.05	dB
Stopband Cutoff	f_{SL}				7800	Hz
Stopband Attenuation		$f > f_{SL}$	75			dB
ADC DC-BLOCKING FILTER						
DC-Blocking Filter -3dB Corner	f_C	As a fraction of output sample rate		f_S / 1608		Hz
DC Attenuation				120		dB
Maximum DC Input				0.125		V
DAC/ADC DATA RATE ACCURACY						
LRCLK Output Sample Rate Deviation From Ideal (Note 10)		f_S = 8kHz to 48kHz (master mode with DAC only enabled) (See Table 1 for details)	-0.025		+0.025	%

Stereo Audio CODECs with Microphone, DirectDrive Headphones, Speaker Amplifiers, or Line Outputs

ELECTRICAL CHARACTERISTICS (continued)

(AV_{DD} = CPV_{DD} = +3V, DV_{DD} = DV_{DDS2} = +1.8V, PV_{DD} = +3.3V, R_{HP} = 32Ω, Z_{SPK} = 8Ω + 10µH, R_{REC} = 32Ω, R_{OUTL+} to R_{OUTL-} = 10kΩ, R_{OUTR+} to R_{OUTR-} = 10kΩ, C1 = 0.22µF, C2 = C_{NREG} = C_{PREG} = $C_{INTMICBIAS}$, C_{MBIAS} = C_{REF} = 1µF, MCLK = 13MHz, all PGAs = 0dB, HP/REC volume = -20.0dB, SPK volume = -20.4dB, line output gain = -0.4dB, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (See *Functional Diagrams/Typical Operating Circuits*).

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
DAC/ADC DATA RATE ACCURACY							
LRCLK Output Sample Rate Deviation From Ideal (Note 10)		Master mode with ADC SDOUT enabled; audio mode, unless otherwise noted	f_S = 8kHz (voice mode)		0		%
			f_S = 16kHz (voice mode)		0		
			f_S = 8kHz		0.31		
			f_S = 11.025kHz		0.27		
			f_S = 12kHz		0.31		
			f_S = 16kHz		-0.43		
			f_S = 22.05kHz		-0.41		
			f_S = 24kHz		0.31		
			f_S = 32kHz		-0.43		
			f_S = 44.1kHz		-1.74		
			f_S = 48kHz		-0.43		
LRCLK Input Sample Rate Range		Synchronous or asynchronous input (slave mode with only DAC enabled)		7.8		50	kHz
DAC TRANSDUCER/VIBE OUTPUT							
Vibe PGA Range	TGAIN	11 steps in 6dB increments		-30		+30	dB
0dBFS Output Voltage		1-bit DAC output externally filtered pullup resistor to DV_{DD} (TGAIN = 0dB)			DV_{DD} / 2		V_{P-P}
Output Offset Voltage		1-bit DAC output externally filtered, no signal, pullup resistor to DV_{DD}			DV_{DD} / 2		V
Vibe PGA Output Resolution	PGAR				10		bits
LPF Passband -3dB Cutoff	f_{PBL}	f_S = 8kHz, 16kHz, or 32kHz			483		Hz
		f_S = 11.025kHz, 22.05kHz, or 44.1kHz			665		
		f_S = 12kHz, 24kHz, or 48kHz			724		
LPF Stopband Attenuation	f_{SBL}	f > 3.5xf_{PBL}		27			dB
1-Bit DAC Digital Dynamic Range	DR_V	Ideal dynamic range (0 to 8kHz or 0 to f_S / 2 for f_S < 16kHz)			48		dB
1-Bit DAC Operating Frequency	f_V				650		kHz
OPEN-DRAIN DIGITAL OUTPUT ($\overline{VIBE}$)							
Output High Current	I_{OH}	V_{OUT} = DV_{DD}				3	µA
Output Low Voltage	V_{OL}	I_{OL} = 3mA				0.4	V

ELECTRICAL CHARACTERISTICS (continued)

(AV_{DD} = CPV_{DD} = +3V, DV_{DD} = DV_{DDS2} = +1.8V, PV_{DD} = +3.3V, R_{HP} = 32Ω, Z_{SPK} = 8Ω + 10µH, R_{REC} = 32Ω, R_{OUTL+} to R_{OUTL-} = 10kΩ, R_{OUTR+} to R_{OUTR-} = 10kΩ, C1 = 0.22µF, C2 = C_{NREG} = C_{PREG} = $C_{INTMICBIAS}$, C_{MBIAS} = C_{REF} = 1µF, MCLK = 13MHz, all PGAs = 0dB, HP/REC volume = -20.0dB, SPK volume = -20.4dB, line output gain = -0.4dB, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (See *Functional Diagrams/Typical Operating Circuits*).

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
HEADPHONE AMPLIFIERS							
Output Power	P_{OUT}	f = 1kHz, THD < 1%, volume +5.5dB	R_L = 16Ω		80		mW
			R_L = 32Ω	30	55		
0dBFS Output Voltage		+4.5dB volume setting, input is full-scale signal from the audio DAC		3.14	3.38	3.62	V_{P-P}
Line In to HP Out Voltage Gain		+4.5dB volume setting	Stereo/mono	1.54	1.66	1.78	V/V
			Balanced mono	3.1	3.35	3.6	
Output Offset Voltage	V_{OS}				10	40	mV
Total Harmonic Distortion Plus Noise	THD+N	R_L = 32Ω, P_{OUT} = 50mW, f = 1kHz, BW = 22Hz to 20kHz			0.03		%
		R_L = 16Ω, P_{OUT} = 60mW, f = 1kHz, BW = 22Hz to 20kHz			0.03		
Dynamic Range	DR	+5.5dB volume setting (DAC input to HP output), A-weighted		70	87.5		dB
Power-Supply Rejection Ratio (DAC Input to HP Out)	PSRR	AV_{CC} = 2.6V to 3.6V		60	95		dB
		V_{RIPPLE} = 100mV_{P-P}, f = 217Hz			95		
		V_{RIPPLE} = 100mV_{P-P}, f = 10kHz			68		
Maximum Capacitive Load	C_L	No sustained oscillations			150		pF
Crosstalk (Line Input to Headphone Output)		R_L = 32Ω, P_{OUT} = 1.6mW, f = 1kHz			-85		dB
Channel Gain Matching	AV_{MATCH}	Line input to headphone output			±1		%
Click-and-Pop Level	K_{CP}	Peak voltage, 32-samples per second, A-weighted, R_L = 32Ω (Note 11)	Into shutdown, HP disabled		-53		dBV
			Out of shutdown, HP enabled		-48		
SPEAKER AMPLIFIERS (MAX9851) (Note 12)							
Output Power	P_{OUT}	f = 1kHz, 2V_{P-P} line input, +13.1dB speaker amp volume setting	PV_{DD} = 3.3V, THD+N < 1%	R_L = 8Ω	500		mW
			PV_{DD} = 5V, THD+N < 1%	R_L = 8Ω	1150		
			PV_{DD} = 3.3V, THD+N < 10%	R_L = 8Ω	600		
			PV_{DD} = 5V, THD+N < 10%	R_L = 8Ω	1250		
0dBFS Output Voltage		+12.1dB volume setting, P_{VDD} = +5V			8.4		V_{P-P}

Stereo Audio CODECs with Microphone, DirectDrive Headphones, Speaker Amplifiers, or Line Outputs

ELECTRICAL CHARACTERISTICS (continued)

(AV_{DD} = CPV_{DD} = +3V, DV_{DD} = DV_{DDS2} = +1.8V, PV_{DD} = +3.3V, R_{HP} = 32Ω, Z_{SPK} = 8Ω + 10µH, R_{REC} = 32Ω, R_{OUTL+} to R_{OUTL-} = 10kΩ, R_{OUTR+} to R_{OUTR-} = 10kΩ, C1 = 0.22µF, C2 = C_{NREG} = C_{PREG} = $C_{INTMICBIAS}$, C_{MBIAS} = C_{REF} = 1µF, MCLK = 13MHz, all PGAs = 0dB, HP/REC volume = -20.0dB, SPK volume = -20.4dB, line output gain = -0.4dB, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (See *Functional Diagrams/Typical Operating Circuits*).

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Line In to Speaker Out Voltage Gain		+12.1dB volume setting, P_{VDD} = +5V		4.0	4.2	4.4	V/V
Output Offset Voltage	V_{OS}				10	100	mV
Total Harmonic Distortion Plus Noise	THD+N	R_L = 8Ω, P_{OUT} = 125mW, f = 1kHz, BW = 22Hz to 20kHz, +10.1dB volume setting			0.03		%
Dynamic Range	DR	+12.1dB volume setting, A-weighted			90		dB
Power-Supply Rejection Ratio	PSRR	PV_{DD} = 2.6V to 5.5V		50	70		dB
		V_{RIPPLE} = 100mV_{P-P}, f = 217Hz			70		
		V_{RIPPLE} = 100mV_{P-P}, f = 10kHz			55		
Crosstalk		R_L = 8Ω, P_{OUT} = 100mW, f = 1kHz			60		dB
Channel Gain Matching	AV_{MATCH}				±4		%
Class D Switching Frequency					1100		kHz
Click-and-Pop Level	K_{CP}	Peak voltage, 32-samples per second, A-weighted R_L = 8Ω (Note 11)	Into shutdown		-35		dBV
			Out of shutdown		-35		
Efficiency		P_{OUT} = 1W per channel, R_L = 8Ω			75		%
LINE OUTPUT AMPLIFIERS (MAX9853) (Note 12)							
Line Output Common-Mode Voltage				1.13	1.23	1.33	V
Line Output Differential Offset Voltage				-90		+90	mV
Maximum Differential Output Voltage				3.16	4.16	4.74	V_{P-P}
Dynamic Range	DR	1.4mV_{RMS} (-60dB) output voltage, A-weighted			88		dB
Total Harmonic Distortion Plus Noise	THD+N	f_{IN} = 1kHz, V_{OUT} = 2V_{P-P}, BW = 22Hz to 20kHz			0.004		%
Power-Supply Rejection Ratio	PSRR	AV_{DD} = 2.6V to 3.6V		57	100		dB
		V_{RIPPLE} = 100mV_{P-P}, f = 217Hz			95		
		V_{RIPPLE} = 100mV_{P-P}, f = 20kHz			55		
Line Input to Line Output Gain Accuracy				-0.4		+0.6	dB

ELECTRICAL CHARACTERISTICS (continued)

(AV_{DD} = CPV_{DD} = +3V, DV_{DD} = DV_{DDS2} = +1.8V, PV_{DD} = +3.3V, R_{HP} = 32Ω, Z_{SPK} = 8Ω + 10µH, R_{REC} = 32Ω, R_{OUTL+} to R_{OUTL-} = 10kΩ, R_{OUTR+} to R_{OUTR-} = 10kΩ, C1 = 0.22µF, C2 = C_{NREG} = C_{PREG} = $C_{INTMICBIAS}$, C_{MBIAS} = C_{REF} = 1µF, MCLK = 13MHz, all PGAs = 0dB, HP/REC volume = -20.0dB, SPK volume = -20.4dB, line output gain = -0.4dB, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (See *Functional Diagrams/Typical Operating Circuits*).

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
RECEIVER AMPLIFIER (Note 12)							
Output Power	P_{OUT}	f = 1kHz, THD < 1%, +5.5dB volume setting	R_L = 16Ω, input signal from LINEIN1		80		mW
			R_L = 16Ω, input signal is the sum of LINEIN1+LINEIN2		105		
			R_L = 32Ω, input signal from LINEIN1	35	55		
Maximum Output Voltage		+4.5dB volume setting, 0dB PGA setting, input signal 0dBFS from DAC output, only 1 input selected		3.09	3.35	3.64	V_{P-P}
Line In to REC Out Voltage Gain		+4.5dB volume setting, 0dB PGA setting, only 1 input selected		1.54	1.68	1.82	V/V
Output Offset Voltage	V_{OS}				10	60	mV
Total Harmonic Distortion Plus Noise	THD+N	R_L = 32Ω, P_{OUT} = 40mW, f = 1kHz, BW = 22Hz to 20kHz, +3dB volume setting			0.03		%
		R_L = 16Ω, P_{OUT} = 40mW, f = 1kHz, BW = 22Hz to 20kHz, +3dB volume setting			0.04		
Dynamic Range	DR	+6dB volume setting, A-weighted			92		dB
Power-Supply Rejection Ratio	PSRR	AV_{DD} = 2.6V to 3.3V		60	100		dB
		V_{RIPPLE} = 100mV_{P-P}, f = 217Hz			98		
		V_{RIPPLE} = 100mV_{P-P}, f = 20kHz			65		
Maximum Capacitive Load	C_L	No sustained oscillations			150		pF
Click-and-Pop Level	K_{CP}	Peak voltage, 32 samples per second, A-weighted, R_L = 16Ω (Note 11)			-44.6		dBV
VOLUME CONTROL/PGAs							
Headphone/Receiver Volume Control Range				-80		+6.1	dB
Headphone/Receiver Mute Attenuation		f = 1kHz			100		dB
Speaker Volume Control Range (MAX9851)				-72.4		+13.7	dB
Speaker Mute Attenuation (MAX9851)		f = 1kHz			100		dB
Differential Line Output Gain Control Range (MAX9853)				-78.4		+7.9	dB
Differential Line Output Mute Attenuation (MAX9853)		f = 1kHz			100		dB

Stereo Audio CODECs with Microphone, DirectDrive Headphones, Speaker Amplifiers, or Line Outputs

ELECTRICAL CHARACTERISTICS (continued)

(AV_{DD} = CPV_{DD} = +3V, DV_{DD} = DV_{DDS2} = +1.8V, PV_{DD} = +3.3V, R_{HP} = 32Ω, Z_{SPK} = 8Ω + 10µH, R_{REC} = 32Ω, R_{OUTL+} to R_{OUTL-} = 10kΩ, R_{OUTR+} to R_{OUTR-} = 10kΩ, C1 = 0.22µF, C2 = C_{NREG} = C_{PREG} = $C_{INTMICBIAS}$, C_{MBIAS} = C_{REF} = 1µF, MCLK = 13MHz, all PGAs = 0dB, HP/REC volume = -20.0dB, SPK volume = -20.4dB, line output gain = -0.4dB, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (See *Functional Diagrams/Typical Operating Circuits*).

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Sidetone Volume Control Range				-34.0		+30.5	dB
Sidetone Mute Attenuation		f = 1kHz, sidetone deselected from input mixer			80		dB
CHARGE PUMP							
Charge-Pump Oscillator Frequency	f_{OSC}			295	650	1200	kHz
MICROPHONE AMPLIFIERS							
Preamplifier Gain	AV_{PRE}	EXTMIC_	AV_{PRE} = +20dB	+18.5		+20.5	dB
			AV_{PRE} = +20dB	-0.9		+0.4	
MIC PGA Gain	AV_{MICPGA}	PGA gain = 0dB		-0.9		+0.4	dB
		PGA gain = +20dB		+18.5		+20.5	
MIC Mute Attenuation		f = 1kHz			105		dB
Common-Mode Rejection Ratio	CMRR	EXTMIC_, V_{IN} = 100mV_{P-P} at 217Hz, AV_{PRE} = +20dB			80		dB
MIC Input Voltage Range		INTMIC_, EXTMIC_		-1		+1	V
		EXTMICGND		-0.1		+0.1	
MIC Input Resistance	R_{IN_MIC}	INTMIC_, EXTMIC_		30	50	70	kΩ
MIC GND Sense Input Resistance	R_{IN_MICS}	EXTMICGND		15	25	36	kΩ
MIC Input Resistance Matching	R_{MATCH}	INTMICP to INTMICN or EXTMICL to EXTMICR			0.3		%
MIC Input Bias Voltage	V_{CML}	Measured at INTMIC_, EXTMIC_, and EXTMICGND		-0.1	0	+0.1	V
Input Voltage Noise	E_{IN_MIC}	f = 1kHz, AV_{PRE} = +20dB, R_{SOURCE} = 0Ω			25		nV/√Hz
Total Harmonic Distortion Plus Noise	THD+N	AV_{PRE} = 0dB, AV_{MICPGA} = 0dB, V_{IN} = 2V_{P-P}, f = 1kHz, BW = 22Hz to 20kHz			0.035		%
		AV_{PRE} = +20dB, AV_{MICPGA} = 0dB, V_{IN} = 200mV_{P-P}, f = 1kHz, BW = 22Hz to 20kHz			0.035		
		AV_{PRE} = +20dB, AV_{MICPGA} = +20dB, V_{IN} = 20mV_{P-P}, f = 1kHz, BW = 22Hz to 20kHz			0.06		
MIC Power-Supply Rejection Ratio	PSRR	AV_{DD} = 2.6V to 3.3V, T_A = +25°C		48	65		dB
		V_{RIPPLE} = 100mV_{P-P} at 217Hz, output referred			65		dB
		V_{RIPPLE} = 100mV_{P-P} at 10kHz, output referred			65		dB

ELECTRICAL CHARACTERISTICS (continued)

(AV_{DD} = CPV_{DD} = +3V, DV_{DD} = DV_{DDS2} = +1.8V, PV_{DD} = +3.3V, R_{HP} = 32Ω, Z_{SPK} = 8Ω + 10µH, R_{REC} = 32Ω, R_{OUTL+} to R_{OUTL-} = 10kΩ, R_{OUTR+} to R_{OUTR-} = 10kΩ, C1 = 0.22µF, C2 = C_{NREG} = C_{PREG} = $C_{INTMICBIAS}$, C_{MBIAS} = C_{REF} = 1µF, MCLK = 13MHz, all PGAs = 0dB, HP/REC volume = -20.0dB, SPK volume = -20.4dB, line output gain = -0.4dB, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (See *Functional Diagrams/Typical Operating Circuits*).

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
MICROPHONE BIAS						
INTMICBIAS Output Voltage	$V_{MICBIAS}$		2.3	2.4	2.5	V
INTMICBIAS Load Regulation		$I_{MICBIAS}$ = 0 to 2mA		0.7	10	Ω
INTMICBIAS Minimum Capacitive Load				1		µF
INTMICBIAS Short-Circuit Current		To AGND		15		mA
INTMICBIAS Power-Supply Rejection Ratio	PSRR	AV_{DD} = 2.6V to 3.3V, T_A = +25°C		72		dB
		V_{RIPPLE} = 100mV at 217Hz		85		dB
		V_{RIPPLE} = 100mV at 10kHz		70		dB
INTMICBIAS Noise Voltage	V_{NOISE}	f = 22Hz to 20kHz		2.8		μV_{RMS}
		f = 1kHz		20		$nV/\sqrt{Hz}$
EXTMICBIAS_ Output Impedance	R_{EXTMIC}	2.2kΩ setting	2.00		2.42	kΩ
		470Ω setting	425		515	Ω
EXTMICBIAS_ Off-Impedance		$V_{EXTMICBIAS\_}$ = 0 to 3.0V	1	2		MΩ
LINE INPUT (Note 13)						
Line Input Maximum Input Voltage				2		V_{P-P}
Line Input Resistance	R_{IN}		10	20		kΩ
Line Channel-to-Channel Gain Matching	AV_{MATCH}			±1		%
PGA Gain Range			-34.0		+30.5	dB
HEADSET AUTO-DETECT (Normal Operation)						
MIC Sense High Threshold	V_{TH1}	MIC bias and bias resistor enabled	0.92 x $V_{MICBIAS}$	0.95 x $V_{MICBIAS}$	0.98 x $V_{MICBIAS}$	V
MIC Sense Low Threshold	V_{TH2}	MIC bias and bias resistor enabled	0.06 x $V_{MICBIAS}$	0.1 x $V_{MICBIAS}$	0.17x $V_{MICBIAS}$	V
MIC Sense Deglitch Period	t_{GLITCH}	Pulses shorter than $t_{GLITCH1}$ are eliminated		20		ms
Headphone Sense Current	I_{SENSE}	V_{HPL} / V_{HPR} = AGND (headphones disabled)		3.4	5	µA
Headphone Sense Voltage	V_{SENSE}	HPR/HPL (headphone amplifiers disabled)		AV_{DD}		V
		Test 2 (HPTEST = 1) - HPR only		0		
Headphone Sense Threshold	V_{TH3}		0.74 x AV_{DD}	0.73 x AV_{DD}	0.82 x AV_{DD}	V
SLEEP MODE (AV_{CC} = 0V or 3V)						
MIC Sense Current	I_{MIC}	EXTMICBIASL = AGND		3	10	µA
MIC Sense Voltage	V_{MIC}			PV_{DD}		V
MIC Sense Sleep Threshold	V_{TH4}	Voltage at EXTMICBIASL	0.9	2	2.7	V

Stereo Audio CODECs with Microphone, DirectDrive Headphones, Speaker Amplifiers, or Line Outputs

TIMING CHARACTERISTICS

(AV_{DD} = CPV_{DD} = +3V, DV_{DD} = DV_{DDS2} = +1.8V, PV_{DD} = +3.3V, R_{HP} = 32Ω, Z_{SPK} = 8Ω + 10µH, R_{REC} = 32Ω, R_{OUTL+} to R_{OUTL-} = 10kΩ, R_{OUTR+} to R_{OUTR-} = 10kΩ, C1 = 0.22µF, C2 = C_{NREG} = C_{PREG} = $C_{INTMICBIAS}$, C_{MBIAS} = C_{REF} = 1µF, MCLK = 13MHz, all PGAs = 0dB, HP/REC volume = -20.0dB, SPK volume = -20.4dB, line output gain = -0.4dB, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (See *Functional Diagrams/Typical Operating Circuits*).

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
INPUT CLOCK CHARACTERISTICS						
MCLK Input Frequency	f_{MCLK}			13 / 26		MHz
MCLK Duty Cycle			45	50	55	%
Maximum MCLK Jitter		Maximum allowable RMS for performance limits		100		ps_{RMS}
DIGITAL INPUTS (BCLKS_, LRCLKS_, SDINS_, MCLK, SDA, SCL, FAULTIN)						
Input-Voltage High	V_{IH}		0.7 x DV_{DD}			V
Input-Voltage Low	V_{IL}				0.3 x DV_{DD}	V
Input Hysteresis				200		mV
Input Leakage Current	I_{IH}, I_{IL}		-3		+3	µA
FAULTIN Input Low Leakage Current (MAX9853)	I_{IL}	FAULTIN has internal pullup resistor			30	µA
FAULTIN Input High Leakage Current (MAX9853)	I_{IH}				3	µA
Input Capacitance				10		pF
CMOS DIGITAL OUTPUTS (BCLKS_, LRCLKS_, SDOUTS_)						
Output Low Voltage	V_{OL}	I_{OL} = 3mA			0.4	V
Output High Voltage	V_{OH}	I_{OH} = 3mA	DV_{DD} - 0.4			V
DIGITAL AUDIO INTERFACE TIMING CHARACTERISTICS (Digital Audio Interface S1 and S2)						
BCLK Cycle Time	t_{BCLKS}	Slave operation	75			ns
	t_{BCLKM}	Master operation		308		ns
BCLK High Time	t_{BCLKH}	Slave operation	30			ns
BCLK Low Time	t_{BCLKL}	Slave operation	30			ns
BCLK_ or LRCLK_ Rise and Fall Time	t_r, t_f	Master operation, C_L = 15pF		7		ns
SDIN_ or LRCLK_ to BCLK_ Rising Set-Up Time	t_{SU}	BCI = 0 (see I^2C register definition)	30			ns
SDIN_ or LRCLK_ to BCLK_ Rising Hold Time	t_{HD}	BCI = 0 (see I^2C register definition)	5			ns
SDOUTS1 Delay Time	t_{DLY}	BCI = 0 (see I^2C register definition), C_L = 30pF			35	ns
SDOUTS2 Delay Time	t_{DLY}	BCI = 0 (see I^2C register definition), C_L = 30pF			50	ns

TIMING CHARACTERISTICS (continued)

(AV_{DD} = CPV_{DD} = +3V, DV_{DD} = DV_{DDS2} = +1.8V, PV_{DD} = +3.3V, R_{HP} = 32Ω, Z_{SPK} = 8Ω + 10µH, R_{REC} = 32Ω, R_{OUTL+} to R_{OUTL-} = 10kΩ, R_{OUTR+} to R_{OUTR-} = 10kΩ, C1 = 0.22µF, C2 = C_{NREG} = C_{PREG} = $C_{INTMICBIAS}$, C_{MBIAS} = C_{REF} = 1µF, MCLK = 13MHz, all PGAs = 0dB, HP/REC volume = -20.0dB, SPK volume = -20.4dB, line output gain = -0.4dB, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (See *Functional Diagrams/Typical Operating Circuits*).

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
VOICE MODE TIMING CHARACTERISTICS (Digital Audio Interface S1 and S2)						
BCLK_ Cycle Time	t_{BC}		75			ns
BCLK_ High Time	t_{BH}		30			ns
BCLK_ Low Time	t_{BL}		30			ns
BCLK_ or LRCLK_ Rise and Fall Time	t_r, t_f	Master mode, C_{LOAD} = 15pF		7		ns
SDIN_ or LRCLK_ to BCLK_ Rising Edge Setup Time	t_{SU}	BCI = 0 (see I^2C register definition)	30			ns
SDIN_ or LRCLK_ to BCLK_ Rising Edge Hold Time	t_{HD}	BCI = 0 (see I^2C register definition)	5			ns
SDOUTS1 Delay Time	t_{DLY}	BCI = 0 (see I^2C register definition), from BCLK rising edge			35	ns
SDOUTS2 Delay Time	t_{DLY}	BCI = 0 (see I^2C register definition), from BCLK rising edge			50	ns
OPEN-DRAIN DIGITAL OUTPUTS (SDA, $\overline{IRQ}$)						
Output High Current	I_{OH}	V_{OUT} = DV_{DD}			3	µA
Output Low Voltage	V_{OL}	I_{OL} = 3mA for DV_{DD} > 2V			0.4	V
		I_{OL} = 3mA for DV_{DD} < 2V			0.2 x DV_{DD}	
OPEN-DRAIN DIGITAL OUTPUT (SHDNOUT) (MAX9853 Only)						
Output High Current	I_{OH}	V_{OUT} = DV_{DD}			3	µA
Output Low Voltage	V_{OL}	I_{OL} = 100µA			0.4	V
I^2C TIMING CHARACTERISTICS						
Serial Clock Frequency	f_{SCL}		0		400	kHz
Bus Free Time Between STOP and START Conditions	t_{BUF}		1.3			µs
Hold Time (Repeated) START Condition	$t_{HD,STA}$		0.6			µs
SCL Pulse Width Low	t_{LOW}		1.3			µs
SCL Pulse Width High	t_{HIGH}		0.6			µs
Setup Time for a Repeated START Condition	$t_{SU,STA}$		0.6			µs

Stereo Audio CODECs with Microphone, DirectDrive Headphones, Speaker Amplifiers, or Line Outputs

TIMING CHARACTERISTICS (continued)

(AV_{DD} = CPV_{DD} = +3V, DV_{DD} = DV_{DDS2} = +1.8V, PV_{DD} = +3.3V, R_{HP} = 32Ω, Z_{SPK} = 8Ω + 10µH, R_{REC} = 32Ω, R_{OUTL+} to R_{OUTL-} = 10kΩ, R_{OUTR+} to R_{OUTR-} = 10kΩ, C1 = 0.22µF, C2 = C_{NREG} = C_{PREG} = $C_{INTMICBIAS}$, C_{MBIAS} = C_{REF} = 1µF, MCLK = 13MHz, all PGAs = 0dB, HP/REC volume = -20.0dB, SPK volume = -20.4dB, line output gain = -0.4dB, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (See *Functional Diagrams/Typical Operating Circuits*).

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Data Hold Time	$t_{HD,DAT}$		0		900	ns
Data Setup Time	$t_{SU,DAT}$		100			ns
SDA and SCL Receiving Rise Time	t_r	(Note 14)	$20+0.1C_b$		300	ns
SDA and SCL Receiving Fall Time	t_f	(Note 14)	$20+0.1C_b$		300	ns
SDA Transmitting Fall Time	t_f	DV_{DD} = 1.8V (Note 14)	$20+0.1C_b$		250	ns
		DV_{DD} = 3.3V (Note 14)	$20+0.05C_b$		250	
Setup Time for STOP Condition	$t_{SU,STO}$		0.6			µs
Bus Capacitance	C_b				400	pF
Pulse Width of Suppressed Spike	t_{SP}		0		50	ns

Note 1: DAC playback mode is defined as clocking all zeros into the DAC which operates in stereo audio mode at the 48kHz sample rate in master mode.

Note 2: Full-duplex voice mode is defined as operating the DAC and ADC in mono 8kHz voice mode with line inputs, microphone inputs, and an analog output enabled.

Note 3: Record operation is defined as operating the stereo ADC with the stereo external microphone inputs enabled at the 48kHz sample rate in master mode.

Note 4: Speaker output available only on the MAX9851. PV_{DD} powers only the headset autodetect circuitry when in sleep mode on the MAX9853.

Note 5: DAC performance measured at headphone outputs.

Note 6: Dynamic range measured using the EIAJ method. The input is applied at -60dBFS, f_{IN} = 1kHz. The THD+N referred to 0dBFS A-weighted.

Note 7: The SNR is referred to 0dBFS A-weighted.

Note 8: ADC performance measured from line inputs (unless otherwise noted).

Note 9: Microphone amplifiers connected to ADC, mic inputs AC-grounded.

Note 10: In master-mode operation, sample clock rate is proportional to MCLK input.

Note 11: Speaker amplifier testing performed with 8Ω resistive load in series with a 68µH inductive load connected across BTL outputs. Headphone and receiver amplifier testing performed with 32Ω resistive load connected to GND. Mode transitions are controlled by toggling the amplifier on and off using the corresponding enable bit. Units expressed in dBV.

Note 12: Input signal for speaker, line output, and receiver output performance measured using line inputs.

Note 13: Line input specifications measured from line inputs to line outputs.

Note 14: C_B is in pF.

TYPICAL POWER DISSIPATION (No Output Load)

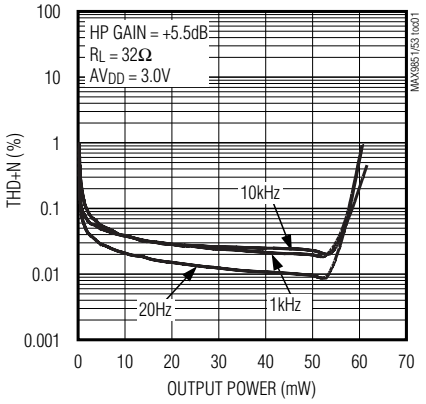
(AV_{DD} = CPV_{DD} = +3V, DV_{DD} = DV_{DDS2} = +1.8V, PV_{DD} = +2.7V.)

MODE	OUTPUT AMPLIFIER	TOTAL POWER (mW)
DAC playback mode operating at 48kHz sampling rate	Stereo headphone	27
	Stereo speaker	55
	Mono receiver	24
Line-only playback mode	Stereo headphone	16
	Stereo speaker	44
	Mono receiver	14
DAC and line input playback mode operating at 48kHz sampling rate	Stereo headphone	27
	Stereo speaker	55
	Mono receiver	25
8kHz voice mode with mono DAC, mono ADC, line inputs and a mono microphone enabled	Stereo headphone	48
	Stereo speaker	76
	Mono receiver	46
8kHz voice mode and 48kHz stereo audio mode with stereo DAC, mono ADC, line inputs and a mono microphone enabled	Stereo headphone	53
	Stereo speaker	81
	Mono receiver	51
ADC record mode with stereo microphone and line inputs enabled	—	46
ADC record and stereo playback with stereo microphone and stereo headphones	—	57

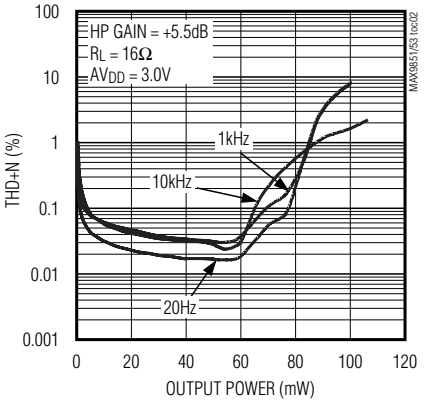
Typical Operating Characteristics

(AV_{DD} = CPV_{DD} = +3V, DV_{DD} = DV_{DDS2} = +1.8V, PV_{DD} = +3.3V, R_{HP} = 32Ω, Z_{SPK} = 8Ω + 10µH, R_{REC} = 32Ω, R_{OUTL+} to R_{OUTL-} = R_{OUTR+} to R_{OUTR-} = 10kΩ, C1 = 0.22µF, C2 = C_{VMREG} = C_{VPREG} = C_{MBIAS} = C_{REF} = 1µF, MCLK = 13MHz, all PGAs = 0dB, HP/REC volume = -20.0dB, SPK volume = -20.4dB, line output gain = -0.4dB, f_S = 48kHz for nonvoice mode, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.)

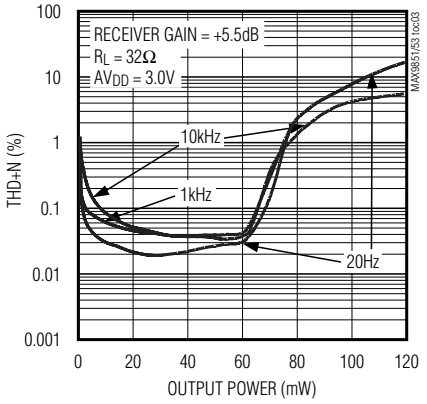
TOTAL HARMONIC DISTORTION PLUS NOISE vs. OUTPUT POWER (DAC TO HP)



TOTAL HARMONIC DISTORTION PLUS NOISE vs. OUTPUT POWER (DAC TO HP)



TOTAL HARMONIC DISTORTION PLUS NOISE vs. OUTPUT POWER (DAC TO RECEIVER)

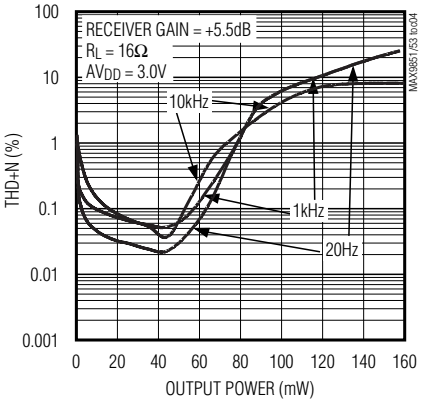


Stereo Audio CODECs with Microphone, DirectDrive Headphones, Speaker Amplifiers, or Line Outputs

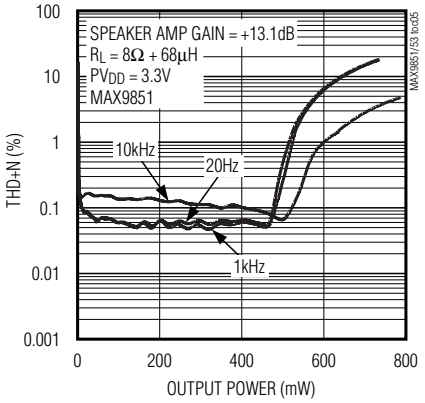
Typical Operating Characteristics (continued)

(AV_{DD} = CPV_{DD} = +3V, DV_{DD} = DV_{DDS2} = +1.8V, PV_{DD} = +3.3V, R_{HP} = 32Ω, Z_{SPK} = 8Ω + 10µH, R_{REC} = 32Ω, R_{OUTL+} to R_{OUTL-} = R_{OUTR+} to R_{OUTR-} = 10kΩ, C1 = 0.22µF, C2 = C_{VMREG} = C_{VPREG} = C_{MBIAS} = C_{REF} = 1µF, MCLK = 13MHz, all PGAs = 0dB, HP/REC volume = -20.0dB, SPK volume = -20.4dB, line output gain = -0.4dB, f_S = 48kHz for nonvoice mode, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.)

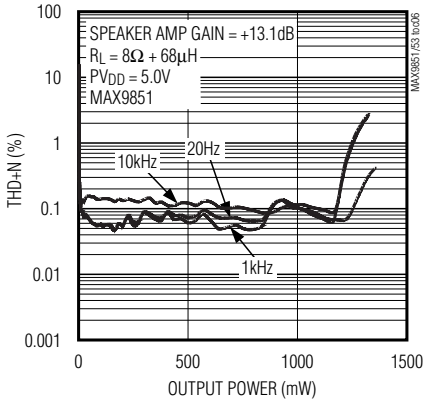
TOTAL HARMONIC DISTORTION PLUS NOISE vs. OUTPUT POWER (DAC TO RECEIVER)



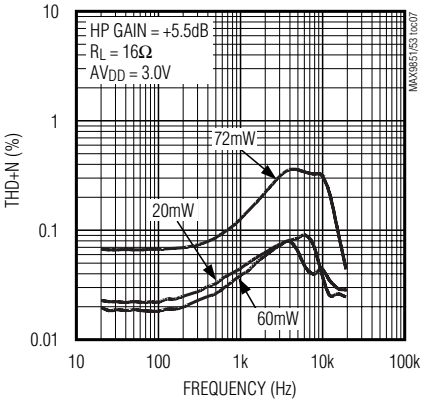
TOTAL HARMONIC DISTORTION PLUS NOISE vs. OUTPUT POWER (DAC TO SPEAKER AMP)



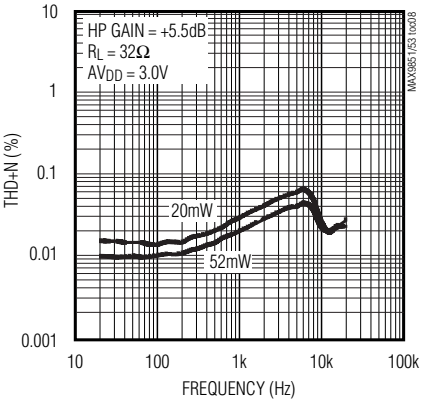
TOTAL HARMONIC DISTORTION PLUS NOISE vs. OUTPUT POWER (DAC TO SPEAKER AMP)



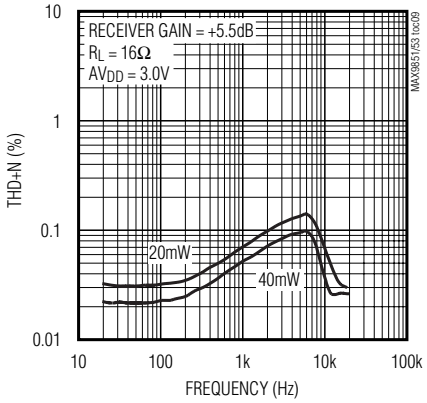
TOTAL HARMONIC DISTORTION PLUS NOISE vs. FREQUENCY (DAC TO HP)



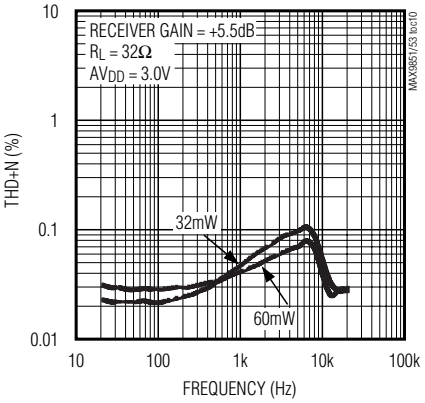
TOTAL HARMONIC DISTORTION PLUS NOISE vs. FREQUENCY (DAC TO HP)



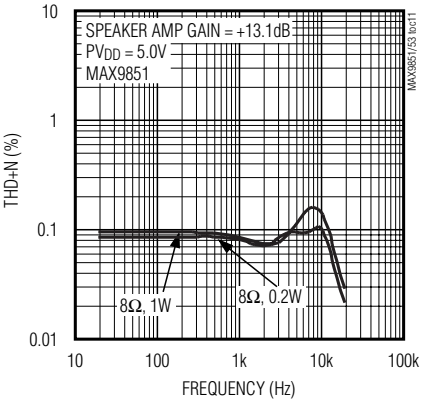
TOTAL HARMONIC DISTORTION PLUS NOISE vs. FREQUENCY (DAC TO RECEIVER)



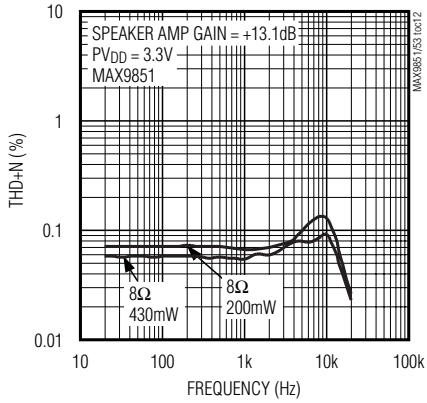
TOTAL HARMONIC DISTORTION PLUS NOISE vs. FREQUENCY (DAC TO RECEIVER)



TOTAL HARMONIC DISTORTION PLUS NOISE vs. FREQUENCY (DAC TO SPEAKER AMP)



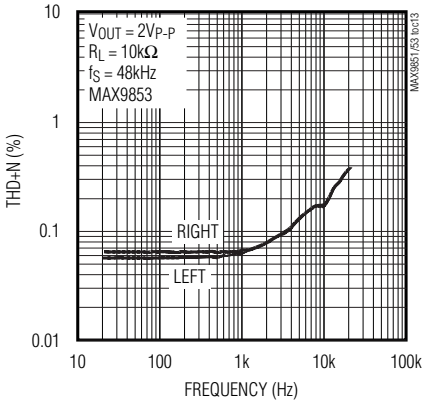
TOTAL HARMONIC DISTORTION PLUS NOISE vs. FREQUENCY (DAC TO SPEAKER AMP)



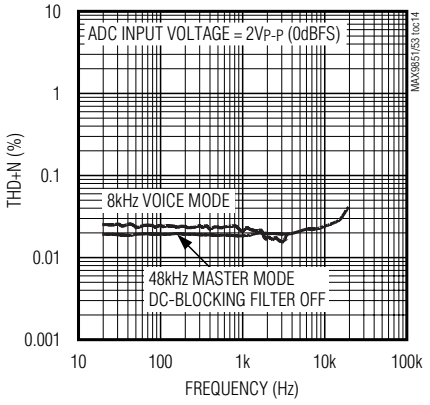
Typical Operating Characteristics (continued)

(AV_{DD} = CPV_{DD} = +3V, DV_{DD} = DV_{DDS2} = +1.8V, PV_{DD} = +3.3V, R_{HP} = 32Ω, Z_{SPK} = 8Ω + 10µH, R_{REC} = 32Ω, R_{OUTL+} to R_{OUTL-} = R_{OUTR+} to R_{OUTR-} = 10kΩ, C1 = 0.22µF, C2 = C_{VMREG} = C_{VPREG} = C_{MBIAS} = C_{REF} = 1µF, MCLK = 13MHz, all PGAs = 0dB, HP/REC volume = -20.0dB, SPK volume = -20.4dB, line output gain = -0.4dB, f_S = 48kHz for nonvoice mode, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.)

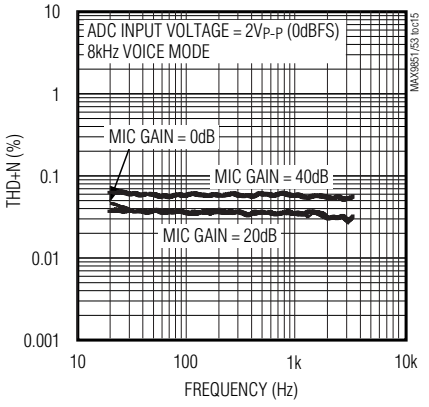
TOTAL HARMONIC DISTORTION PLUS NOISE vs. FREQUENCY (DAC TO LINE OUT)



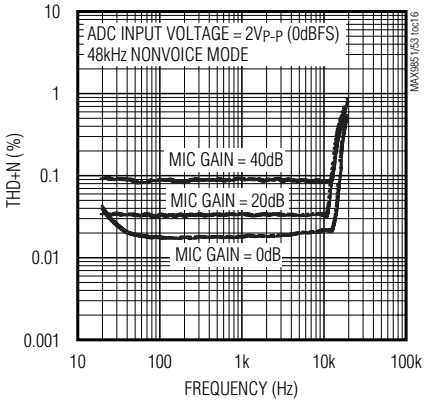
TOTAL HARMONIC DISTORTION PLUS NOISE vs. FREQUENCY (LINE IN TO ADC)



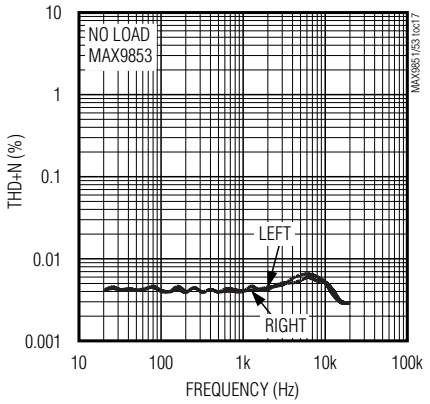
TOTAL HARMONIC DISTORTION PLUS NOISE vs. FREQUENCY (INTERNAL MIC TO ADC)



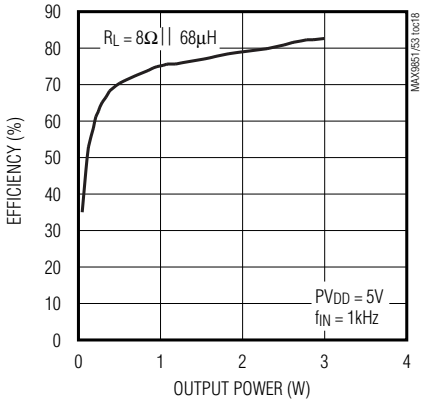
TOTAL HARMONIC DISTORTION PLUS NOISE vs. FREQUENCY (INTERNAL MIC TO ADC)



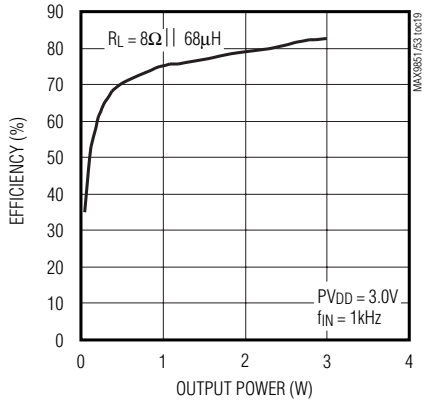
TOTAL HARMONIC DISTORTION PLUS NOISE vs. FREQUENCY (LINE IN TO LINE OUT)



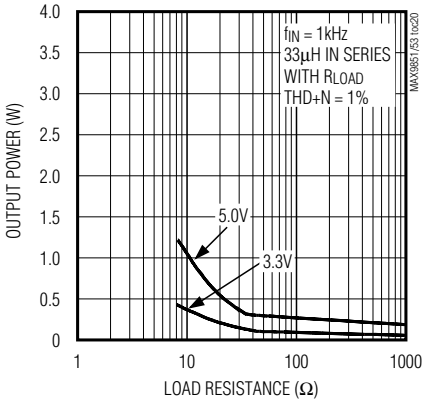
SPEAKER AMP EFFICIENCY vs. OUTPUT POWER



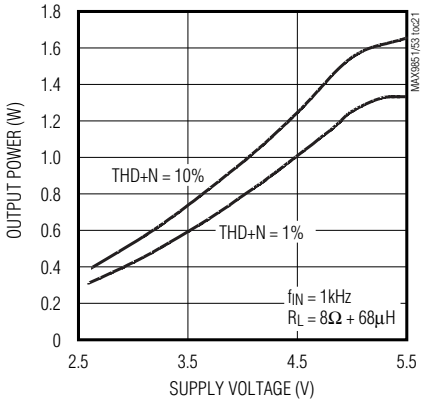
SPEAKER AMP EFFICIENCY vs. OUTPUT POWER



SPEAKER AMP OUTPUT POWER vs. LOAD RESISTANCE



SPEAKER AMP OUTPUT POWER vs. SUPPLY VOLTAGE (PV_{DD})

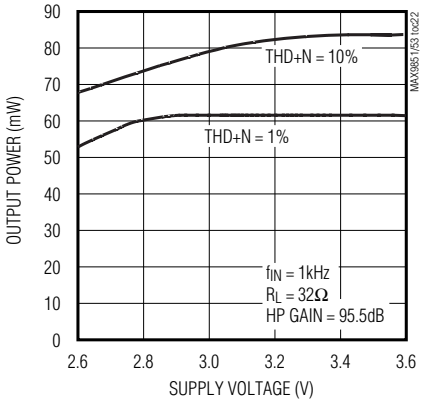


Stereo Audio CODECs with Microphone, DirectDrive Headphones, Speaker Amplifiers, or Line Outputs

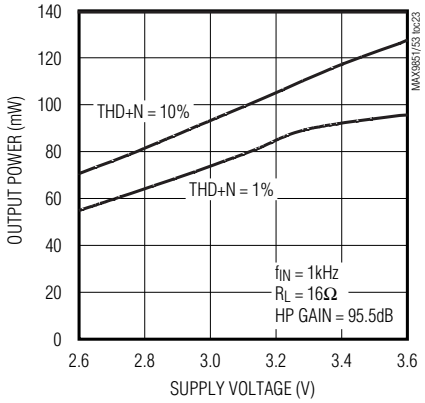
Typical Operating Characteristics (continued)

(AV_{DD} = CPV_{DD} = +3V, DV_{DD} = DV_{DDS2} = +1.8V, PV_{DD} = +3.3V, R_{HP} = 32Ω, Z_{SPK} = 8Ω + 10µH, R_{REC} = 32Ω, R_{OUTL+} to R_{OUTL-} = R_{OUTR+} to R_{OUTR-} = 10kΩ, C1 = 0.22µF, C2 = C_{VMREG} = C_{VPREG} = C_{MBIAS} = C_{REF} = 1µF, MCLK = 13MHz, all PGAs = 0dB, HP/REC volume = -20.0dB, SPK volume = -20.4dB, line output gain = -0.4dB, f_S = 48kHz for nonvoice mode, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.)

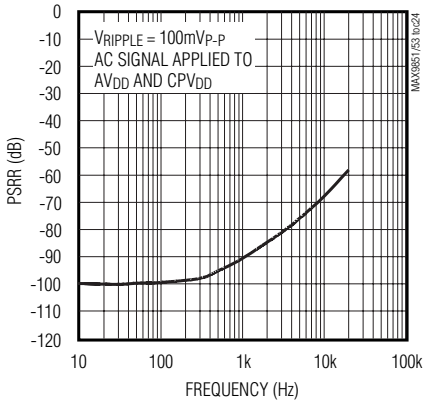
HEADPHONE AMP OUTPUT POWER vs. SUPPLY VOLTAGE (AV_{DD})



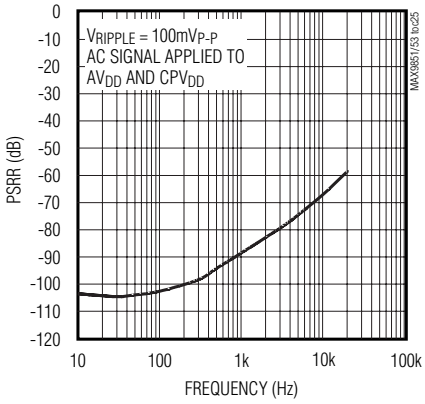
HEADPHONE AMP OUTPUT POWER vs. SUPPLY VOLTAGE (AV_{DD})



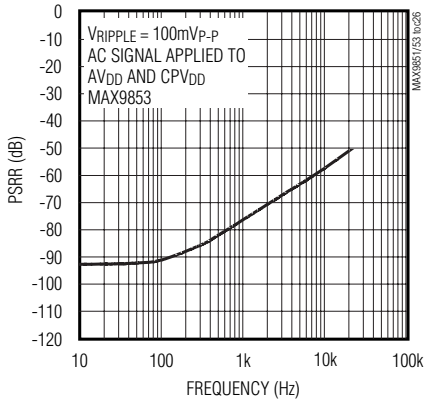
POWER-SUPPLY REJECTION RATIO vs. FREQUENCY (DAC TO HP)



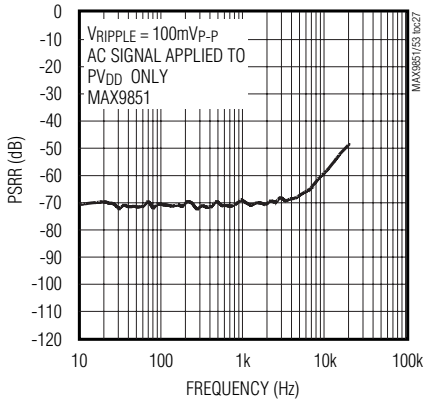
POWER-SUPPLY REJECTION RATIO vs. FREQUENCY (DAC TO RECEIVER)



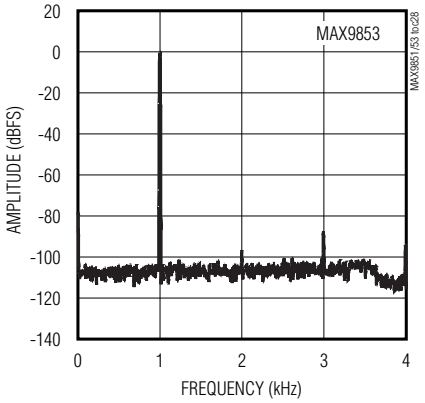
POWER-SUPPLY REJECTION RATIO vs. FREQUENCY (DAC TO LINE OUT)



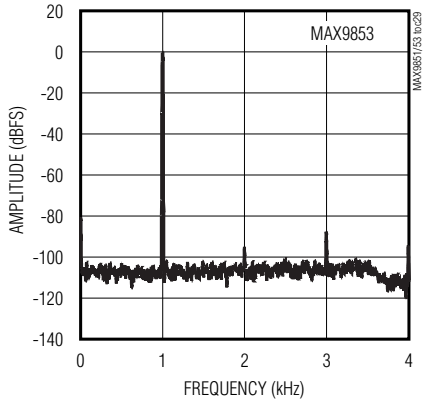
POWER-SUPPLY REJECTION RATIO vs. FREQUENCY (DAC TO SPEAKER)



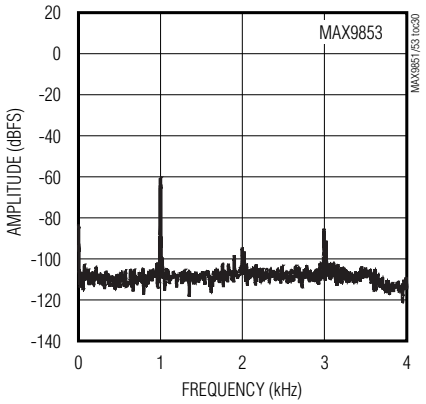
FFT, DAC TO LINE OUT 8kHz SLAVE VOICE MODE, 0dBFS



FFT, DAC TO LINE OUT 8kHz MASTER VOICE MODE, 0dBFS



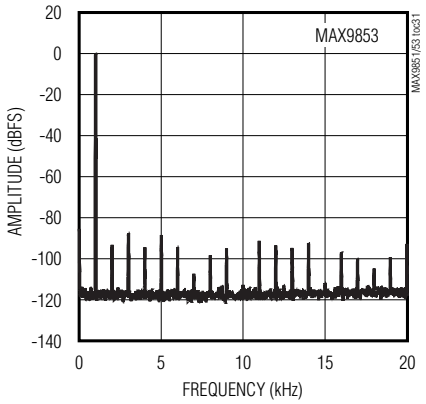
FFT, DAC TO LINE OUT 8kHz MASTER VOICE MODE, -60dBFS



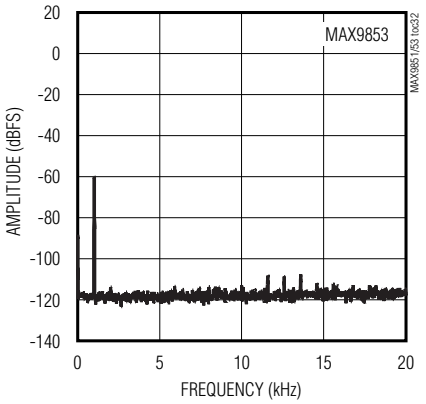
Typical Operating Characteristics (continued)

(AV_{DD} = CPV_{DD} = +3V, DV_{DD} = DV_{DDS2} = +1.8V, PV_{DD} = +3.3V, R_{HP} = 32Ω, Z_{SPK} = 8Ω + 10µH, R_{REC} = 32Ω, R_{OUTL+} to R_{OUTL-} = R_{OUTR+} to R_{OUTR-} = 10kΩ, C1 = 0.22µF, C2 = C_{VMREG} = C_{VPREG} = C_{MBIAS} = C_{REF} = 1µF, MCLK = 13MHz, all PGAs = 0dB, HP/REC volume = -20.0dB, SPK volume = -20.4dB, line output gain = -0.4dB, f_S = 48kHz for nonvoice mode, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.)

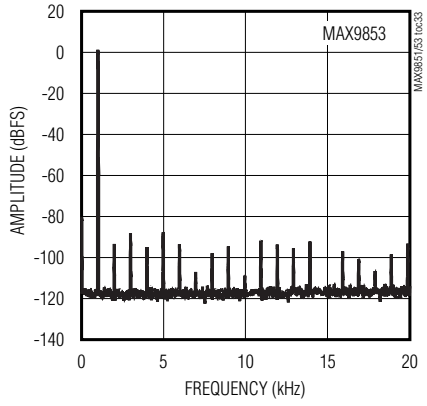
FFT, DAC TO LINE OUT
48kHz SLAVE MODE, 0dBFS



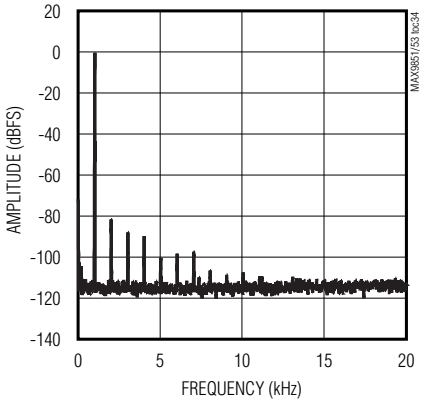
FFT, DAC TO LINE OUT
48kHz SLAVE MODE, -60dBFS



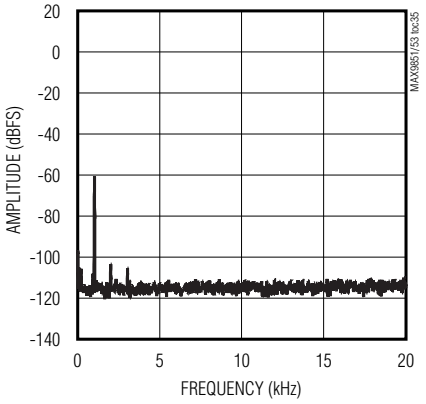
FFT, DAC TO LINE OUT
48kHz MASTER MODE, 0dBFS



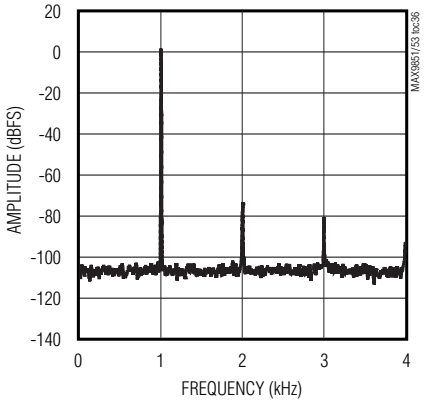
FFT, LINE IN TO ADC
48kHz MASTER MODE, 0dBFS



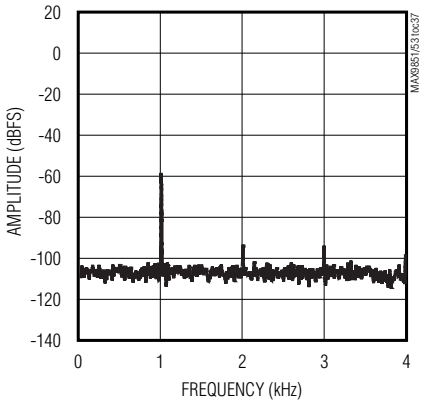
FFT, LINE IN TO ADC
48kHz MASTER MODE, -60dBFS



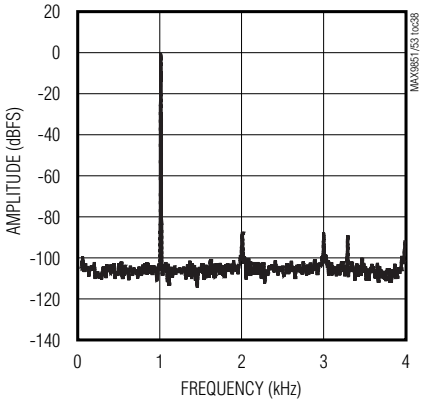
FFT, LINE IN TO ADC
8kHz MASTER VOICE MODE, 0dBFS



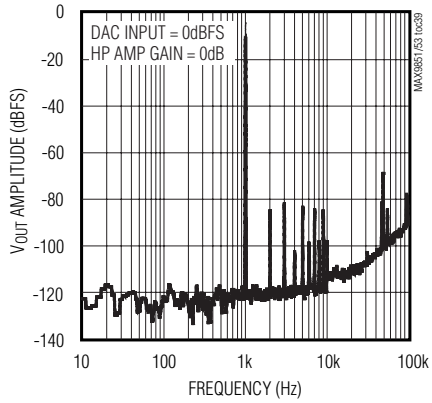
FFT, LINE IN TO ADC
8kHz MASTER VOICE MODE, -60dBFS



FFT, LINE IN TO ADC
8kHz SLAVE VOICE MODE, -60dBFS



WIDEBAND FFT
(DAC TO HP AMP)

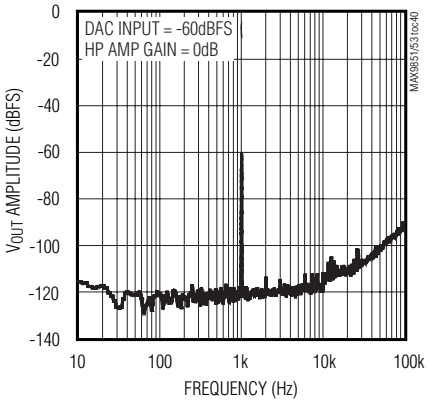


Stereo Audio CODECs with Microphone, DirectDrive Headphones, Speaker Amplifiers, or Line Outputs

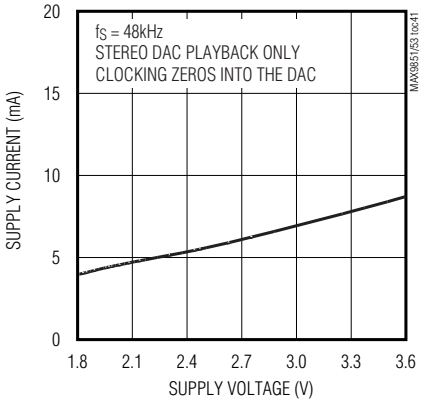
Typical Operating Characteristics (continued)

(AV_{DD} = CPV_{DD} = +3V, DV_{DD} = DV_{DDS2} = +1.8V, PV_{DD} = +3.3V, R_{HP} = 32Ω, Z_{SPK} = 8Ω + 10µH, R_{REC} = 32Ω, R_{OUTL+} to R_{OUTL-} = R_{OUTR+} to R_{OUTR-} = 10kΩ, C1 = 0.22µF, C2 = C_{VMREG} = C_{VPREG} = C_{MBIAS} = C_{REF} = 1µF, MCLK = 13MHz, all PGAs = 0dB, HP/REC volume = -20.0dB, SPK volume = -20.4dB, line output gain = -0.4dB, f_S = 48kHz for nonvoice mode, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.)

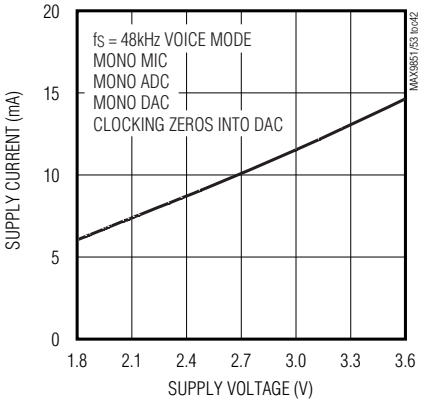
WIDEBAND FFT (DAC TO HP AMP)



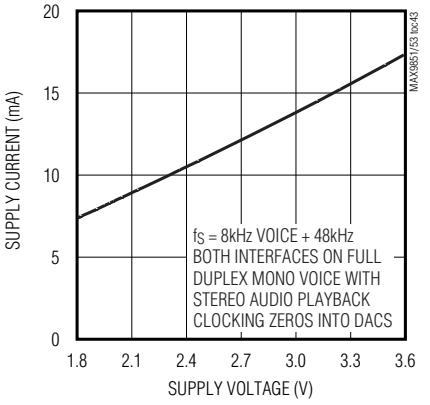
DV_{DD} AND DV_{DDS2} SUPPLY CURRENT vs. SUPPLY VOLTAGE



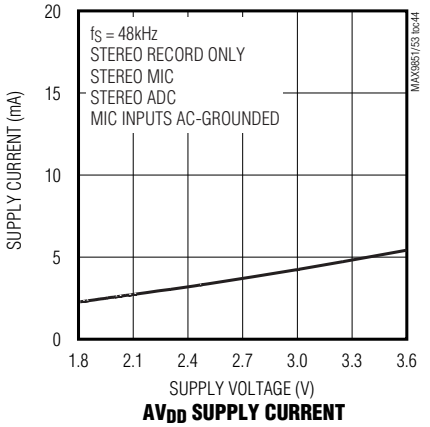
DV_{DD} AND DV_{DDS2} SUPPLY CURRENT vs. SUPPLY VOLTAGE



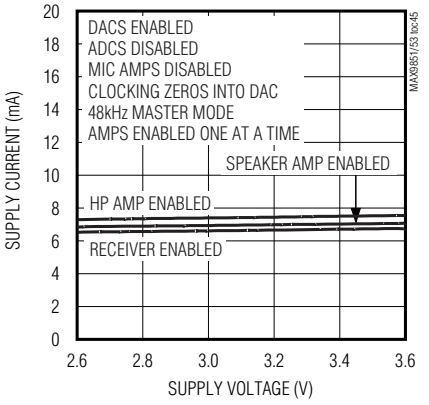
DV_{DD} AND DV_{DDS2} SUPPLY CURRENT vs. SUPPLY VOLTAGE



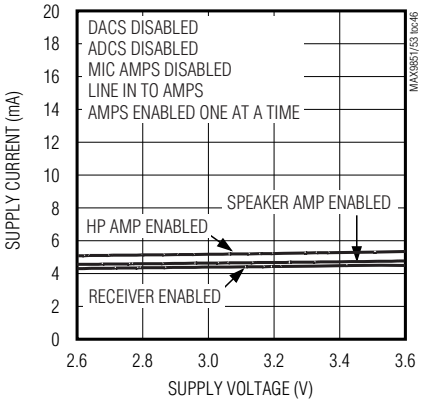
DV_{DD} AND DV_{DDS2} SUPPLY CURRENT vs. SUPPLY VOLTAGE



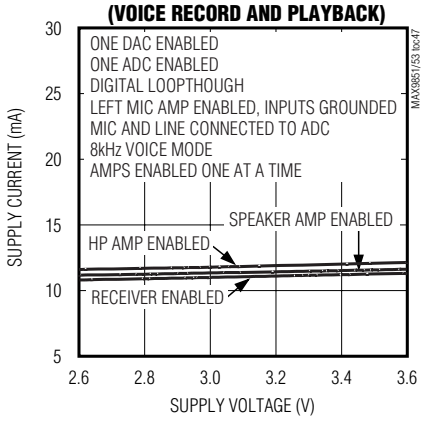
AV_{DD} SUPPLY CURRENT vs. SUPPLY VOLTAGE (STEREO PLAYBACK)



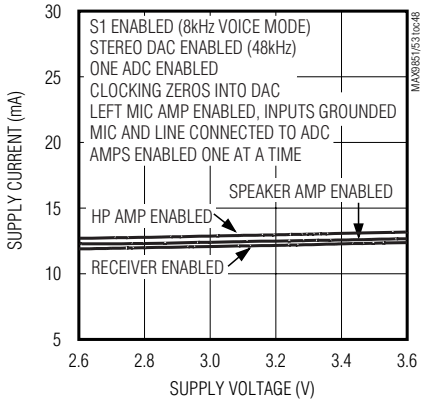
AV_{DD} SUPPLY CURRENT vs. SUPPLY VOLTAGE (ANALOG PATH)



AV_{DD} SUPPLY CURRENT vs. SUPPLY VOLTAGE (VOICE RECORD AND PLAYBACK)



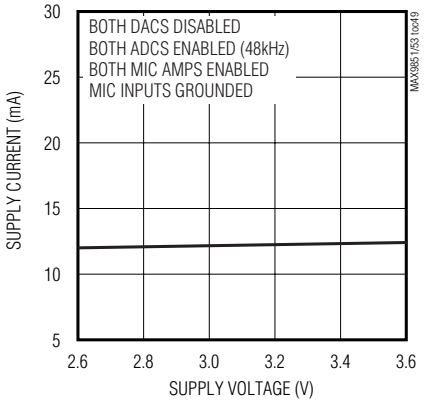
AV_{DD} SUPPLY CURRENT vs. SUPPLY VOLTAGE (DUAL DIGITAL PATH)



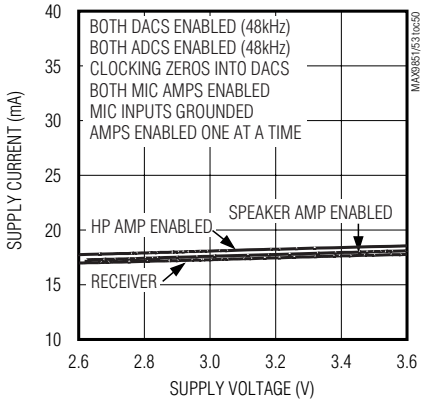
Typical Operating Characteristics (continued)

(AV_{DD} = CPV_{DD} = +3V, DV_{DD} = DV_{DDS2} = +1.8V, PV_{DD} = +3.3V, R_{HP} = 32Ω, Z_{SPK} = 8Ω + 10µH, R_{REC} = 32Ω, R_{OUTL+} to R_{OUTL-} = R_{OUTR+} to R_{OUTR-} = 10kΩ, C1 = 0.22µF, C2 = C_{VMREG} = C_{VPREG} = C_{MBIAS} = C_{REF} = 1µF, MCLK = 13MHz, all PGAs = 0dB, HP/REC volume = -20.0dB, SPK volume = -20.4dB, line output gain = -0.4dB, f_S = 48kHz for nonvoice mode, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.)

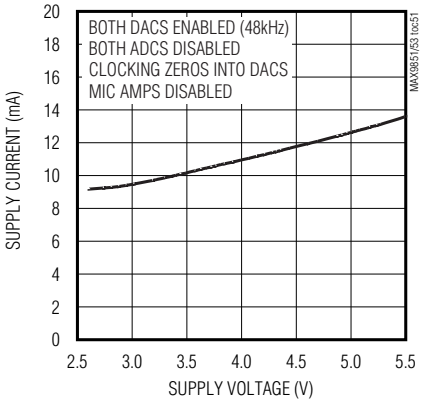
AV_{DD} SUPPLY CURRENT vs. SUPPLY VOLTAGE (STEREO RECORD)



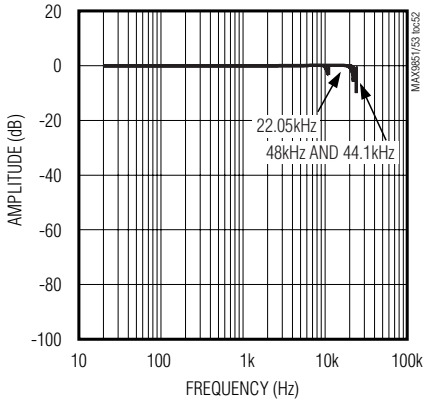
AV_{DD} SUPPLY CURRENT vs. SUPPLY VOLTAGE (STEREO RECORD AND PLAYBACK)



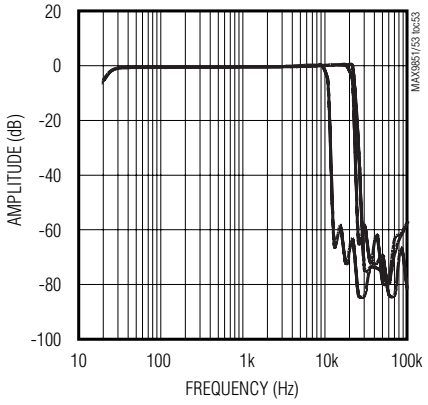
PV_{DD} SUPPLY CURRENT vs. SUPPLY VOLTAGE (DAC TO SPEAKER AMP)



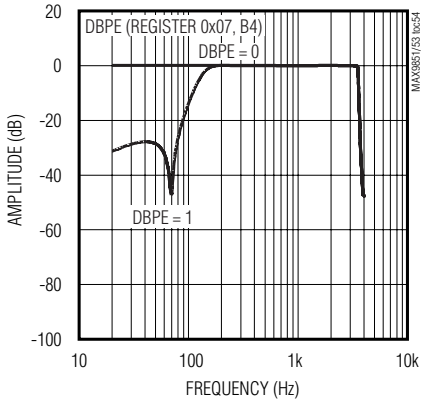
DAC FREQUENCY RESPONSE 48kHz, 44.1kHz, AND 22.05kHz



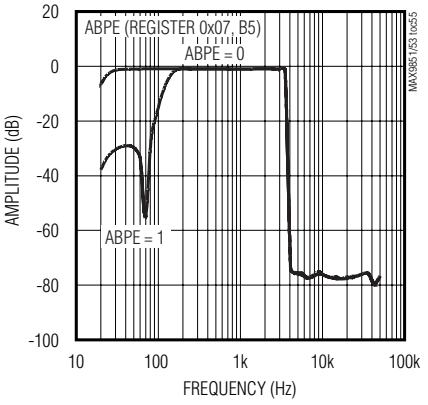
ADC FREQUENCY RESPONSE 48kHz, 44.1kHz, AND 22.05kHz



DAC FREQUENCY RESPONSE 8kHz VOICE MODE



ADC FREQUENCY RESPONSE 8kHz VOICE MODE



Pin Description

PIN		NAME	FUNCTION
MAX9851	MAX9853		
1	1	EXTMICBIASL	Left External Microphone Bias. Provides a 2.4V microphone bias for the external microphone's left channel through selectable 2.2kΩ or 470Ω output impedance resistor.
2	2	PREG	Internal Positive Regulator Output. Bypass to AGND with a 1µF capacitor.
3	—	PV_{DD}	Left Speaker Positive Power-Supply Input. Bypass to PGND with a 0.1µF capacitor.
4	—	LSPK+	Positive Left-Channel Class D Speaker Output
5	—	LSPK-	Negative Left-Channel Class D Speaker Output
6	—	PGND	Class D Speaker Amplifier Ground
7	—	RSPK-	Negative Right-Channel Class D Speaker Output
8	—	RSPK+	Positive Right-Channel Class D Speaker Output
9	—	PV_{DD}	Right Speaker Positive Power-Supply Input. Bypass to PGND with a 0.1µF capacitor.
—	3	OUTL+	Noninverted Differential Left-Channel Line-Level Output. OUTL+ is biased at 1.23V.
—	4	OUTL-	Inverted Differential Left-Channel Line-Level Output. OUTL- is biased at 1.23V.
—	5	SHDNOUT	Shutdown Output. Open-drain shutdown output used to control an external amplifier shutdown input through the MAX9851/MAX9853 I^2C interface. Connect a 10kΩ pullup resistor to DV_{DD} for full output swing.
—	6	FAULTIN	Fault Input. Logic input with internal 300kΩ pullup resistor. The state of FAULTIN is reported in status register 0x00 and can be used to trigger a hardware interrupt.
—	7	PV_{DD}	Headset Autodetect Positive Power-Supply Input. Connect to PV_{DD} battery voltage for proper headset detect operation during sleep mode (see the *Headset Detect* section). Connect to AV_{DD} if not used. Bypass to AGND with a 0.1µF capacitor.
—	8	OUTR-	Inverted Differential Right-Channel Line-Level Output. OUTR- is biased at 1.23V.
	9	OUTR+	Noninverted Differential Right-Channel Line-Level Output. OUTR+ is biased at 1.23V.
10	10	NREG	Internal Negative Regulator Output. Bypass to AGND with a 1µF capacitor.
11	11	REF	Reference Output. Bypass to AGND with a 1µF ceramic capacitor.
12	12	MBIAS	Internal Microphone Bias Regulator Output. Bypass to AGND with a 1µF capacitor.
13	13	LINEIN1	Line Input 1. AC-couple analog audio signal to LINEIN1.
14	14	LINEIN2	Line Input 2. AC-couple analog audio signal to LINEIN2.
15	15	AV_{DD}	Audio Power-Supply Input. Bypass to AGND with 0.1µF and 10µF capacitors.
16	16	HPL	Left-Channel Headphone Output (Stereo Mode)/Noninverting Headphone Output (Balanced Mono Mode). HPL is a DirectDrive output biased at AGND.
17	17	HPR	Right-Channel Headphone Output (Stereo Mode)/Noninverting Headphone Output (Balanced Mono Mode). HPR is a DirectDrive output biased at AGND.
18	18	SV_{SS}	Headphone and Receiver Amplifier Negative Supply Input. Connect to PV_{SS}.
19	19	REC	Handset Receiver Output. REC is a DirectDrive output biased at AGND.
20	20	PV_{SS}	Inverting Charge-Pump Output. Bypass to CPGND with a 1µF ceramic capacitor and connect to SV_{SS} to provide the headphone and receiver amplifiers with a negative supply.

Pin Description (continued)

PIN		NAME	FUNCTION
MAX9851	MAX9853		
21	21	C1N	Charge-Pump Flying Capacitor Negative Terminal. Connect a 0.22µF ceramic capacitor between C1N and C1P.
22	22	CPGND	Charge-Pump Ground
23	23	C1P	Charge-Pump Flying Capacitor Positive Terminal. Connect a 0.22µF ceramic capacitor between C1N and C1P.
24	24	CPV_{DD}	Charge-Pump Positive Power-Supply Input. Bypass to CPGND with a 1µF capacitor.
25	25	SCL	I^2C-Compatible Serial Clock Input. Connect a 10kΩ pullup resistor to DV_{DD} for full output swing.
26	26	SDA	I^2C-Compatible Serial Data Input/Output. Connect a 10kΩ pullup resistor to DV_{DD} for full output swing.
27	27	SDINS1	Primary Interface Digital Audio Serial Data DAC Input. Voiceband filtering available on this input.
28	28	SDOUTS1	Primary Interface Digital Audio Serial Data ADC Output. Voiceband filtering available on this output.
29	29	BCLKS1	Primary Interface Digital Audio Bit Clock Input/Output. BCLKS1 is an input when the MAX9851/MAX9853 is in slave mode and an output when in master mode.
30	30	LRCLKS1	Primary Interface Digital Audio Left-Right Clock Input/Output. LRCLKS1 is the audio sample rate clock and determines whether the audio data on SDINS1 is routed to the left or right channel. LRCLKS1 is an input when the MAX9851/MAX9853 is in slave mode and an output when in master mode.
31	31	DGND	Digital Ground
32	32	DV_{DD}	Digital Power-Supply Input. DV_{DD} provides power to the digital core, the I^2C interface and the primary digital audio interface. Bypass to DGND with a 1µF capacitor.
33	33	LRCLKS2	Secondary Interface Digital Audio Left-Right Clock Input/Output. LRCLKS2 is the audio sample rate clock and determines whether the audio data on SDINS2 is routed to the left or right channel. LRCLKS2 is an input when the MAX9851/MAX9853 is in slave mode and an output when in master mode.
34	34	BCLKS2	Secondary Interface Digital Audio Bit Clock Input/Output. BCLKS2 is an input when the MAX9851/MAX9853 is in slave mode and an output when in master mode.
35	35	SDOUTS2	Secondary Interface Digital Audio Serial Data ADC Output
36	36	SDINS2	Secondary Interface Digital Audio Serial Data DAC Input