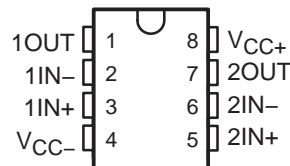


NE5532, NE5532A, SA5532, SA5532A DUAL LOW-NOISE OPERATIONAL AMPLIFIERS

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/ μs 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 Reel of 2500	NE5532D	N5532	
			NE5532DR		
			Tube of 75 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 Reel of 2500	SA5532D	SA5532	
			SA5532DR		
			Tube of 75 Reel of 2500	SA5532AD	SA5532A
				SA5532ADR	

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



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.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

 **TEXAS
INSTRUMENTS**

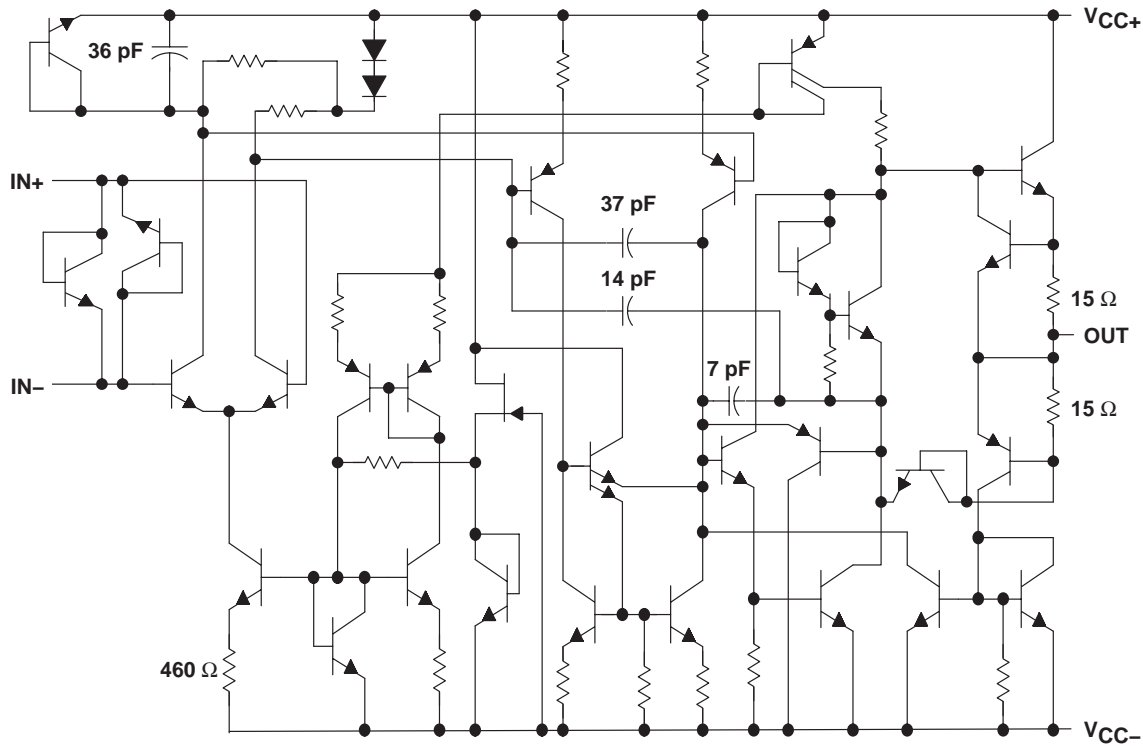
POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

Copyright © 2004, Texas Instruments Incorporated

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

SLOS075H – NOVEMBER 1979 – REVISED MAY 2004

schematic (each amplifier)



Component values shown are nominal.

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

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)	± 10 mA
Duration of output short circuit (see Note 4)	Unlimited
Package thermal impedance, θ_{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

† 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 $T_J(\max)$, θ_{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

SLOS075H – NOVEMBER 1979 – REVISED MAY 2004

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 range	NE5532, NE5532A	0	70	°C
		SA5532, SA5532A	-40	85	

electrical characteristics, V_{CC±} = +15 V, T_A = 25°C (unless otherwise noted)

PARAMETER	TEST CONDITIONS†		NE5532, NE5532A SA5532, SA5532A			UNIT	
			MIN	TYP	MAX		
V _{IO}	Input offset voltage	V _O = 0	T _A = 25°C		0.5	4	mV
			T _A = Full range‡		5		
I _{IO}	Input offset current	T _A = 25°C		10	150	nA	
		T _A = Full range‡		200			
I _{IB}	Input bias current	T _A = 25°C		200	800	nA	
		T _A = Full range‡		1000			
V _{ICR}	Common-mode input-voltage range			±12	±13	V	
V _{OPP}	Maximum peak-to-peak output-voltage swing	R _L ≥ 600 Ω	V _{CC±} = ±15 V		24	26	V
			V _{CC±} = ±18 V		30	32	
A _{VD}	Large-signal differential-voltage amplification	R _L ≥ 600 Ω, V _O = ±10 V	T _A = 25°C		15	50	V/mV
			T _A = Full range‡		10		
		R _L ≥ 2 kΩ, V _O = ±10 V	T _A = 25°C		25	100	
			T _A = Full range‡		15		
A _{vd}	Small-signal differential-voltage amplification	f = 10 kHz		2.2		V/mV	
B _{OM}	Maximum-output-swing bandwidth	R _L = 600 Ω	V _O = ±10 V		140		kHz
			V _{CC±} = ±18 V, V _O = ±14 V		100		
B ₁	Unity-gain bandwidth	R _L = 600 Ω,	C _L = 100 pF		10		MHz
r _i	Input resistance			30	300	kΩ	
z _o	Output impedance	A _{VD} = 30 dB, R _L = 600 Ω, f = 10 kHz		0.3		Ω	
CMRR	Common-mode rejection ratio	V _{IC} = V _{ICR} min		70	100	dB	
k _{SVR}	Supply-voltage rejection ratio (ΔV _{CC±} /ΔV _{IO})	V _{CC±} = ±9 V to ±15 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 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

SLOS075H – NOVEMBER 1979 – REVISED MAY 2004

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/ μ 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 Hz	8			8	10	nV/ $\sqrt{\text{Hz}}$	
		f = 1 kHz	5			5	6		
I_n	Equivalent input noise current	f = 30 Hz	2.7			2.7			pA/ $\sqrt{\text{Hz}}$
		f = 1 kHz	0.7			0.7			



PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
NE5532AD	ACTIVE	SOIC	D	8	75	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR
NE5532ADE4	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
NE5532ADRE4	ACTIVE	SOIC	D	8	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR
NE5532AIP	OBSOLETE	PDIP	P	8		TBD	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
NE5532APSRE4	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
NE5532DE4	ACTIVE	SOIC	D	8	75	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR
NE5532DG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1YEAR
NE5532DR	ACTIVE	SOIC	D	8	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR
NE5532DRE4	ACTIVE	SOIC	D	8	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR
NE5532DRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1YEAR
NE5532IP	OBSOLETE	PDIP	P	8		TBD	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
NE5532PSRE4	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
SA5532ADE4	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
SA5532ADRE4	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
SA5532DE4	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	CU NIPDAU	Level-2-260C-1 YEAR/

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
						(RoHS)		Level-1-235C-UNLIM
SA5532DRE4	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

⁽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) 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.

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.

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.

P (R-PDIP-T8)

PLASTIC DUAL-IN-LINE

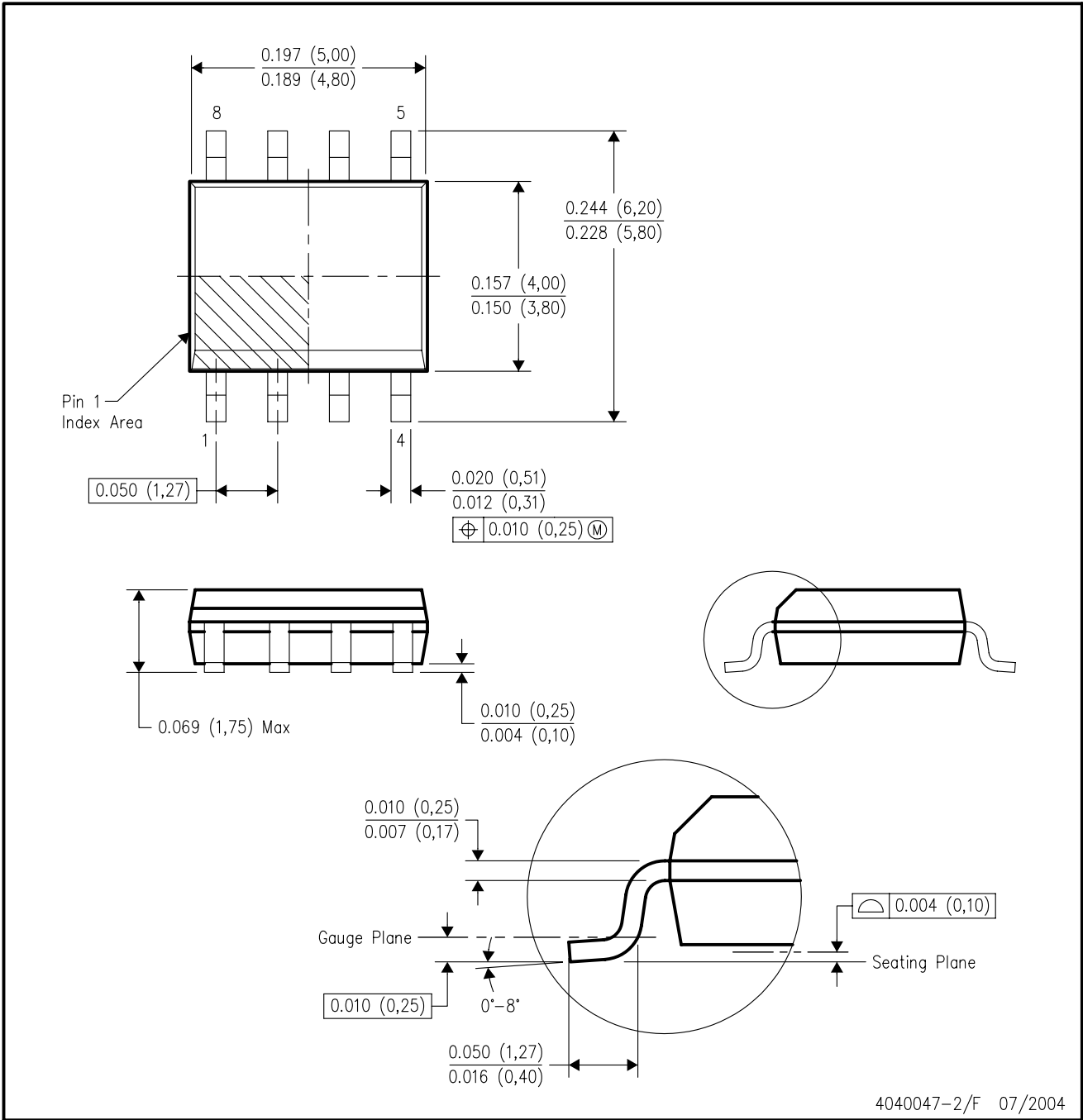


- NOTES: A. All linear dimensions are in inches (millimeters).
 B. This drawing is subject to change without notice.
 C. Falls within JEDEC MS-001

For the latest package information, go to http://www.ti.com/sc/docs/package/pkg_info.htm

D (R-PDSO-G8)

PLASTIC SMALL-OUTLINE PACKAGE

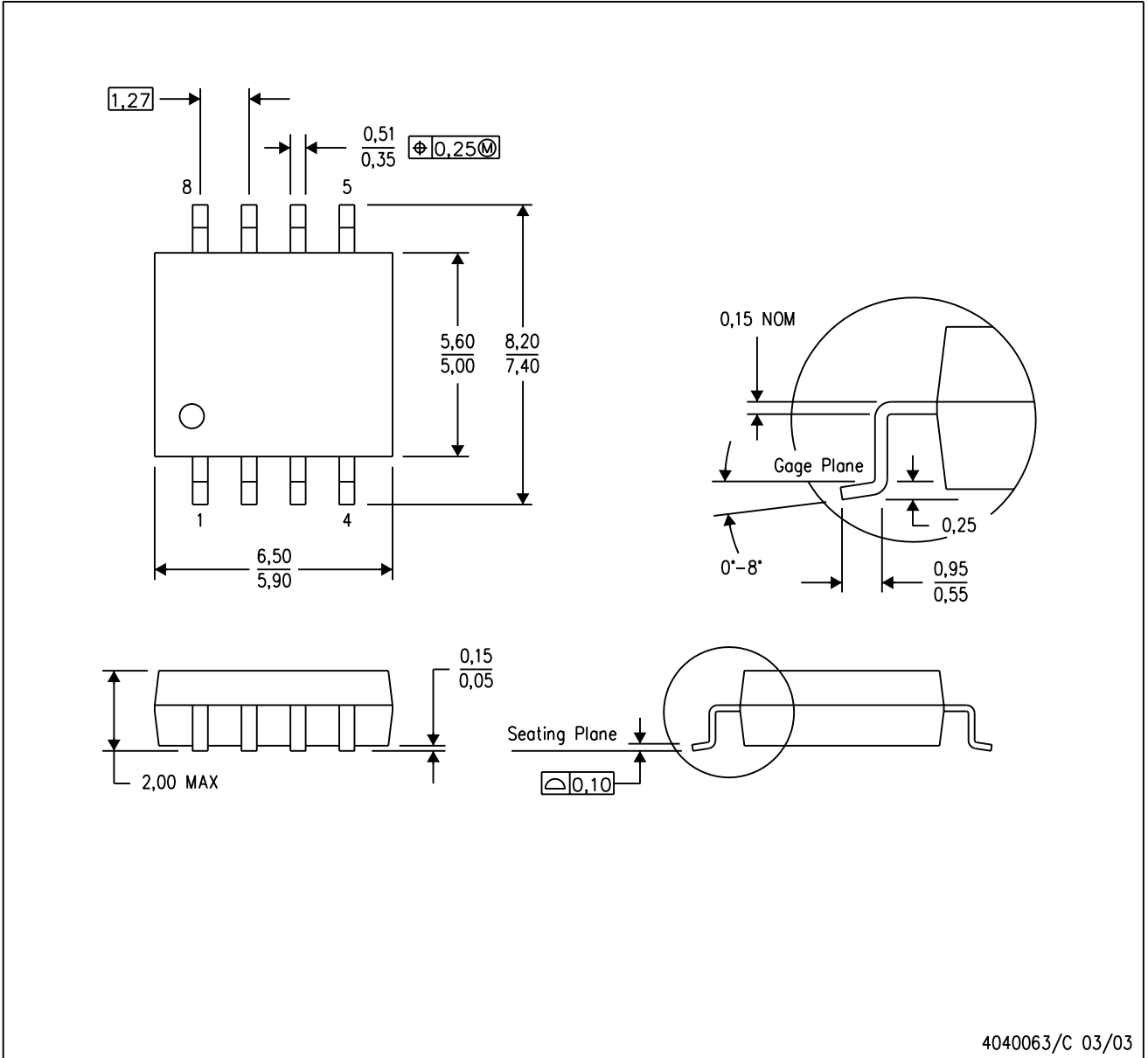


- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
 - D. Falls within JEDEC MS-012 variation AA.

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, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

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

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

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI 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 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. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

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

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products		Applications	
Amplifiers	amplifier.ti.com	Audio	www.ti.com/audio
Data Converters	dataconverter.ti.com	Automotive	www.ti.com/automotive
DSP	dsp.ti.com	Broadband	www.ti.com/broadband
Interface	interface.ti.com	Digital Control	www.ti.com/digitalcontrol
Logic	logic.ti.com	Military	www.ti.com/military
Power Mgmt	power.ti.com	Optical Networking	www.ti.com/opticalnetwork
Microcontrollers	microcontroller.ti.com	Security	www.ti.com/security
		Telephony	www.ti.com/telephony
		Video & Imaging	www.ti.com/video
		Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments
Post Office Box 655303 Dallas, Texas 75265