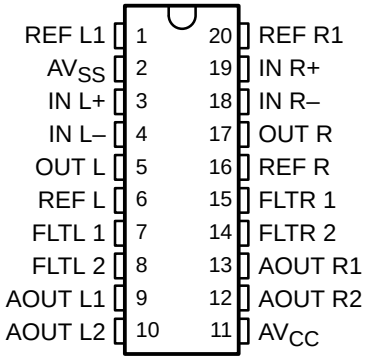
SLAS123B – MARCH 1995 – REVISED NOVEMBER 1995

- **Analog Front-End Integrated Circuit for the 18-Bit Stereo Audio Sigma-Delta Analog-to-Digital Converter TLC320AD58C**
- **Low Distortion, Low Noise**
  - **THD+N . . . 0.00056% Typ**
  - **SNR . . . 108-dB Typ**
- **Adjustable Signal Gain**
- **5-V Single Supply Operation**
- **Internal Voltage Reference**
- **Operating Temperature . . . 0°C to 70°C**

NS PACKAGE
(TOP VIEW)



AVAILABLE OPTIONS

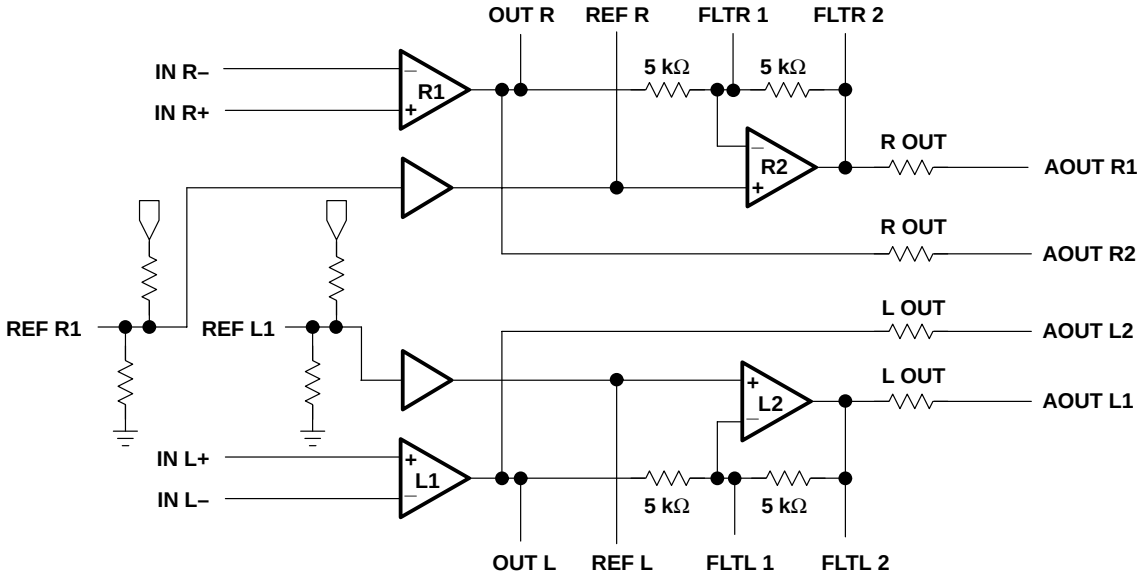
T_A	PACKAGE
	SMALL OUTLINE (NS)
0°C to 70°C	TL32088CNS

description

The TL32088 is an analog signal conditioning integrated circuit built using a proprietary Texas Instruments bipolar process. This device is used for the analog signal input stage for the 18-bit, stereo audio, sigma-delta, analog-to-digital converter (ADC) TLC320AD58C exclusively. The TL32088 can convert input signals from single-ended to differential and differential to single-ended. The TL32088 also implements a single-ended to single-ended and differential to differential amplifier buffer. The differential output can be connected to the TLC320AD58C directly. The TLC32088 is composed of high performance amplifiers that offer wide output swing with low distortion and low noise. The reference voltage for the internal amplifier circuit is provided from an internal voltage reference circuit.

The TL32088 provides a wide output swing while maintaining 0.00056% THD+N and 108-dB SNR and, therefore, is ideally suited for high-end audio systems.

functional block diagram



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absolute maximum rating over operating free-air temperature range (unless otherwise noted)†

Supply voltage, AV_{CC} (see Note 1) . . . . . 7 V
Differential input voltage, V_{ID} (see Note 2) . . . . . AV_{CC}
Input voltage range, V_I (any input) (see Notes 1 and 3) . . . . . –0.3 to AV_{CC}
Output voltage, V_O . . . . . –0.3 to AV_{CC}
Output current, I_O . . . . . 20 mA
Duration of short-circuit current at or below 25°C (output shorted to GND) . . . . . unlimited
Continuous total power dissipation, P_D ($T_A \le 25°C$) (see Note 4) . . . . . 625 mW
Operating free-air temperature range, T_A . . . . . 0°C to 70°C
Storage temperature range, T_{stg} . . . . . –65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds . . . . . 260°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 under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTES: 1. All voltage values, except differential voltage, are with respect to GND.
2. Differential voltage is at the noninverting input with respect to the inverting input.
3. All input voltage values must not exceed V_{CC}.
4. Derating factor above $T_A = 25°C$ is 10 mW/°C.

recommended operating conditions

	MIN	NOM	MAX	UNIT
Supply voltage, AV_{CC}	4.75	5	5.25	V
Input voltage range, V_I (see Note 5)	1.1		3.9	V
Operating free-air temperature, T_A	0		70	°C

NOTE 5: The output voltage is undetermined when the input voltage exceeds recommended input voltage range.

electrical characteristics over recommended operating free-air temperature range, V_{CC} = 5 V (unless otherwise noted)

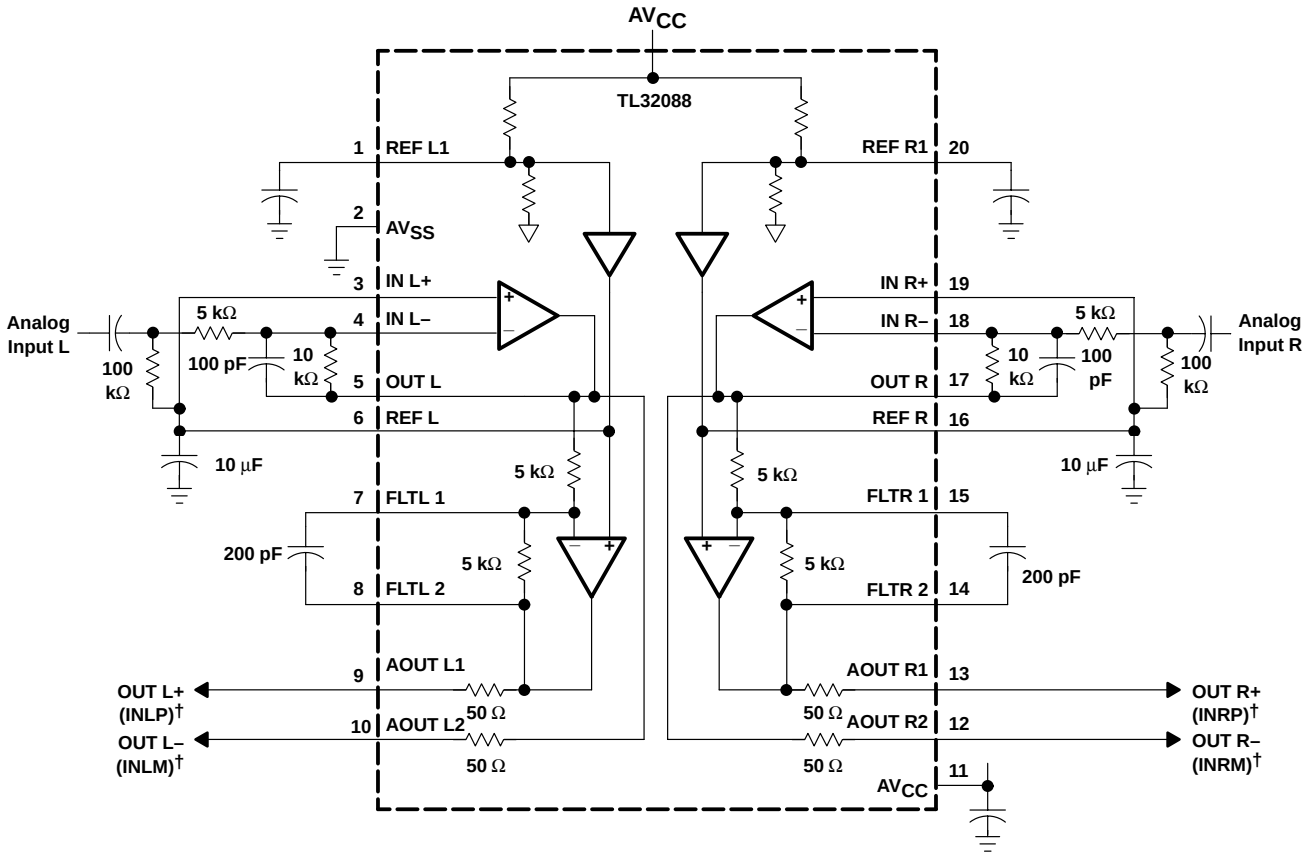
PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
V_{IO}	Input offset voltage	V_{IC} = 2.5 V, V_O = 2.5 V (AMP L1, R1)	T_A = 25°C		1	6	mV
			T_A = 0°C to 70°C			7.5	
I_{IO}	Input offset current	V_{IC} = 2.5 V, V_O = 2.5 V (AMP L1, R1)	T_A = 25°C		5	100	nA
			T_A = 0°C to 70°C			150	
I_{IB}	Input bias current	V_{IC} = 2.5 V, V_O = 2.5 V (AMP L1, R1)	T_A = 25°C		20	150	nA
			T_A = 0°C to 70°C			250	
V_{IC}	Common-mode input voltage	$V_O \le 7.5$ mV (AMP L1, R1)	T_A = 25°C	0.9		4.1	V
			T_A = 0°C to 70°C	1.1		3.9	
V_{OM+}	Maximum positive-peak output voltage			4.4			V
$V_{OM–}$	Maximum negative-peak output voltage					0.6	V
A_{vd}	Differential voltage amplification	V_O = 2.5 V ± 1 V (AMP L1, R1)	T_A = 25°C		60		dB
CMRR	Common-mode rejection ratio	V_O = 2.5 V ± 1 V (AMP L1, R1)	T_A = 25°C		85		dB
V_{ref}	Reference voltage			2.4	2.5	2.6	V
E_G	Gain error	See Note 6				±3%	
r_o	Output resistance		T_A = 25°C		50		Ω
I_{CC}	Supply current (both channels)	V_O = 2.5 V, No load	T_A = 25°C		17	20	mA
			T_A = 0°C to 70°C			25	

NOTE 6: Gain error is between OUT L and FLTL 1, OUT R and FLTR 1.

operating characteristics over recommended operating free-air temperature range, V_{CC} = 5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
SR	Slew rate	A_V = 1, V_I = 2.5 V + 0.5 V (AMP L1, R1)		3		V/μs
B_1	Unity-gain bandwidth	AMP L1, R1		7		MHz
SNR	Signal-to-noise ratio (EIAJ)	A-Weighted test circuit (see Figure 2)	104	108		dB
THD+N	Total harmonic distortion plus noise	$V_{O(PP)}$ = 3.2 V f = 1 kHz, BW = 10 Hz to 20 kHz test circuit		0.00056%	0.001%	
	Crosstalk	$V_{O(PP)}$ = 3.2 V, f = 20 kHz		–125		dB

APPLICATION INFORMATION



† TLC320AD58C input terminals.

Figure 1. TL32088 to TLC320AD58C Connections

APPLICATION INFORMATION

Table 1. A-Weighted Data

FREQUENCY	A WEIGHTING (dB)	FREQUENCY	A WEIGHTING (dB)
25	–44.6 ±2	800	–0.1 ±1
31.5	–39.2 ±2	1000	0 ±0
40	–34.5 ±2	1250	0.6 ±1
50	–30.2 ±2	1600	1.0 ±1
63	–26.1 ±2	2000	1.2 ±1
80	–22.3 ±2	2500	1.2 ±1
100	–19.1 ±1	3150	1.2 ±1
125	–16.1 ±1	4000	1.0 ±1
160	–13.2 ±1	5000	0.5 ±1
200	–10.8 ±1	6300	–0.1 ±1
250	–8.6 ±1	8000	–1.1 ±1
315	–6.5 ±1	10000	–2.4 ±1
400	–4.8 ±1	12500	–4.2 ±2
500	–3.2 ±1	16000	–6.5 ±2
630	–1.9 ±1	—	—

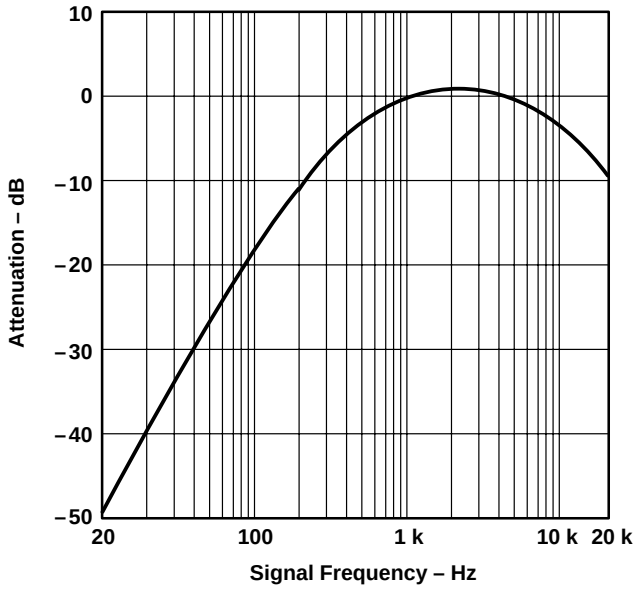


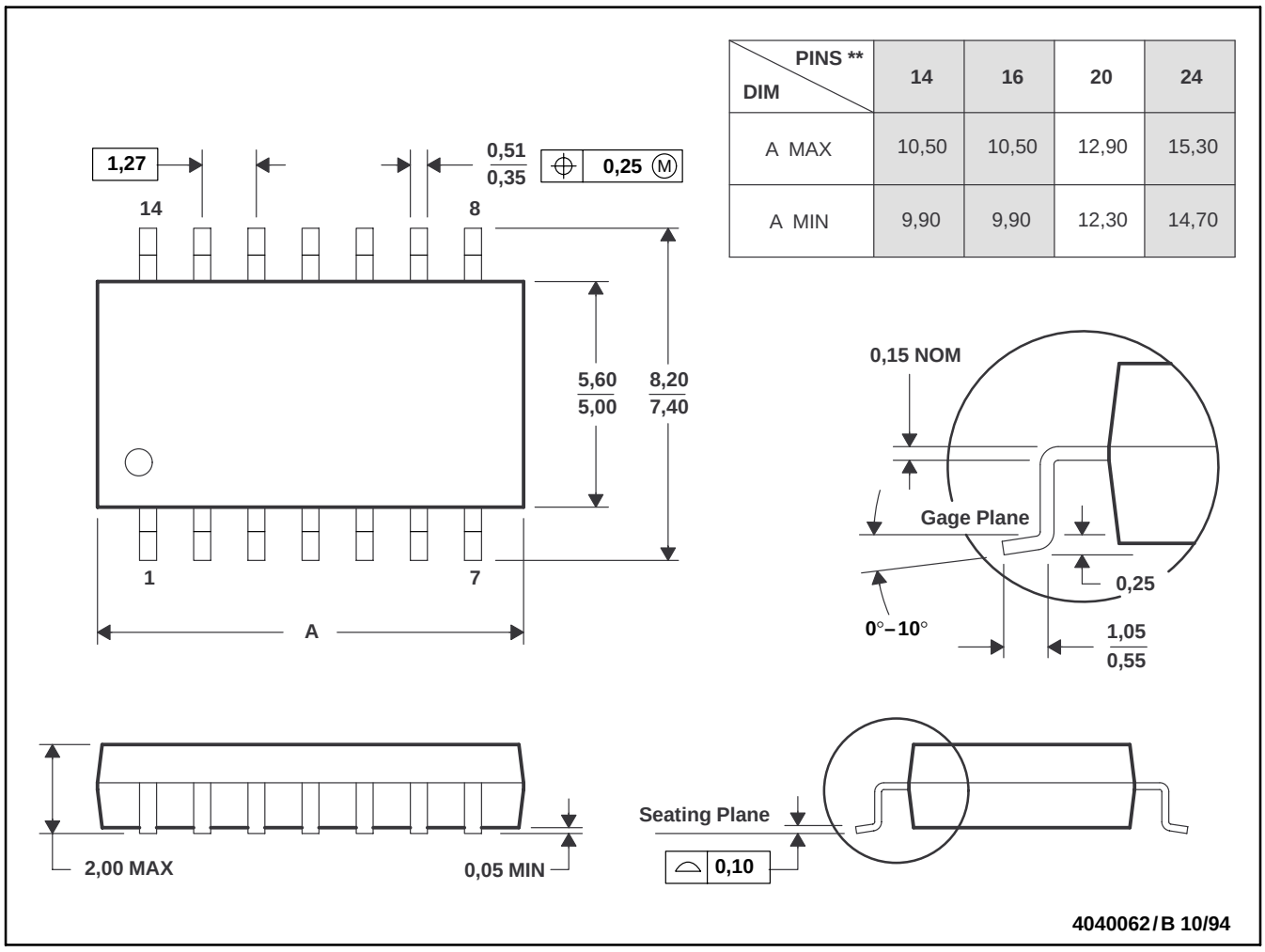
Figure 2. A-Weighted Function

MECHANICAL DATA

NS (R-PDSO-G)** **PLASTIC SMALL-OUTLINE PACKAGE**

14 PIN SHOWN

DIM \ PINS **	14	16	20	24
A MAX	10,50	10,50	12,90	15,30
A MIN	9,90	9,90	12,30	14,70



NOTES: A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

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