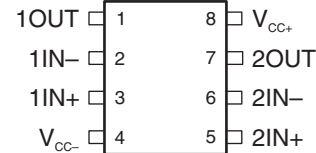


## DUAL LOW-NOISE OPERATIONAL AMPLIFIERS

### FEATURES

- **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** 26 V Typ  
With  $V_{CC\pm} = \pm 15$  V and  $R_L = 600 \Omega$
- **High Slew Rate:** 9 V/ $\mu\text{s}$  Typ

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<sup>(1)</sup>

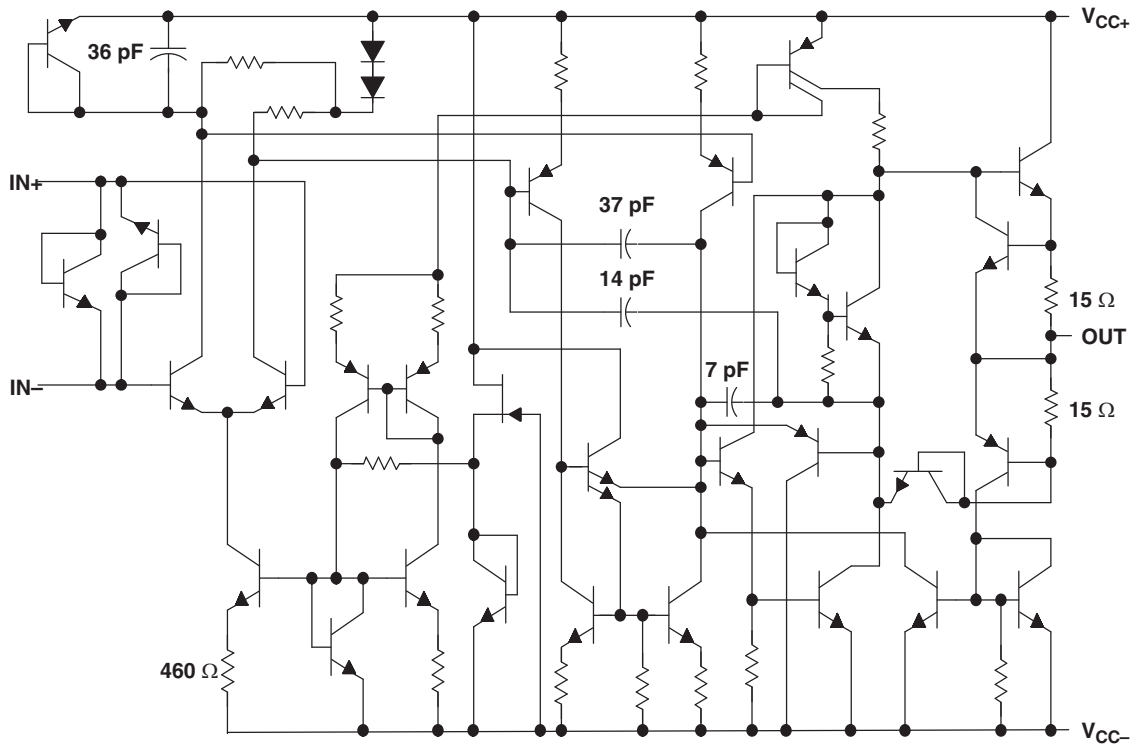
$T_A$	PACKAGE <sup>(2)</sup>		ORDERABLE PART NUMBER	TOP-SIDE MARKING
0°C to 70°C	PDIP – P	Tube of 50	NE5532P	NE5532P
			NE5532AP	NE5532AP
	SOIC – D	Tube of 75	NE5532D	N5532
			Reel of 2500	
		Reel of 2500	NE5532AD	N5532A
			NE5532ADR	
	SOP – PS	Reel of 2000	NE5532PSR	N5532
			NE5532APSR	N5532A
–40°C to 85°C	PDIP – P	Tube of 50	SA5532P	SA5532P
			SA5532AP	SA5532AP
	SOIC – D	Tube of 75	SA5532D	SA5532
			Reel of 2500	
		Reel of 2500	SA5532AD	SA5532A
			SA5532ADR	

- (1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at [www.ti.com](http://www.ti.com).
- (2) Package drawings, thermal data, and symbolization are available at [www.ti.com/packaging](http://www.ti.com/packaging).



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

**SCHEMATIC (EACH AMPLIFIER)**



Component values shown are nominal.

**ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>**

over operating free-air temperature range (unless otherwise noted)

V <sub>CC</sub>	Supply voltage <sup>(2)</sup>	V <sub>CC+</sub>	22 V
		V <sub>CC-</sub>	-22 V
Input voltage, either input <sup>(2)(3)</sup>		V <sub>CC±</sub>	
Input current <sup>(4)</sup>		±10 mA	
Duration of output short circuit <sup>(5)</sup>		Unlimited	
θ <sub>JA</sub>	Package thermal impedance <sup>(6)(7)</sup>	D package	97°C/W
		P package	85°C/W
		PS package	95°C/W
T <sub>J</sub>	Operating virtual-junction temperature	150°C	
T <sub>stg</sub>	Storage temperature range	-65°C to 150°C	

- (1) 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.
- (2) All voltage values, except differential voltages, are with respect to the midpoint between V<sub>CC+</sub> and V<sub>CC-</sub>.
- (3) The magnitude of the input voltage must never exceed the magnitude of the supply voltage.
- (4) 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.
- (5) 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.
- (6) The package thermal impedance is calculated in accordance with JESD 51-7.
- (7) Maximum power dissipation is a function of T<sub>J(max)</sub>, θ<sub>JA</sub>, and T<sub>A</sub>. The maximum allowable power dissipation at any allowable ambient temperature is P<sub>D</sub> = (T<sub>J(max)</sub> - T<sub>A</sub>)/θ<sub>JA</sub>. Operating at the absolute maximum T<sub>J</sub> of 150°C can affect reliability.

## RECOMMENDED OPERATING CONDITIONS

		MIN	MAX	UNIT
$V_{CC+}$	Supply voltage	5	15	V
$V_{CC-}$	Supply voltage	-5	-15	V
$T_A$	Operating free-air temperature	NE5532, NE5532A		°C
		SA5532, SA5532A		

## ELECTRICAL CHARACTERISTICS

 $V_{CC\pm} = \pm 15\text{ V}$ ,  $T_A = 25^\circ\text{C}$  (unless otherwise noted)

PARAMETER		TEST CONDITIONS <sup>(1)</sup>		MIN	TYP	MAX	UNIT
$V_{IO}$	Input offset voltage	$V_O = 0$	$T_A = 25^\circ\text{C}$		0.5	4	mV
			$T_A = \text{Full range}^{(2)}$			5	
$I_{IO}$	Input offset current	$T_A = 25^\circ\text{C}$			10	150	nA
		$T_A = \text{Full range}^{(2)}$				200	
$I_{IB}$	Input bias current	$T_A = 25^\circ\text{C}$			200	800	nA
		$T_A = \text{Full range}^{(2)}$				1000	
$V_{ICR}$	Common-mode input-voltage range			$\pm 12$	$\pm 13$		V
$V_{OPP}$	Maximum peak-to-peak output-voltage swing	$R_L \geq 600\ \Omega$ , $V_{CC\pm} = \pm 15\text{ V}$		24	26		V
$A_{VD}$	Large-signal differential-voltage amplification	$R_L \geq 600\ \Omega$ , $V_O = \pm 10\text{ V}$	$T_A = 25^\circ\text{C}$	15	50		V/mV
			$T_A = \text{Full range}^{(2)}$	10			
		$R_L \geq 2\text{ k}\Omega$ , $V_O = \pm 10\text{ V}$	$T_A = 25^\circ\text{C}$	25	100		
			$T_A = \text{Full range}^{(2)}$	15			
$A_{vd}$	Small-signal differential-voltage amplification	$f = 10\text{ kHz}$			2.2		V/mV
$B_{OM}$	Maximum output-swing bandwidth	$R_L = 600\ \Omega$ , $V_O = \pm 10\text{ V}$			140		kHz
$B_1$	Unity-gain bandwidth	$R_L = 600\ \Omega$ , $C_L = 100\text{ pF}$			10		MHz
$r_i$	Input resistance			30	300		k $\Omega$
$z_o$	Output impedance	$A_{VD} = 30\text{ dB}$ , $R_L = 600\ \Omega$ , $f = 10\text{ kHz}$			0.3		$\Omega$
CMRR	Common-mode rejection ratio	$V_{IC} = V_{ICR\text{ min}}$		70	100		dB
$k_{SVR}$	Supply-voltage rejection ratio ( $\Delta V_{CC\pm}/\Delta V_{IO}$ )	$V_{CC\pm} = \pm 9\text{ V to } \pm 15\text{ V}$ , $V_O = 0$		80	100		dB
$I_{OS}$	Output short-circuit current			10	38	60	mA
$I_{CC}$	Total supply current	$V_O = 0$ , No load			8	16	mA
	Crosstalk attenuation ( $V_{O1}/V_{O2}$ )	$V_{O1} = 10\text{ V peak}$ , $f = 1\text{ kHz}$			110		dB

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

(2) Full temperature ranges are:  $-40^\circ\text{C}$  to  $85^\circ\text{C}$  for the SA5532 and SA5532A, and  $0^\circ\text{C}$  to  $70^\circ\text{C}$  for the NE5532 and NE5532A.

**OPERATING CHARACTERISTICS**

$V_{CC\pm} = \pm 15\text{ V}$ ,  $T_A = 25^\circ\text{C}$  (unless otherwise noted)

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	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			pA/ $\sqrt{\text{Hz}}$
		$f = 1\text{ kHz}$	0.7			0.7			

**PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
NE5532AD	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	N5532A	<a href="#">Samples</a>
NE5532ADE4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	N5532A	<a href="#">Samples</a>
NE5532ADR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	N5532A	<a href="#">Samples</a>
NE5532ADRE4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	N5532A	<a href="#">Samples</a>
NE5532ADRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	N5532A	<a href="#">Samples</a>
NE5532AIP	OBSOLETE	PDIP	P	8		TBD	Call TI	Call TI	-40 to 85		
NE5532AP	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	0 to 70	NE5532AP	<a href="#">Samples</a>
NE5532APE4	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	0 to 70	NE5532AP	<a href="#">Samples</a>
NE5532APSR	ACTIVE	SO	PS	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	N5532A	<a href="#">Samples</a>
NE5532APSRE4	ACTIVE	SO	PS	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	N5532A	<a href="#">Samples</a>
NE5532D	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	N5532	<a href="#">Samples</a>
NE5532DG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	N5532	<a href="#">Samples</a>
NE5532DR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU   CU SN	Level-1-260C-UNLIM	0 to 70	N5532	<a href="#">Samples</a>
NE5532DRE4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	N5532	<a href="#">Samples</a>
NE5532DRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	N5532	<a href="#">Samples</a>
NE5532IP	OBSOLETE	PDIP	P	8		TBD	Call TI	Call TI	-40 to 85		
NE5532P	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	0 to 70	NE5532P	<a href="#">Samples</a>
NE5532PE4	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	0 to 70	NE5532P	<a href="#">Samples</a>

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
NE5532PSR	ACTIVE	SO	PS	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	N5532	<a href="#">Samples</a>
NE5532PSRE4	ACTIVE	SO	PS	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	N5532	<a href="#">Samples</a>
NE5532PSRG4	ACTIVE	SO	PS	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	N5532	<a href="#">Samples</a>
SA5532AD	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	SA5532A	<a href="#">Samples</a>
SA5532ADE4	ACTIVE	SOIC	D	8		TBD	Call TI	Call TI	-40 to 85		<a href="#">Samples</a>
SA5532ADG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	SA5532A	<a href="#">Samples</a>
SA5532ADR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	SA5532A	<a href="#">Samples</a>
SA5532ADRE4	ACTIVE	SOIC	D	8		TBD	Call TI	Call TI	-40 to 85		<a href="#">Samples</a>
SA5532ADRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	SA5532A	<a href="#">Samples</a>
SA5532AP	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	-40 to 85	SA5532AP	<a href="#">Samples</a>
SA5532APE4	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	-40 to 85	SA5532AP	<a href="#">Samples</a>
SA5532D	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	SA5532	<a href="#">Samples</a>
SA5532DE4	ACTIVE	SOIC	D	8		TBD	Call TI	Call TI	-40 to 85		<a href="#">Samples</a>
SA5532DG4	ACTIVE	SOIC	D	8		TBD	Call TI	Call TI	-40 to 85		<a href="#">Samples</a>
SA5532DR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	SA5532	<a href="#">Samples</a>
SA5532DRE4	ACTIVE	SOIC	D	8		TBD	Call TI	Call TI	-40 to 85		<a href="#">Samples</a>
SA5532DRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	SA5532	<a href="#">Samples</a>
SA5532P	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	-40 to 85	SA5532P	<a href="#">Samples</a>
SA5532PE4	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	-40 to 85	SA5532P	<a href="#">Samples</a>

(1) 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.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**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.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

**Important Information and Disclaimer:** The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

**TAPE AND REEL INFORMATION**

**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
NE5532ADR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
NE5532APSR	SO	PS	8	2000	330.0	16.4	8.2	6.6	2.5	12.0	16.0	Q1
NE5532DR	SOIC	D	8	2500	330.0	12.8	6.4	5.2	2.1	8.0	12.0	Q1
NE5532DR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
NE5532DRG4	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
NE5532PSR	SO	PS	8	2000	330.0	16.4	8.2	6.6	2.5	12.0	16.0	Q1
SA5532ADR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
SA5532DR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1



**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
NE5532ADR	SOIC	D	8	2500	340.5	338.1	20.6
NE5532APSR	SO	PS	8	2000	367.0	367.0	38.0
NE5532DR	SOIC	D	8	2500	364.0	364.0	27.0
NE5532DR	SOIC	D	8	2500	340.5	338.1	20.6
NE5532DRG4	SOIC	D	8	2500	340.5	338.1	20.6
NE5532PSR	SO	PS	8	2000	367.0	367.0	38.0
SA5532ADR	SOIC	D	8	2500	340.5	338.1	20.6
SA5532DR	SOIC	D	8	2500	340.5	338.1	20.6

P (R-PDIP-T8)

PLASTIC DUAL-IN-LINE PACKAGE



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

D (R-PDSO-G8)

PLASTIC SMALL OUTLINE



NOTES: A. All linear dimensions are in inches (millimeters).  
 B. This drawing is subject to change without notice.  
 C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.  
 D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.  
 E. Reference JEDEC MS-012 variation AA.

D (R-PDSO-G8)

PLASTIC SMALL OUTLINE



4211283-2/E 08/12

- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Publication IPC-7351 is recommended for alternate designs.
  - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
  - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

# MECHANICAL DATA

PS (R-PDSO-G8)

PLASTIC SMALL-OUTLINE PACKAGE



- 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.

## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

### Products

Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>
DLP® Products	<a href="http://www.dlp.com">www.dlp.com</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>
OMAP Applications Processors	<a href="http://www.ti.com/omap">www.ti.com/omap</a>
Wireless Connectivity	<a href="http://www.ti.com/wirelessconnectivity">www.ti.com/wirelessconnectivity</a>

### Applications

Automotive and Transportation	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
Communications and Telecom	<a href="http://www.ti.com/communications">www.ti.com/communications</a>
Computers and Peripherals	<a href="http://www.ti.com/computers">www.ti.com/computers</a>
Consumer Electronics	<a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>
Energy and Lighting	<a href="http://www.ti.com/energy">www.ti.com/energy</a>
Industrial	<a href="http://www.ti.com/industrial">www.ti.com/industrial</a>
Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
Space, Avionics and Defense	<a href="http://www.ti.com/space-avionics-defense">www.ti.com/space-avionics-defense</a>
Video and Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>

### TI E2E Community

[e2e.ti.com](http://e2e.ti.com)