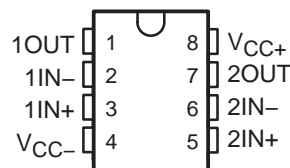


# NE5532, NE5532A, SA5532, SA5532A DUAL LOW-NOISE OPERATIONAL AMPLIFIERS

SLOS075H – NOVEMBER 1979 – REVISED MAY 2004

- **Equivalent Input Noise Voltage**  
5 nV/ $\sqrt{\text{Hz}}$  Typ at 1 kHz
- **Unity-Gain Bandwidth** . . . 10 MHz Typ
- **Common-Mode Rejection Ratio** . . . 100 dB Typ
- **High dc Voltage Gain** . . . 100 V/mV Typ
- **Peak-to-Peak Output Voltage Swing** 32 V  
Typ With  $V_{CC\pm} = \pm 18 \text{ V}$  and  $R_L = 600 \Omega$
- **High Slew Rate** . . . 9 V/ $\mu\text{s}$  Typ
- **Wide Supply-Voltage Range** . . .  $\pm 3 \text{ V}$  to  $\pm 20 \text{ V}$

NE5532, NE5532A . . . D, P, OR PS PACKAGE  
SA5532, SA5532A . . . D OR P PACKAGE  
(TOP VIEW)



## description/ordering information

The NE5532, NE5532A, SA5532, and SA5532A are high-performance operational amplifiers combining excellent dc and ac characteristics. They feature very low noise, high output-drive capability, high unity-gain and maximum-output-swing bandwidths, low distortion, high slew rate, input-protection diodes, and output short-circuit protection. These operational amplifiers are compensated internally for unity-gain operation. These devices have specified maximum limits for equivalent input noise voltage.

## ORDERING INFORMATION

$T_A$	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
0°C to 70°C	PDIP – P	Tube of 50	NE5532P	NE5532P
			NE5532AP	NE5532AP
	SOIC – D	Tube of 75	NE5532D	N5532
		Reel of 2500	NE5532DR	
		Tube of 75	NE5532AD	N5532A
		Reel of 2500	NE5532ADR	
	SOP – PS	Reel of 2000	NE5532PSR	N5532
			NE5532APSR	N5532A
–40°C to 85°C	PDIP – P	Tube of 50	SA5532P	SA5532P
			SA5532AP	SA5532AP
	SOIC – D	Tube of 75	SA5532D	SA5532
		Reel of 2500	SA5532DR	
		Tube of 75	SA5532AD	SA5532A
		Reel of 2500	SA5532ADR	

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at [www.ti.com/sc/package](http://www.ti.com/sc/package).



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INSTRUMENTS**

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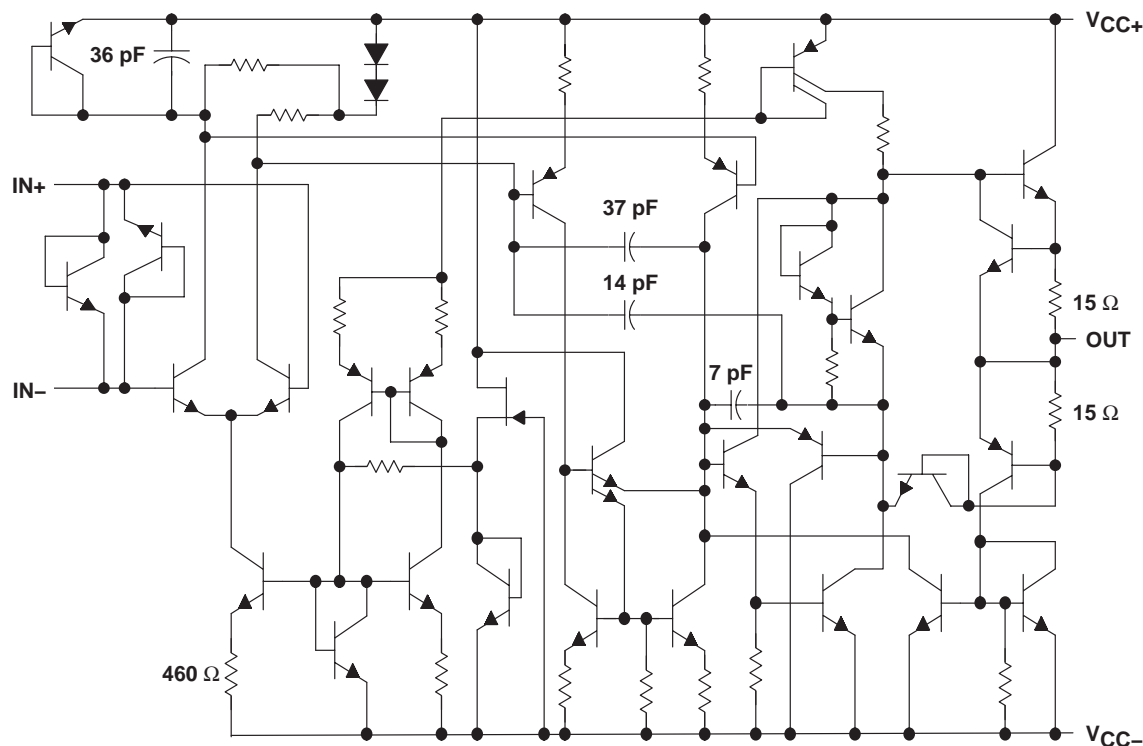
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# NE5532, NE5532A, SA5532, SA5532A

## DUAL LOW-NOISE OPERATIONAL AMPLIFIERS

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### schematic (each amplifier)



Component values shown are nominal.

### absolute maximum ratings over operating free-air temperature range (unless otherwise noted)<sup>†</sup>

Supply voltage (see Note 1): $V_{CC+}$	22 V
$V_{CC-}$	-22 V
Input voltage, either input (see Notes 1 and 2)	$V_{CC\pm}$
Input current (see Note 3)	$\pm 10$ mA
Duration of output short circuit (see Note 4)	Unlimited
Package thermal impedance, $\theta_{JA}$ (see Notes 5 and 6): D package	97°C/W
P package	85°C/W
PS package	95°C/W
Operating virtual junction temperature, $T_J$	150°C
Storage temperature range, $T_{stg}$	-65°C to 150°C

<sup>†</sup> 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 voltages, are with respect to the midpoint between  $V_{CC+}$  and  $V_{CC-}$ .

2. The magnitude of the input voltage must never exceed the magnitude of the supply voltage.

3. Excessive input current will flow if a differential input voltage in excess of approximately 0.6 V is applied between the inputs, unless some limiting resistance is used.

4. The output may be shorted to ground or either power supply. Temperature and/or supply voltages must be limited to ensure the maximum dissipation rating is not exceeded.

5. Maximum power dissipation is a function of  $T_J(\max)$ ,  $\theta_{JA}$ , and  $T_A$ . The maximum allowable power dissipation at any allowable ambient temperature is  $P_D = (T_J(\max) - T_A)/\theta_{JA}$ . Operating at the absolute maximum  $T_J$  of 150°C can affect reliability.

6. The package thermal impedance is calculated in accordance with JESD 51-7.

# NE5532, NE5532A, SA5532, SA5532A DUAL LOW-NOISE OPERATIONAL AMPLIFIERS

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## recommended operating conditions

		MIN	MAX	UNIT
V <sub>CC+</sub>	Supply voltage	5	15	V
V <sub>CC-</sub>	Supply voltage	-5	-15	V
T <sub>A</sub>	Operating free-air temperature range	NE5532, NE5532A	0	70
		SA5532, SA5532A	-40	85
				°C

## electrical characteristics, V<sub>CC±</sub> = +15 V, T<sub>A</sub> = 25°C (unless otherwise noted)

PARAMETER	TEST CONDITIONS†		NE5532, NE5532A SA5532, SA5532A			UNIT
			MIN	TYP	MAX	
V <sub>IO</sub>	Input offset voltage	V <sub>O</sub> = 0	T <sub>A</sub> = 25°C		0.5	4
			T <sub>A</sub> = Full range‡			5
I <sub>IO</sub>	Input offset current	T <sub>A</sub> = 25°C	10	150		nA
		T <sub>A</sub> = Full range‡		200		
I <sub>IB</sub>	Input bias current	T <sub>A</sub> = 25°C	200	800		nA
		T <sub>A</sub> = Full range‡		1000		
V <sub>ICR</sub>	Common-mode input-voltage range		±12	±13		V
V <sub>OPP</sub>	Maximum peak-to-peak output-voltage swing	R <sub>L</sub> ≥ 600 Ω	V <sub>CC±</sub> = ±15 V		24	26
			V <sub>CC±</sub> = ±18 V		30	32
A <sub>VD</sub>	Large-signal differential-voltage amplification	R <sub>L</sub> ≥ 600 Ω, V <sub>O</sub> = ±10 V	T <sub>A</sub> = 25°C		15	50
			T <sub>A</sub> = Full range‡		10	
		R <sub>L</sub> ≥ 2 kΩ, V <sub>O</sub> = ±10 V	T <sub>A</sub> = 25°C		25	100
			T <sub>A</sub> = Full range‡		15	
A <sub>vd</sub>	Small-signal differential-voltage amplification	f = 10 kHz		2.2		V/mV
B <sub>OM</sub>	Maximum-output-swing bandwidth	R <sub>L</sub> = 600 Ω	V <sub>O</sub> = ±10 V		140	
			V <sub>CC±</sub> = ±18 V, V <sub>O</sub> = ±14 V		100	
B <sub>1</sub>	Unity-gain bandwidth	R <sub>L</sub> = 600 Ω, C <sub>L</sub> = 100 pF		10		MHz
r <sub>i</sub>	Input resistance		30	300		kΩ
z <sub>O</sub>	Output impedance	A <sub>VD</sub> = 30 dB, R <sub>L</sub> = 600 Ω, f = 10 kHz		0.3		Ω
CMRR	Common-mode rejection ratio	V <sub>IC</sub> = V <sub>ICR</sub> min	70	100		dB
k <sub>SVR</sub>	Supply-voltage rejection ratio (ΔV <sub>CC±</sub> /ΔV <sub>IO</sub> )	V <sub>CC±</sub> = ±9 V to ±15 V, V <sub>O</sub> = 0	80	100		dB
I <sub>OS</sub>	Output short-circuit current		10	38	60	mA
I <sub>CC</sub>	Total supply current	V <sub>O</sub> = 0, No load		8	16	mA
	Crosstalk attenuation (V <sub>O1</sub> /V <sub>O2</sub> )	V <sub>O1</sub> = 10 V peak, f = 1 kHz		110		dB

† All characteristics are measured under open-loop conditions, with zero common-mode input voltage, unless otherwise specified.

‡ Full temperature ranges are: -40°C to 85°C for the SA5532 and SA5532A, and 0°C to 70°C for the NE5532 and NE5532A.



NE5532, NE5532A, SA5532, SA5532A  
DUAL LOW-NOISE OPERATIONAL AMPLIFIERS

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operating characteristics,  $V_{CC\pm} = \pm 15\text{ V}$ ,  $T_A = 25^\circ\text{C}$

PARAMETER		TEST CONDITIONS	NE5532, SA5532			NE5532A, SA5532A			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
SR	Slew rate at unity gain			9			9		V/ $\mu$ s
	Overshoot factor	$V_I = 100\text{ mV}$ , $R_L = 600\ \Omega$ , $A_{VD} = 1$ , $C_L = 100\text{ pF}$		10			10		%
$V_n$	Equivalent input noise voltage	$f = 30\text{ Hz}$		8			8	10	$\text{nV}/\sqrt{\text{Hz}}$
		$f = 1\text{ kHz}$		5			5	6	
$I_n$	Equivalent input noise current	$f = 30\text{ Hz}$		2.7			2.7		$\text{pA}/\sqrt{\text{Hz}}$
		$f = 1\text{ kHz}$		0.7			0.7		

**PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
NE5532AD	ACTIVE	SOIC	D	8	75	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR
NE5532ADR	ACTIVE	SOIC	D	8	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR
NE5532AIP	OBSOLETE	PDIP	P	8		None	Call TI	Call TI
NE5532AP	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
NE5532APSR	ACTIVE	SO	PS	8	2000	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
NE5532D	ACTIVE	SOIC	D	8	75	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR
NE5532DR	ACTIVE	SOIC	D	8	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR
NE5532IP	OBSOLETE	PDIP	P	8		None	Call TI	Call TI
NE5532P	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
NE5532PSR	ACTIVE	SO	PS	8	2000	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SA5532AD	ACTIVE	SOIC	D	8	75	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SA5532ADR	ACTIVE	SOIC	D	8	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SA5532AP	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
SA5532D	ACTIVE	SOIC	D	8	75	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SA5532DR	ACTIVE	SOIC	D	8	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SA5532P	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC

<sup>(1)</sup> The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

<sup>(2)</sup> Eco Plan - May not be currently available - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**None:** Not yet available Lead (Pb-Free).

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

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<sup>(3)</sup> MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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## P (R-PDIP-T8)

## PLASTIC DUAL-IN-LINE



NOTES: A. All linear dimensions are in inches (millimeters).  
 B. This drawing is subject to change without notice.  
 C. Falls within JEDEC MS-001

For the latest package information, go to [http://www.ti.com/sc/docs/package/pkg\\_info.htm](http://www.ti.com/sc/docs/package/pkg_info.htm)

## D (R-PDSO-G8)

## PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- All linear dimensions are in inches (millimeters).
  - This drawing is subject to change without notice.
  - Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
  - Falls within JEDEC MS-012 variation AA.



# MECHANICAL DATA

PS (R-PDSO-G8)

PLASTIC SMALL-OUTLINE PACKAGE



4040063/C 03/03

- 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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