



1.1nV/√Hz Noise, Low Power, Precision Operational Amplifier in Tiny DFN-8 Package

FEATURES

- **LOW-VOLTAGE NOISE: 1.1nV/√Hz at 1kHz**
- **100nV_{pp} INPUT VOLTAGE NOISE, 0.1Hz–10Hz**
- **LOW OFFSET VOLTAGE: 100μV (max)**
- **LOW OFFSET VOLTAGE DRIFT: 0.2μV/°C (typ)**
- **LOW SUPPLY CURRENT: 3.6mA/Ch**
- **UNITY GAIN STABLE**
- **GAIN BANDWIDTH PRODUCT: 80MHz (G = 100)**
- **SLEW RATE: 27V/μs**
- **WIDE SUPPLY RANGE: ±2.25V to ±18V, +4.5V to +36V**
- **RAIL-TO-RAIL OUTPUT**
- **OUTPUT CURRENT: 30mA**
- **SHUTDOWN: 20μA (max)**
- **AVAILABLE IN TINY DFN-8 (3x3mm), MSOP-8, SO-8**

APPLICATIONS

- **PLL LOOP FILTER**
- **LOW-NOISE, LOW-POWER SIGNAL PROCESSING**
- **HIGH-PERFORMANCE ADC DRIVERS**
- **HIGH-PERFORMANCE DAC OUTPUT AMPLIFIER**
- **ACTIVE FILTERS**
- **LOW-NOISE INSTRUMENTATION AMPS**
- **ULTRASOUND AMPLIFIERS**
- **PROFESSIONAL AUDIO PREAMPLIFIERS**
- **LOW-NOISE FREQUENCY SYNTHESIZERS**
- **INFRARED DETECTOR AMPLIFIERS**
- **HYDROPHONE AMPLIFIERS**
- **MEDICAL**

DESCRIPTION

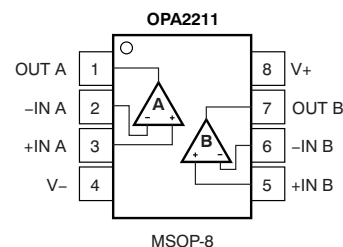
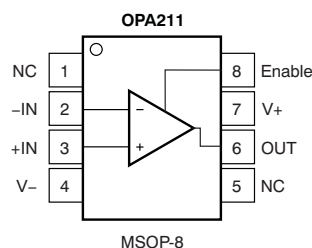
The OPA211 series achieves very low 1.1nV/√Hz noise density with a supply current of only 3.6mA. It also offers rail-to-rail output swing, which helps to maximize dynamic range.

The OPA211 series' extremely low voltage and current noise, high speed and wide output swing make it an excellent choice as a loop filter amplifier in PLL applications.

In precision data acquisition applications, the OPA211 series of op amps provide <1μs settling time to 16-bit accuracy even for 10V output swings. This ac performance, combined with only 100μV of offset and low drift over temperature, make the OPA211 highly suitable for driving fast, high-precision analog-to-digital converters (ADCs) or buffering the outputs of high-resolution digital-to-analog converters (DACs).

The OPA211 is specified over the very wide dual-power supply range of ±2.25V to ±18V, or single-supply operation from +4.5V to +36V.

The OPA211 is available in the tiny DFN-8 (3x3mm) and MSOP-8 and SO-8 packages. A dual version, the OPA2211, is available in the DFN-8 (3x3mm) or an MSOP-8 package. This series of op amps is specified from –40°C to +125°C.



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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.

ABSOLUTE MAXIMUM RATINGS⁽¹⁾

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

	VALUE	UNIT
Supply Voltage	±20	V
Input Voltage	(V ₋) – 0.7 to (V ₊) + 0.7	V
Input Current	±10	mA
Output Short-Circuit ⁽²⁾	Continuous	
Operating Temperature	–55 to +150	°C
Storage Temperature	–65 to +150	°C
Junction Temperature	+150	°C

(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) Short-circuit to ground, one amplifier per package.

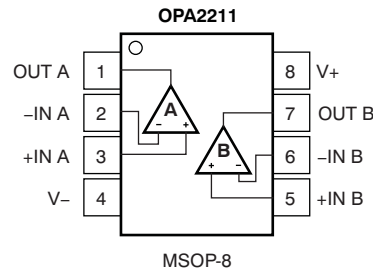
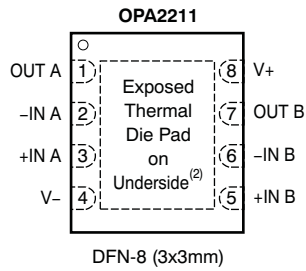
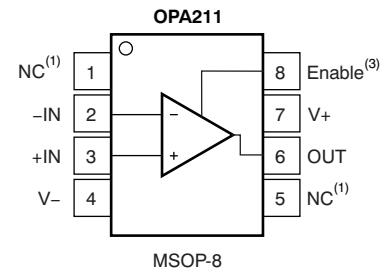
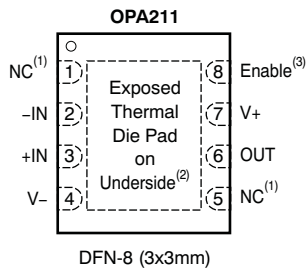
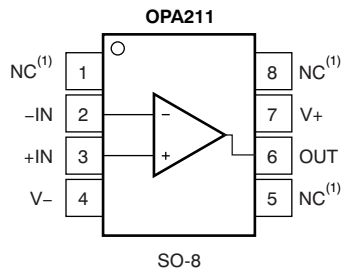
PACKAGE/ORDERING INFORMATION⁽¹⁾

PRODUCT	PACKAGE-LEAD	SINGLE	ENABLE	DUAL	PACKAGE DESIGNATOR	PACKAGE MARKING
Standard Grade						
OPA211A	DFN-8 (3×3mm) ⁽²⁾	ü	ü		DRG	TBD
	MSOP-8 ⁽²⁾	ü	ü		DCK	TBD
OPA211A	SO-8	ü			D	TBD
OPA2211A	DFN-8 (3×3mm) ⁽²⁾			ü	DRG	TBD
	MSOP-8 ⁽²⁾			ü	DCK	TBD
High Grade						
OPA211I	DFN-8 (3×3mm) ⁽²⁾	ü	ü		DRG	TBD
	MSOP-8 ⁽²⁾	ü	ü		DCK	TBD
	SO-8	ü			D	TBD
OPA2211I	DFN-8 (3×3mm) ⁽²⁾			ü	DRG	TBD
	MSOP-8 ⁽²⁾			ü	DCK	TBD

(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.

(2) Available Q4, 2007.

PIN CONFIGURATIONS



- (1) NC denotes no internal connection. Pin can be left floating or connected to any voltage between (V-) and (V+).
- (2) Connect thermal die pad to V-.
- (3) Enable function: $(V-) \leq \text{ENABLED} \leq (V+) - 3V$; $\text{DISABLED} \geq (V+) - 0.35V$.

ELECTRICAL CHARACTERISTICS: $V_S = \pm 2.25V$ to $\pm 18V$

BOLDFACE limits apply over the specified temperature range, $T_A = -40^\circ C$ to $+125^\circ C$.

At $T_A = +25^\circ C$ and $R_L = 10k\Omega$, unless otherwise noted.

PARAMETER	CONDITIONS	Standard Grade OPA211A, OPA2211A			High Grade OPA211I, OPA2211I ⁽¹⁾			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	
OFFSET VOLTAGE								
Input Offset Voltage	V_{OS}	$\pm 15V$	± 20	± 100	± 20	TBD	μV	
Drift	dV_{OS}/dT		0.35	1	0.35		$\mu V/^\circ C$	
vs Power Supply	PSRR	$V_S = \pm 2.25V$ to $\pm 18V$		2		TBD	$\mu V/V$	
INPUT BIAS CURRENT								
Input Bias Current	I_B	$V_{CM} = 0V$	30	150	30	TBD	nA	
Over Temperature			TBD	TBD	TBD	TBD	nA	
Offset Current	I_{OS}	$V_{CM} = 0V$	10	100	10	TBD	nA	
Over Temperature			TBD	TBD	TBD	TBD	nA	
NOISE								
Input Voltage Noise:	e_n							
$f = 0.1Hz$ to $10Hz$			0.1		0.1		μV_{PP}	
Voltage Noise Density:								
$f = 10Hz$			2.5		2.5		nV/\sqrt{Hz}	
$f = 100Hz$			1.6		1.6		nV/\sqrt{Hz}	
$f = 1kHz$			1.1		1.1		nV/\sqrt{Hz}	
Input Current Noise Density:	i_n							
$f = 10Hz$			TBD		TBD		pA/\sqrt{Hz}	
$f = 1kHz$			1.5		1.5		pA/\sqrt{Hz}	
INPUT VOLTAGE RANGE								
Common-Mode Voltage Range	V_{CM}		$(V-)+1.8$	$(V+)-1.4$	$(V-)+1.8$	$(V+)-1.4$	V	
Common-Mode Rejection Ratio	CMRR	$(V-)+1.8V < V_{CM} < (V+)-1.4V$	114	120	114	120	dB	
INPUT IMPEDANCE								
Differential				$10^{10} TBD$		$10^{10} TBD$	ΩpF	
Common-Mode				$10^9 2$		$10^9 2$	ΩpF	
OPEN-LOOP GAIN								
Open-Loop Voltage Gain	A_{OL}	$(V-)+0.2V < V_O < (V+)-0.2V$, $R_L = 10k\Omega$	114	120	114	120	dB	
	A_{OL}	$(V-)+0.6V < V_O < (V+)-0.6V$, $R_L = 600\Omega$	110	114	114	114	dB	
Over Temperature		$(V-)+0.6V < V_O < (V+)-0.6V$, $R_L = 600\Omega$, $I_O < 25mA$	110	114	110	114	dB	
FREQUENCY RESPONSE								
Gain-Bandwidth Product	GBW	$G = 100$	80		80		MHz	
		$G = 1$	58		58		MHz	
Slew Rate	SR		27		27		V/ μs	
Settling Time, 0.01%	t_S	$G = -1$, 10V Step, $C_L = 100pF$	TBD		TBD		μs	
0.0015% (16-bit)		$G = -1$, 10V Step, $C_L = 100pF$	TBD		TBD		μs	
Overload Recovery Time		$G = -1$	< 1		< 1		μs	
Total Harmonic Distortion + Noise	THD+N	$G = +10$, $f = 20kHz$, $V_O = 20V_{PP}$, 600Ω	TBD		TBD		%	

(1) **Shaded cells** indicate different specifications from low-grade version of device.

PRODUCT PREVIEW

ELECTRICAL CHARACTERISTICS: $V_S = \pm 2.25V$ to $\pm 18V$ (continued)

BOLDFACE limits apply over the specified temperature range, $T_A = -40^\circ C$ to $+125^\circ C$.
 At $T_A = +25^\circ C$ and $R_L = 10k\Omega$, unless otherwise noted.

PARAMETER	CONDITIONS	Standard Grade OPA211A, OPA2211A			High Grade OPA211I, OPA2211I ⁽¹⁾			UNIT	
		MIN	TYP	MAX	MIN	TYP	MAX		
OUTPUT									
Voltage Output	V_{OUT}	$R_L = 10k\Omega, A_{OL} > 114dB$ $R_L = 600\Omega, A_{OL} > 110dB$ $R_L = 600\Omega, A_{OL} > 110dB,$ $I_O < 25mA$	(V-) +0.2		(V+) -0.2	(V-) +0.2		(V+) -0.2	V
			(V-) +0.6		(V+) -0.6	(V-) +0.6		(V+) -0.6	V
			(V-) +0.6		(V+) -0.6	(V-) +0.6		(V+) -0.6	V
Short-Circuit Current	I_{SC}		+30/-45			+30/-45			mA
Capacitive Load Drive	C_{LOAD}	See Typical Characteristics			See Typical Characteristics				pF
POWER SUPPLY									
Specified Voltage	V_S	± 2.25		± 18	± 2.25		± 18		V
Quiescent Current (per channel)	I_Q	$I_{OUT} = 0$		3.6	TBD		3.6	TBD	mA
				TBD	TBD		TBD	TBD	mA
Shutdown Current	Disabled		TBD	20		TBD	20		μA
ENABLE Pin Input Voltage	Enabled			(V+) -3			(V+) -3		V
ENABLE Pin Input Voltage	Disabled	(V+) -0.35			(V+) -0.35				V
TEMPERATURE RANGE									
Specified Range		-40		+125	-40		+125		$^\circ C$
Operating Range		-55		+150	-55		+150		$^\circ C$
Thermal Resistance	θ_{JA}	Soldered to approximately 5cm x 5cm copper area							
DFN (3mm x 3mm)			65			65			$^\circ C/W$
SO-8, MSOP-8			150			150			$^\circ C/W$

PRODUCT PREVIEW

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
OPA211AID	PREVIEW	SOIC	D	8	75	TBD	Call TI	Call TI
OPA211AIDGKR	PREVIEW	MSOP	DGK	8	2500	TBD	Call TI	Call TI
OPA211AIDGKT	PREVIEW	MSOP	DGK	8	250	TBD	Call TI	Call TI
OPA211AIDR	PREVIEW	SOIC	D	8	2500	TBD	Call TI	Call TI
POPA211AID	PREVIEW	SOIC	D	8	75	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.

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DGK (S-PDSO-G8)

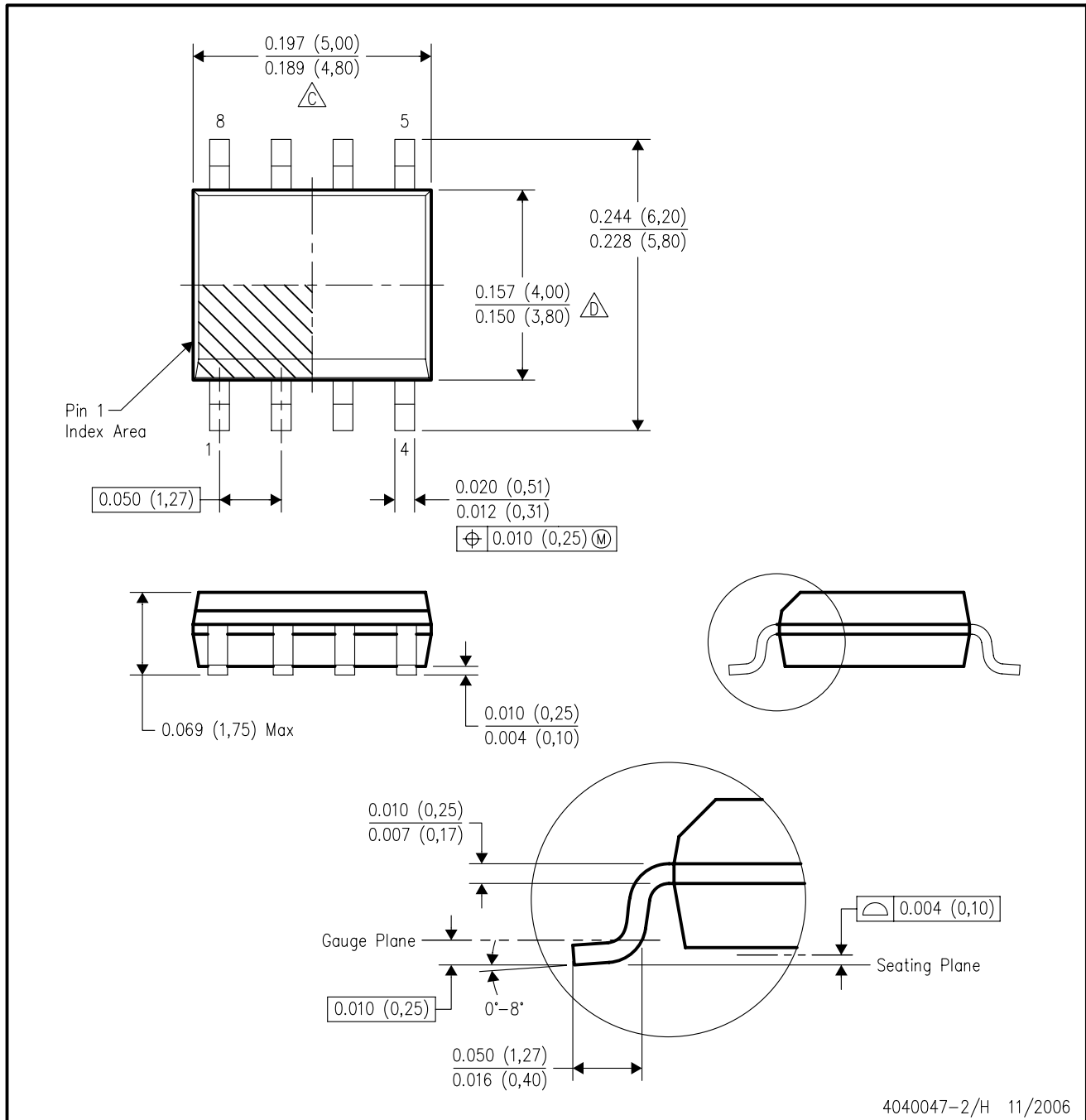
PLASTIC SMALL-OUTLINE PACKAGE



- 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.

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 length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 (0,15) per end.
 - D. Body width does not include interlead flash. Interlead flash shall not exceed .017 (0,43) per side.
 - E. Reference JEDEC MS-012 variation AA.

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