

3-MHz, Low-Power, Low-Noise, RRI/O, 1.8-V CMOS Operational Amplifier

Check for Samples: [OPA314](#), [OPA2314](#), [OPA4314](#)

FEATURES

- **Low I_Q :** 190 $\mu\text{A}/\text{ch}$ (max)
- **Wide Supply Range:** 1.8 V to 5.5 V
- **Low Noise:** 14 $\text{nV}/\sqrt{\text{Hz}}$ at 1 kHz
- **Gain Bandwidth:** 3 MHz
- **Low Input Bias Current:** 0.2 pA
- **Low Offset Voltage:** 0.5 mV
- **Unity-Gain Stable**
- **Internal RF/EMI Filter**
- **Extended Temperature Range:** -40°C to $+125^\circ\text{C}$

APPLICATIONS

- **Battery-Powered Instruments:**
 - Consumer, Industrial, Medical
 - Notebooks, Portable Media Players
- **Photodiode Amplifiers**
- **Active Filters**
- **Remote Sensing**
- **Wireless Metering**
- **Handheld Test Equipment**

DESCRIPTION

The OPA314 family of single, dual, and quad channel operational amplifiers represents a new generation of low-power, general-purpose CMOS amplifiers. Rail-to-rail input and output swings, low quiescent current (150 μA typ) combined with a wide bandwidth of 3 MHz, and very low noise (14 $\text{nV}/\sqrt{\text{Hz}}$ at 1 kHz) make this family very attractive for a variety of battery-powered applications that require a good balance between cost and performance. The low input bias current supports applications with mega-ohm source impedances.

The robust design of the OPA314 devices provides ease-of-use to the circuit designer: unity-gain stability with capacitive loads of up to 300 pF, an integrated RF/EMI rejection filter, no phase reversal in overdrive conditions, and high ESD protection (4-kV HBM).

These devices are optimized for low-voltage operation as low as +1.8 V (± 0.9 V) and up to +5.5 V (± 2.75 V), and are specified over the full extended temperature range of -40°C to $+125^\circ\text{C}$.

The OPA314 (single) is available in both SC70-5 and SOT23-5 packages. The OPA2314 (dual) is offered in SO-8, MSOP-8, and DFN-8 packages. The quad-channel OPA4314 is offered in a TSSOP-14 package.

PRODUCT PREVIEW



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.

All trademarks are the property of their respective owners.

PRODUCT PREVIEW information concerns products in the formative or design phase of development. Characteristic data and other specifications are design goals. Texas Instruments reserves the right to change or discontinue these products without notice.

Copyright © 2011 Texas Instruments Incorporated

www.BDTIC.com/TI



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

PACKAGE INFORMATION⁽¹⁾

PRODUCT	PACKAGE-LEAD	PACKAGE DESIGNATOR	PACKAGE MARKING
OPA314	SC70-5	DCK	TBD
	SOT23-5	DBV	TBD
OPA2314	SO-8	D	TBD
	MSOP-8	DGK	TBD
	DFN-8	DRB	TBD
OPA4314	TSSOP-14	PW	TBD

- (1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or visit the device product folder at www.ti.com.

ABSOLUTE MAXIMUM RATING⁽¹⁾

Over operating free-air temperature range, unless otherwise noted.

		OPA314, OPA2314, OPA4314	UNIT
Supply voltage		7	V
Signal input terminals	Voltage ⁽²⁾	(V ₋) – 0.5 to (V ₊) + 0.5	V
	Current ⁽²⁾	±10	mA
Output short-circuit ⁽³⁾		Continuous	mA
Operating temperature, T _A		–40 to +150	°C
Storage temperature, T _{stg}		–65 to +150	°C
Junction temperature, T _J		+150	°C
ESD rating	Human body model (HBM)	4000	V
	Charged device model (CDM)	1000	V
	Machine model (MM)	200	V

- (1) Stresses above these ratings may cause permanent damage. Exposure to absolute maximum conditions for extended periods may degrade device reliability. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those specified is not supported.
- (2) Input terminals are diode-clamped to the power-supply rails. Input signals that can swing more than 0.5 V beyond the supply rails should be current limited to 10 mA or less.
- (3) Short-circuit to ground, one amplifier per package.

ELECTRICAL CHARACTERISTICS: $V_S = +1.8\text{ V}$ to $+5.5\text{ V}$ ⁽¹⁾
Boldface limits apply over the specified temperature range: $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$.

At $T_A = +25^\circ\text{C}$, $R_L = 10\text{ k}\Omega$ connected to $V_S/2$, $V_{CM} = V_S/2$, and $V_{OUT} = V_S/2$, unless otherwise noted.

PARAMETERS		TEST CONDITIONS	OPA314, OPA2314, OPA4314			UNIT
			MIN	TYP	MAX	
OFFSET VOLTAGE						
V _{OS}	Input offset voltage	V _{CM} = (V _S +) – 1.3 V		0.5	2.5	mV
dV _{OS} /dT	vs Temperature			2		μV/°C
PSRR	vs Power supply	V _{CM} = (V _S +) – 1.3 V	80	100		dB
	Over temperature		74	96		dB
	Channel separation, dc	At dc		10		μV/V
INPUT VOLTAGE RANGE						
V _{CM}	Common-mode voltage range		(V–) – 0.2	(V+) + 0.2		V
CMRR	Common-mode rejection ratio	V _S = 1.8 V to 5.5 V, (V _S –) – 0.2 V < V _{CM} < (V _S +) – 1.3 V	75	96		dB
		V _S = 5.5 V, V _{CM} = –0.2 V to 5.7 V ⁽²⁾	60			dB
	Over temperature	V _S = 1.8 V, (V _S –) – 0.2 V < V _{CM} < (V _S +) – 1.3 V	70	86		dB
		V _S = 5.5 V, (V _S –) – 0.2 V < V _{CM} < (V _S +) – 1.3 V	74	90		dB
		V _S = 5.5 V, V _{CM} = –0.2 V to 5.7 V ⁽²⁾	54	60		dB
INPUT BIAS CURRENT						
I _B	Input bias current			±0.2	±10	pA
	Over temperature	T _A = –40°C to +85°C			±50	pA
		T _A = –40°C to +125°C			±500	pA
I _{OS}	Input offset current			±0.2	±10	pA
	Over temperature	T _A = –40°C to +85°C			±50	pA
		T _A = –40°C to +125°C			±500	pA
NOISE						
	Input voltage noise (peak-to-peak)	f = 0.1 Hz to 10 Hz		5		μV _{PP}
e _n	Input voltage noise density	f = 10 kHz		13		nV/√Hz
		f = 1 kHz		14		nV/√Hz
i _n	Input current noise density	f = 1 kHz		5		fA/√Hz
INPUT CAPACITANCE						
C _{IN}	Differential	V _S = 5.0 V		1		pF
	Common-mode	V _S = 5.0 V		5		pF
OPEN-LOOP GAIN						
A _{OL}	Open-Loop Voltage Gain	V _S = 1.8 V, 0.2 V < V _O < (V+) – 0.2 V, R _L = 10 kΩ	90	110		dB
		V _S = 5.5 V, 0.2 V < V _O < (V+) – 0.2 V, R _L = 10 kΩ	100	120		dB
		V _S = 1.8 V, 0.5 V < V _O < (V+) – 0.5 V, R _L = 2 kΩ ⁽²⁾	84	100		dB
		V _S = 5.5 V, 0.5 V < V _O < (V+) – 0.5 V, R _L = 2 kΩ ⁽²⁾	94	110		dB
	Over temperature	V _S = 5.5 V, 0.2 V < V _O < (V+) – 0.2 V, R _L = 10 kΩ	90	110		dB
		V _S = 5.5 V, 0.5 V < V _O < (V+) – 0.2 V, R _L = 2 kΩ		100		dB
	Phase margin	V _S = 5.0 V, G = +1, R _L = 10 kΩ		65		deg

- (1) Parameters with MIN and/or MAX specification limits are 100% production tested at $+25^\circ\text{C}$, unless otherwise noted. Over temperature limits are based on characterization and statistical analysis.
- (2) Specified by design and/or characterization; not production tested.

ELECTRICAL CHARACTERISTICS: $V_S = +1.8\text{ V}$ to $+5.5\text{ V}^{(1)}$ (continued)**Boldface** limits apply over the specified temperature range: $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$.At $T_A = +25^\circ\text{C}$, $R_L = 10\text{ k}\Omega$ connected to $V_S/2$, $V_{CM} = V_S/2$, and $V_{OUT} = V_S/2$, unless otherwise noted.

PARAMETERS		TEST CONDITIONS	OPA314, OPA2314, OPA4314			UNIT	
			MIN	TYP	MAX		
FREQUENCY RESPONSE							
GBW	Gain-bandwidth product	V _S = 1.8 V, R _L = 10 kΩ, C _L = 10 pF	2.7			MHz	
		V _S = 5.0 V, R _L = 10 kΩ, C _L = 10 pF	3			MHz	
SR	Slew rate ⁽³⁾	V _S = 5.0 V, G = +1	1.5			V/μs	
t _S	Settling time	To 0.1%, V _S = 5.0 V, 2-V step , G = +1	2.3			μs	
		To 0.01%, V _S = 5.0V, 2-V step , G = +1	3.1			μs	
	Overload recovery time	V _S = 5.0 V, V _{IN} × Gain > V _S	5.2			μs	
THD+N	Total harmonic distortion + noise ⁽⁴⁾	V _S = 5.0 V, V _O = 1 V _{RMS} , G = +1, f = 1 kHz, R _L = 10 kΩ	0.001			%	
OUTPUT							
V _O	Voltage output swing from supply rails	V _S = 1.8 V, R _L = 10 kΩ	5		15	mV	
		V _S = 5.5 V, R _L = 10 kΩ	5		20	mV	
		V _S = 1.8 V, R _L = 2 kΩ	25		50	mV	
		V _S = 5.5 V, R _L = 2 kΩ	40		60	mV	
Over temperature		R _L = 10 kΩ				30	mV
		R _L = 2 kΩ	60			mV	
I _{sc}	Short-circuit current	V _S = 5.0 V	±20			mA	
R _O	Open-loop output impedance		600			Ω	
POWER SUPPLY							
V _S	Specified voltage range		1.8		5.5	V	
I _Q	Quiescent current per amplifier	V _S = 1.8 V, I _O = 0 mA	130		180	μA	
		V _S = 5.0 V, I _O = 0 mA	150		190	μA	
Over temperature		V _S = 5.0 V, I _O = 0 mA			220	μA	
	Power-on time	V _S = 0 V to 5 V, to 90% I _Q level	44			μs	
TEMPERATURE							
	Specified range		−40		+125	°C	
	Operating range		−40		+150	°C	
	Storage range		−65		+150	°C	

(3) Signifies the slower value of the positive or negative slew rate.

(4) Third-order filter; bandwidth = 80 kHz at -3 dB.

THERMAL INFORMATION: OPA314

THERMAL METRIC ⁽¹⁾		OPA314		UNITS
		DBV (SOT23)	DCK (SC70)	
		5 PINS	5 PINS	
θ_{JA}	Junction-to-ambient thermal resistance	228.5	281.4	°C/W
$\theta_{JC(top)}$	Junction-to-case(top) thermal resistance	99.1	91.6	
θ_{JB}	Junction-to-board thermal resistance	54.6	59.6	
Ψ_{JT}	Junction-to-top characterization parameter	7.7	1.5	
Ψ_{JB}	Junction-to-board characterization parameter	53.8	58.8	
$\theta_{JC(bottom)}$	Junction-to-case(bottom) thermal resistance	N/A	N/A	

(1) For more information about traditional and new thermal metrics, see the *IC Package Thermal Metrics* application report, [SPRA953](#).

THERMAL INFORMATION: OPA2314

THERMAL METRIC ⁽¹⁾		OPA2314			UNITS
		D (SO)	DGK (MSOP)	DRB (DFN)	
		8 PINS	8 PINS	8 PINS	
θ_{JA}	Junction-to-ambient thermal resistance	138.4	191.2	53.8	°C/W
$\theta_{JC(top)}$	Junction-to-case(top) thermal resistance	89.5	61.9	69.2	
θ_{JB}	Junction-to-board thermal resistance	78.6	111.9	20.1	
Ψ_{JT}	Junction-to-top characterization parameter	29.9	5.1	3.8	
Ψ_{JB}	Junction-to-board characterization parameter	78.1	110.2	20.0	
$\theta_{JC(bottom)}$	Junction-to-case(bottom) thermal resistance	N/A	N/A	11.6	

(1) For more information about traditional and new thermal metrics, see the *IC Package Thermal Metrics* application report, [SPRA953](#).

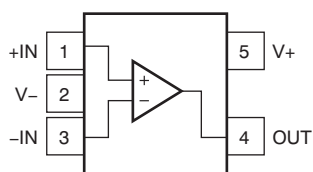
THERMAL INFORMATION: OPA4314

THERMAL METRIC ⁽¹⁾		OPA4314	UNITS
		PW (TSSOP)	
		14 PINS	
θ_{JA}	Junction-to-ambient thermal resistance	121.0	°C/W
$\theta_{JC(top)}$	Junction-to-case(top) thermal resistance	49.4	
θ_{JB}	Junction-to-board thermal resistance	62.8	
Ψ_{JT}	Junction-to-top characterization parameter	5.9	
Ψ_{JB}	Junction-to-board characterization parameter	62.2	
$\theta_{JC(bottom)}$	Junction-to-case(bottom) thermal resistance	N/A	

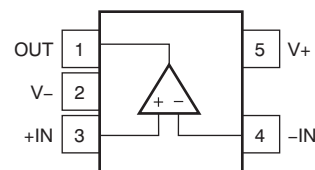
(1) For more information about traditional and new thermal metrics, see the *IC Package Thermal Metrics* application report, [SPRA953](#).

PIN CONFIGURATIONS

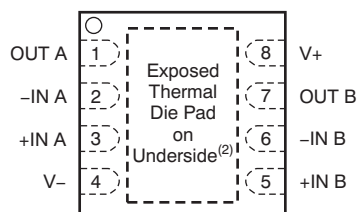
DCK PACKAGE
SC70-5
(TOP VIEW)



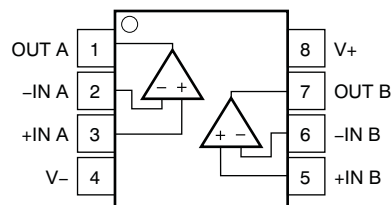
DBV PACKAGE
SOT23-5
(TOP VIEW)



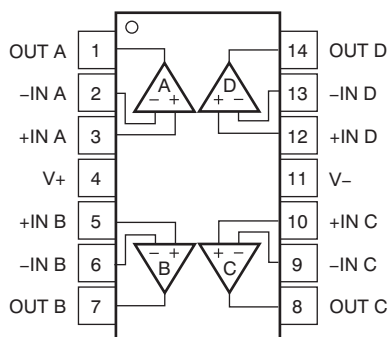
DRB PACKAGE⁽¹⁾
DFN-8
(TOP VIEW)



D, DGK PACKAGES
SO-8, MSOP-8
(TOP VIEW)



PW PACKAGE
TSSOP-14
(TOP VIEW)



(1) Pitch: 0,65mm.

(2) Connect thermal pad to V-. Pad size: 1,8mm × 1,5mm.

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/ Ball Finish	MSL Peak Temp ⁽³⁾	Samples (Requires Login)
OPA2314AID	PREVIEW	SOIC	D	8		TBD	Call TI	Call TI	
OPA2314AIDGKR	PREVIEW	MSOP	DGK	8		TBD	Call TI	Call TI	
OPA2314AIDGKT	PREVIEW	MSOP	DGK	8		TBD	Call TI	Call TI	
OPA2314AIDR	PREVIEW	SOIC	D	8		TBD	Call TI	Call TI	
OPA2314AIDRBR	PREVIEW	SON	DRB	8		TBD	Call TI	Call TI	
OPA2314AIDRBT	PREVIEW	SON	DRB	8		TBD	Call TI	Call TI	

⁽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)

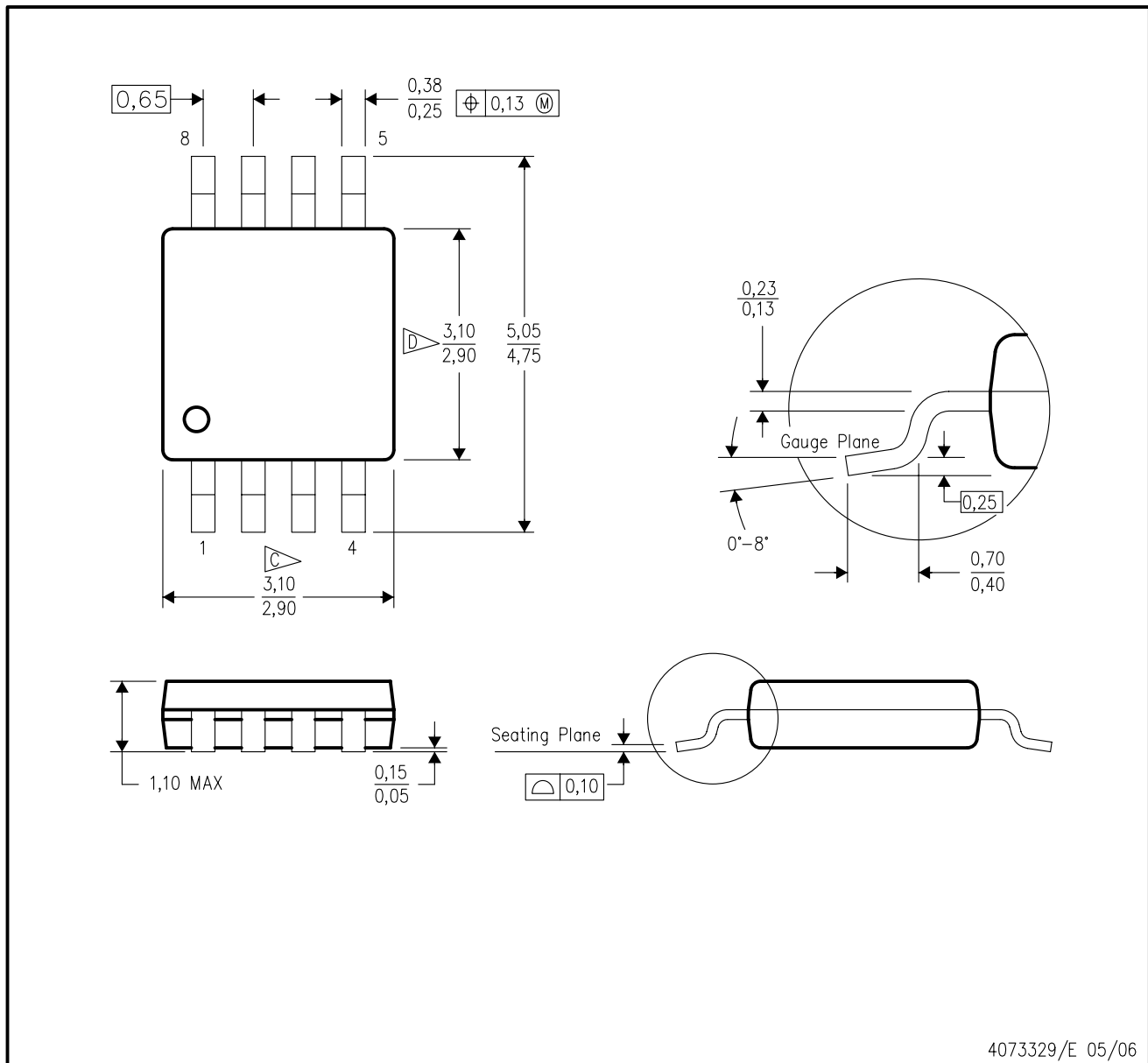
⁽³⁾ MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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.

DGK (S-PDSO-G8)

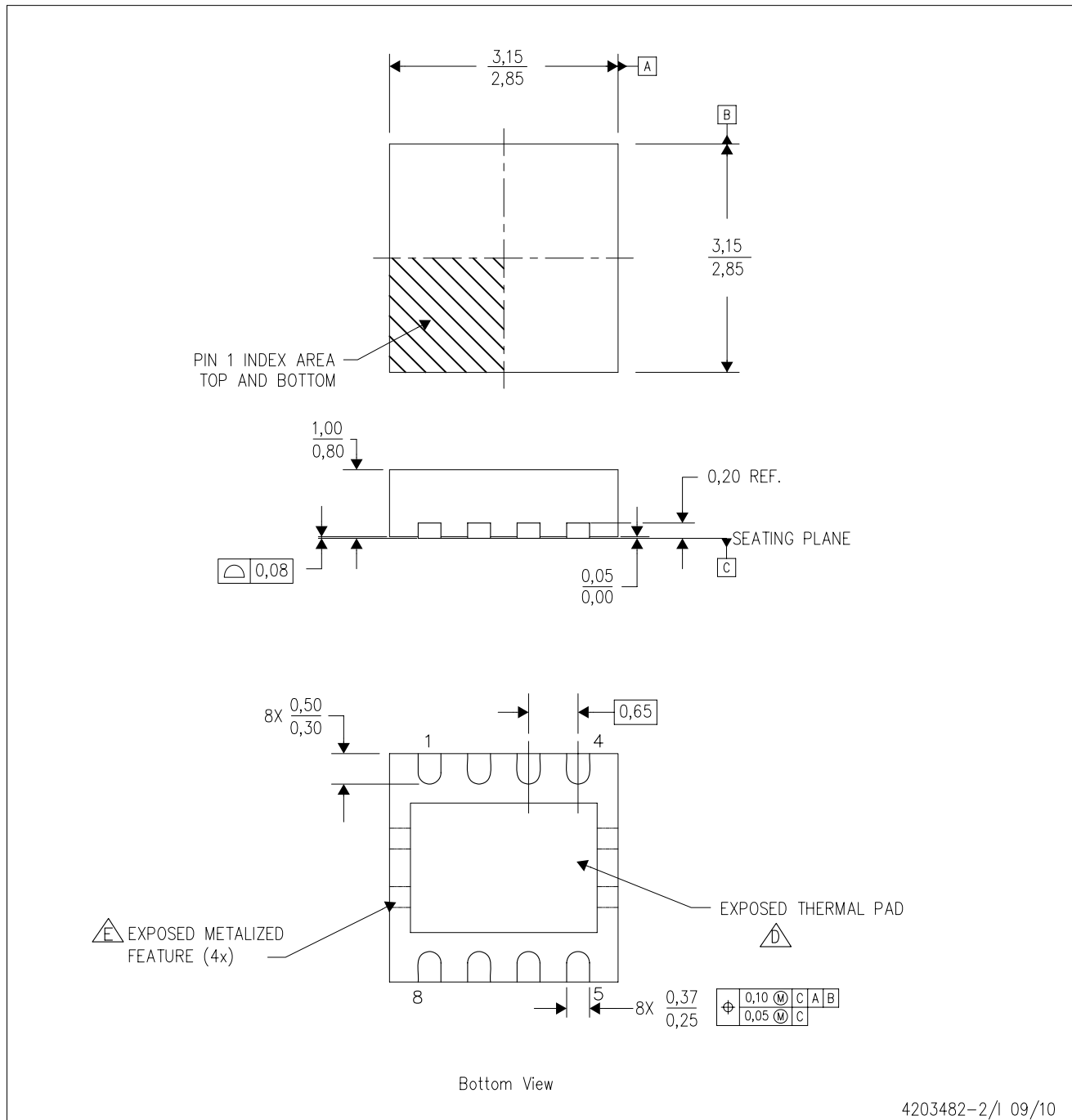
PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 per end.
 - D. Body width does not include interlead flash. Interlead flash shall not exceed 0.50 per side.
 - E. Falls within JEDEC MO-187 variation AA, except interlead flash.

DRB (S-PVSON-N8)

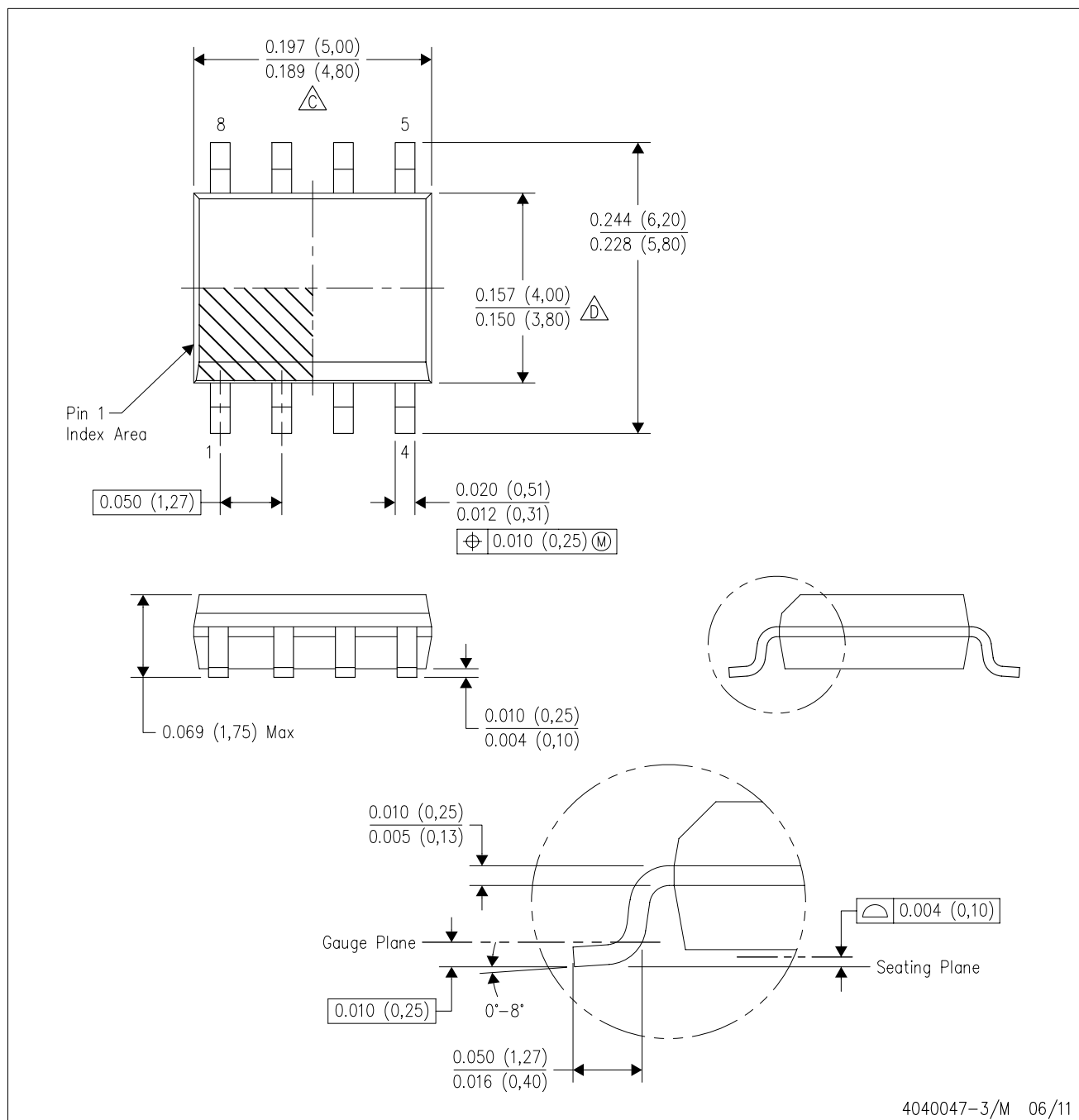
PLASTIC SMALL OUTLINE NO-LEAD



- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
 - B. This drawing is subject to change without notice.
 - C. Small Outline No-Lead (SON) package configuration.
 - The package thermal pad must be soldered to the board for thermal and mechanical performance.
 - See the Product Data Sheet for details regarding the exposed thermal pad features and dimensions.

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.
 - $\triangle C$ 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.
 - $\triangle D$ 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.

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 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. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

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.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

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

Products

Audio	www.ti.com/audio
Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
RF/IF and ZigBee® Solutions	www.ti.com/lprf

Applications

Communications and Telecom	www.ti.com/communications
Computers and Peripherals	www.ti.com/computers
Consumer Electronics	www.ti.com/consumer-apps
Energy and Lighting	www.ti.com/energy
Industrial	www.ti.com/industrial
Medical	www.ti.com/medical
Security	www.ti.com/security
Space, Avionics and Defense	www.ti.com/space-avionics-defense
Transportation and Automotive	www.ti.com/automotive
Video and Imaging	www.ti.com/video
Wireless	www.ti.com/wireless-apps

TI E2E Community Home Page

e2e.ti.com

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2011, Texas Instruments Incorporated

www.BDTIC.com/TI