

OPA244
OPA2244
OPA4244

MicroPower, Single-Supply **OPERATIONAL AMPLIFIERS** *MicroAmplifier™ Series*

FEATURES

- **MicroSIZE PACKAGES**
 OPA244 (Single): SOT-23-5
 OPA2244 (Dual): MSOP-8
 OPA4244 (Quad): TSSOP-14
- **MicroPOWER:** $I_Q = 50\mu\text{A}/\text{channel}$
- **SINGLE SUPPLY OPERATION**
- **WIDE BANDWIDTH:** 430kHz
- **WIDE SUPPLY RANGE:**
 Single Supply: 2.2V to 36V
 Dual Supply: $\pm 1.1\text{V}$ to $\pm 18\text{V}$

APPLICATIONS

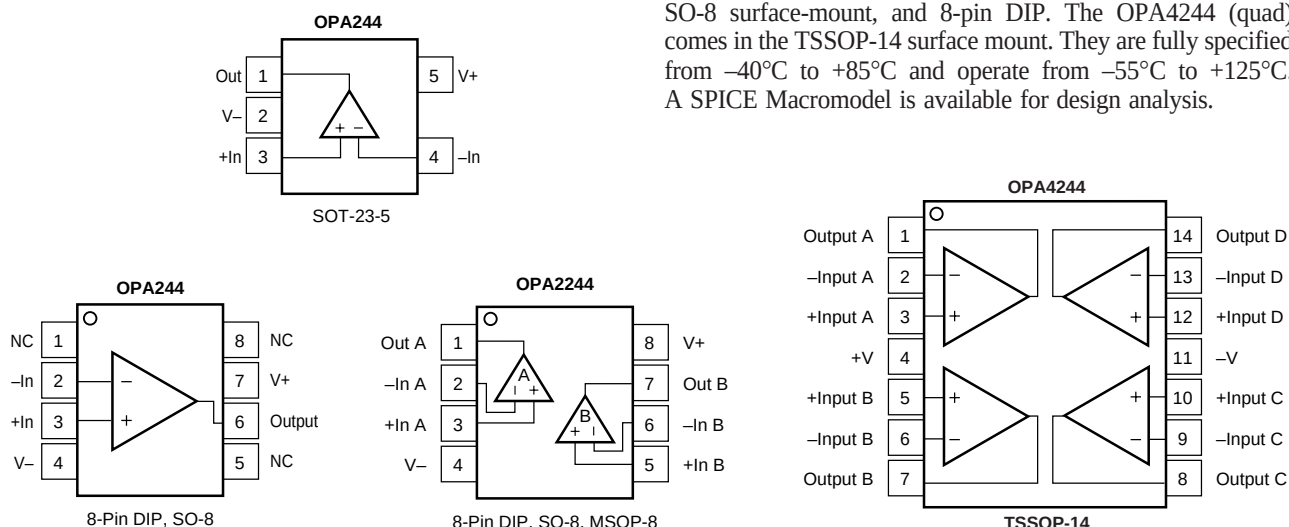
- BATTERY POWERED SYSTEMS
- PORTABLE EQUIPMENT
- PCMCIA CARDS
- BATTERY PACKS AND POWER SUPPLIES
- CONSUMER PRODUCTS

DESCRIPTION

The OPA244 (single), OPA2244 (dual), and OPA4244 (quad) op amps are designed for very low quiescent current ($50\mu\text{A}/\text{channel}$), yet achieve excellent bandwidth. Ideal for battery powered and portable instrumentation, all versions are offered in micro packages for space-limited applications. The dual and quad versions feature completely independent circuitry for lowest crosstalk and freedom from interaction, even when overdriven or overloaded.

The OPA244 series is easy to use and free from phase inversion and overload problems found in some other op amps. These amplifiers are stable in unity gain and excellent performance is maintained as they swing to their specified limits. They can be operated from single (+2.2V to +36V) or dual supplies ($\pm 1.1\text{V}$ to $\pm 18\text{V}$). The input common-mode voltage range includes ground—ideal for many single supply applications. All versions have similar performance. However, there are some differences, such as common-mode rejection. All versions are interchangeable in most applications.

All versions are offered in miniature, surface-mount packages. OPA244 (single version) comes in the tiny 5-lead SOT-23-5 surface mount, SO-8 surface mount, and 8-pin DIP. OPA2244 (dual version) is available in the MSOP-8 surface mount, SO-8 surface-mount, and 8-pin DIP. The OPA4244 (quad) comes in the TSSOP-14 surface mount. They are fully specified from -40°C to $+85^\circ\text{C}$ and operate from -55°C to $+125^\circ\text{C}$. A SPICE Macromodel is available for design analysis.



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SPECIFICATIONS: $V_S = +2.6V$ to $+36V$

Boldface limits apply over the specified temperature range, $T_A = -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$

At $T_A = +25^\circ\text{C}$, $R_L = 20\text{k}\Omega$ connected to ground, unless otherwise noted.

PARAMETER	CONDITION	OPA244NA, PA, UA			UNITS
		MIN	TYP ⁽¹⁾	MAX	
OFFSET VOLTAGE Input Offset Voltage $T_A = -40^{\circ}\text{C to } 85^{\circ}\text{C}$ vs Temperature vs Power Supply $T_A = -40^{\circ}\text{C to } 85^{\circ}\text{C}$	V_{OS} $V_S = \pm 7.5\text{V}, V_{CM} = 0$ dV_{OS}/dT $PSRR$ $T_A = -40^{\circ}\text{C to } 85^{\circ}\text{C}$ $V_S = +2.6\text{V to } +36\text{V}$ $V_S = +2.6\text{V to } +36\text{V}$		± 0.7 ± 4 5	± 1.5 ± 2 50 50	mV mV $\mu\text{V}/^{\circ}\text{C}$ $\mu\text{V}/\text{V}$ $\mu\text{V}/\text{V}$
INPUT BIAS CURRENT Input Bias Current Input Offset Current	I_B I_{OS} $V_{CM} = V_S/2$ $V_{CM} = V_S/2$		-10 ± 1	-25 ± 10	nA nA
NOISE Input Voltage Noise, $f = 0.1\text{kHz to } 10\text{kHz}$ Input Voltage Noise Density, $f = 1\text{kHz}$ Current Noise Density, $f = 1\text{kHz}$	e_n i_n		0.4 22 40		$\mu\text{Vp-p}$ $\text{nV}/\sqrt{\text{Hz}}$ $\text{fA}/\sqrt{\text{Hz}}$
INPUT VOLTAGE RANGE Common-Mode Voltage Range Common-Mode Rejection $T_A = -40^{\circ}\text{C to } 85^{\circ}\text{C}$	V_{CM} CMRR $V_S = \pm 18\text{V}, V_{CM} = -18\text{V to } +17.1\text{V}$ $V_S = \pm 18\text{V}, V_{CM} = -18\text{V to } +17.1\text{V}$	0 84 84		(V+) - 0.9	V dB dB
INPUT IMPEDANCE Differential Common-Mode			$10^6 \parallel 2$ $10^9 \parallel 2$		$\Omega \parallel \text{pF}$ $\Omega \parallel \text{pF}$
OPEN-LOOP GAIN Open-Loop Voltage Gain $T_A = -40^{\circ}\text{C to } 85^{\circ}\text{C}$	A_{OL} $V_O = 0.5\text{V to } (V+) - 0.9$ $V_O = 0.5\text{V to } (V+) - 0.9$	86 86	106		dB dB
FREQUENCY RESPONSE Gain-Bandwidth Product Slew Rate Settling Time 0.01% Overload Recovery Time	GBW SR $G = 1$ 10V Step $V_{IN} \bullet \text{Gain} = V_S$		430 -0.1/+0.16 150 8		kHz V/ μs μs μs
OUTPUT Voltage Output, Positive $T_A = -40^{\circ}\text{C to } 85^{\circ}\text{C}$ Voltage Output, Negative $T_A = -40^{\circ}\text{C to } 85^{\circ}\text{C}$ Voltage Output, Positive $T_A = -40^{\circ}\text{C to } 85^{\circ}\text{C}$ Voltage Output, Negative $T_A = -40^{\circ}\text{C to } 85^{\circ}\text{C}$ Short-Circuit Current Capacitive Load Drive	V_O $A_{OL} \geq 80\text{dB}, R_L = 20\text{k}\Omega \text{ to } V_S/2$ $A_{OL} \geq 80\text{dB}, R_L = 20\text{k}\Omega \text{ to } V_S/2$ $A_{OL} \geq 80\text{dB}, R_L = 20\text{k}\Omega \text{ to } V_S/2$ $A_{OL} \geq 80\text{dB}, R_L = 20\text{k}\Omega \text{ to } V_S/2$ $A_{OL} \geq 80\text{dB}, R_L = 20\text{k}\Omega \text{ to Ground}$ $A_{OL} \geq 80\text{dB}, R_L = 20\text{k}\Omega \text{ to Ground}$ $A_{OL} \geq 80\text{dB}, R_L = 20\text{k}\Omega \text{ to Ground}$ $A_{OL} \geq 80\text{dB}, R_L = 20\text{k}\Omega \text{ to Ground}$ $A_{OL} \geq 80\text{dB}, R_L = 20\text{k}\Omega \text{ to Ground}$ I_{SC} C_{LOAD}	(V+) - 0.9 (V+) - 0.9 0.5 0.5 0.5 0.5 0.1 0.1 0.1 0.1 -25/+12	(V+) - 0.75 (V+) - 0.75 0.2 0.2 (V+) - 0.75 (V+) - 0.75 0.1 0.1 0.1 0.1 See Typical Curve		V V V V V V V V V V mA
POWER SUPPLY Specified Voltage Range Minimum Operating Voltage Quiescent Current $T_A = -40^{\circ}\text{C to } 85^{\circ}\text{C}$	V_S I_Q $T_A = -40^{\circ}\text{C to } 85^{\circ}\text{C}$	$T_A = -40^{\circ}\text{C to } 85^{\circ}\text{C}$ $I_O = 0$ $I_O = 0$	+2.6 +2.2 50	+36 60 70	V V μA μA
TEMPERATURE RANGE Specified Range Operating Range Storage Range Thermal Resistance SOT-23-5 Surface-Mount SO-8 Surface-Mount 8-Pin DIP	θ_{JA}		-40 -55 -65 200 150 100	85 125 150	$^{\circ}\text{C}$ $^{\circ}\text{C}$ $^{\circ}\text{C}$ $^{\circ}\text{C}/\text{W}$ $^{\circ}\text{C}/\text{W}$ $^{\circ}\text{C}/\text{W}$

NOTE: (1) $V_S = +15V$.

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SPECIFICATIONS: $V_S = +2.6V$ to $+36V$

Boldface limits apply over the specified temperature range, $T_A = -40^{\circ}C$ to $+85^{\circ}C$

At $T_A = +25^{\circ}C$, $R_L = 20k\Omega$ connected to ground, unless otherwise noted.

PARAMETER	CONDITION	OPA2244EA, PA, UA			UNITS
		MIN	TYP ⁽¹⁾	MAX	
OFFSET VOLTAGE Input Offset Voltage V_{OS} $T_A = -40^{\circ}C$ to $85^{\circ}C$ vs Temperature dV_{OS}/dT vs Power Supply PSRR $T_A = -40^{\circ}C$ to $85^{\circ}C$ Channel Separation	$V_S = \pm 7.5V$, $V_{CM} = 0$ $T_A = -40^{\circ}C$ to $85^{\circ}C$ $V_S = +2.6V$ to $+36V$ $V_S = +2.6V$ to $+36V$		± 0.7 ± 4 5 140	± 1.5 ± 2 50 50	mV mV $\mu V/^{\circ}C$ $\mu V/V$ $\mu V/V$ dB
INPUT BIAS CURRENT Input Bias Current I_B Input Offset Current I_{OS}	$V_{CM} = V_S/2$ $V_{CM} = V_S/2$		-10 ± 1	-25 ± 10	nA nA
NOISE Input Voltage Noise, $f = 0.1kHz$ to $10kHz$ Input Voltage Noise Density, $f = 1kHz$ e_n Current Noise Density, $f = 1kHz$ i_n			0.4 22 40		$\mu Vp-p$ $nV/\sqrt{Hz}$ $fA/\sqrt{Hz}$
INPUT VOLTAGE RANGE Common-Mode Voltage Range V_{CM} Common-Mode Rejection CMRR $T_A = -40^{\circ}C$ to $85^{\circ}C$	$V_S = \pm 18V$, $V_{CM} = -18V$ to $+17.1V$ $V_S = \pm 18V$, $V_{CM} = -18V$ to $+17.1V$	0 72 72	98	$(V+) - 0.9$	V dB dB
INPUT IMPEDANCE Differential Common-Mode			$10^6 \parallel 2$ $10^9 \parallel 2$		$\Omega \parallel pF$ $\Omega \parallel pF$
OPEN-LOOP GAIN Open-Loop Voltage Gain A_{OL} $T_A = -40^{\circ}C$ to $85^{\circ}C$	$V_O = 0.5V$ to $(V+) - 0.9$ $V_O = 0.5V$ to $(V+) - 0.9$	86 86	106		dB dB
FREQUENCY RESPONSE Gain-Bandwidth Product GBW Slew Rate SR Settling Time 0.01% Overload Recovery Time	$G = 1$ 10V Step $V_{IN} \cdot \text{Gain} = V_S$		430 $-0.1/+0.16$ 150 8		kHz V/ μs μs μs
OUTPUT Voltage Output, Positive V_O $T_A = -40^{\circ}C$ to $85^{\circ}C$ Voltage Output, Negative $T_A = -40^{\circ}C$ to $85^{\circ}C$ Voltage Output, Positive $T_A = -40^{\circ}C$ to $85^{\circ}C$ Voltage Output, Negative $T_A = -40^{\circ}C$ to $85^{\circ}C$ Short-Circuit Current I_{SC} Capacitive Load Drive C_{LOAD}	$A_{OL} \geq 80dB$, $R_L = 20k\Omega$ to $V_S/2$ $A_{OL} \geq 80dB$, $R_L = 20k\Omega$ to $V_S/2$ $A_{OL} \geq 80dB$, $R_L = 20k\Omega$ to $V_S/2$ $A_{OL} \geq 80dB$, $R_L = 20k\Omega$ to $V_S/2$ $A_{OL} \geq 80dB$, $R_L = 20k\Omega$ to Ground $A_{OL} \geq 80dB$, $R_L = 20k\Omega$ to Ground $A_{OL} \geq 80dB$, $R_L = 20k\Omega$ to Ground $A_{OL} \geq 80dB$, $R_L = 20k\Omega$ to Ground $A_{OL} \geq 80dB$, $R_L = 20k\Omega$ to Ground	$(V+) - 0.9$ $(V+) - 0.9$ 0.5 0.5 0.1 0.1 $-25/+12$ See Typical Curve	$(V+) - 0.75$ $(V+) - 0.75$ 0.2 0.2 $(V+) - 0.75$ $(V+) - 0.75$ 0.1 0.1 $-25/+12$ See Typical Curve		V V V V V V V V V mA
POWER SUPPLY Specified Voltage Range V_S Minimum Operating Voltage Quiescent Current (per amplifier) I_Q $T_A = -40^{\circ}C$ to $85^{\circ}C$	$T_A = -40^{\circ}C$ to $85^{\circ}C$ $I_O = 0$ $I_O = 0$	+2.6	+2.2 40	+36 50 63	V V μA μA
TEMPERATURE RANGE Specified Range Operating Range Storage Range Thermal Resistance θ_{JA} MSOP-8 Surface-Mount SO-8 Surface-Mount 8-Pin DIP		-40 -55 -65		85 125 150	$^{\circ}C$ $^{\circ}C$ $^{\circ}C$ $^{\circ}C/W$ $^{\circ}C/W$ $^{\circ}C/W$

NOTE: (1) $V_S = +15V$.

SPECIFICATIONS: $V_S = +2.6V$ to $+36V$

Boldface limits apply over the specified temperature range, $T_A = -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$

At $T_A = +25^\circ\text{C}$, $R_1 = 20\text{k}\Omega$ connected to ground, unless otherwise noted.

PARAMETER		CONDITION	OPA4244EA			UNITS
			MIN	TYP ⁽¹⁾	MAX	
OFFSET VOLTAGE Input Offset Voltage $T_A = -40^{\circ}\text{C}$ to 85°C vs Temperature vs Power Supply $T_A = -40^{\circ}\text{C}$ to 85°C Channel Separation		V_{OS} dV_{OS}/dT $PSRR$	$V_S = \pm 7.5V, V_{CM} = 0$ $T_A = -40^{\circ}\text{C}$ to 85°C $V_S = +2.6V$ to $+36V$ $V_S = +2.6V$ to $+36V$	 ± 0.7 ± 4 5 140	 ± 1.5 ± 2 50 50	 mV mV $\mu V/^{\circ}\text{C}$ $\mu V/V$ $\mu V/V$ dB
INPUT BIAS CURRENT Input Bias Current Input Offset Current		I_B I_{OS}	$V_{CM} = V_S/2$ $V_{CM} = V_S/2$	 -10 ± 1	 -25 ± 10	 nA nA
NOISE Input Voltage Noise, $f = 0.1\text{kHz}$ to 10kHz Input Voltage Noise Density, $f = 1\text{kHz}$ Current Noise Density, $f = 1\text{kHz}$		 e_n i_n		 0.4 22 40		 $\mu V/p-p$ $nV/\sqrt{Hz}$ $fA/\sqrt{Hz}$
INPUT VOLTAGE RANGE Common-Mode Voltage Range Common-Mode Rejection $T_A = -40^{\circ}\text{C}$ to 85°C		V_{CM} $CMRR$	$V_S = \pm 18V, V_{CM} = -18V$ to $+17.1V$ $V_S = \pm 18V, V_{CM} = -18V$ to $+17.1V$	 0 82 82	 104	 V dB dB
INPUT IMPEDANCE Differential Common-Mode				 $10^6 \parallel 2$ $10^9 \parallel 2$		 $\Omega \parallel pF$ $\Omega \parallel pF$
OPEN-LOOP GAIN Open-Loop Voltage Gain $T_A = -40^{\circ}\text{C}$ to 85°C		A_{OL}	$V_O = 0.5V$ to $(V+) - 0.9$ $V_O = 0.5V$ to $(V+) - 0.9$	 86 86	 106	 dB dB
FREQUENCY RESPONSE Gain-Bandwidth Product Slew Rate Settling Time 0.01% Overload Recovery Time		GBW SR	 $G = 1$ 10V Step $V_{IN} \bullet \text{Gain} = V_S$	 430 -0.1/+0.16 150 8		 kHz $V/\mu s$ μs μs
OUTPUT Voltage Output, Positive $T_A = -40^{\circ}\text{C}$ to 85°C Voltage Output, Negative $T_A = -40^{\circ}\text{C}$ to 85°C Voltage Output, Positive $T_A = -40^{\circ}\text{C}$ to 85°C Voltage Output, Negative $T_A = -40^{\circ}\text{C}$ to 85°C Short-Circuit Current Capacitive Load Drive		V_O I_{SC} C_{LOAD}	$A_{OL} \geq 80dB, R_L = 20k\Omega$ to $V_S/2$ $A_{OL} \geq 80dB, R_L = 20k\Omega$ to $V_S/2$ $A_{OL} \geq 80dB, R_L = 20k\Omega$ to $V_S/2$ $A_{OL} \geq 80dB, R_L = 20k\Omega$ to $V_S/2$ $A_{OL} \geq 80dB, R_L = 20k\Omega$ to Ground $A_{OL} \geq 80dB, R_L = 20k\Omega$ to Ground $A_{OL} \geq 80dB, R_L = 20k\Omega$ to Ground $A_{OL} \geq 80dB, R_L = 20k\Omega$ to Ground $A_{OL} \geq 80dB, R_L = 20k\Omega$ to Ground	$(V+) - 0.9$ $(V+) - 0.9$ 0.5 0.5	$(V+) - 0.75$ $(V+) - 0.75$ 0.2 0.2 $(V+) - 0.75$ $(V+) - 0.75$ 0.1 0.1 -25/+12	 V V V V V V V V mA
POWER SUPPLY Specified Voltage Range Minimum Operating Voltage Quiescent Current (per amplifier) $T_A = -40^{\circ}\text{C}$ to 85°C		V_S I_Q	$T_A = -40^{\circ}\text{C}$ to 85°C $I_O = 0$ $I_O = 0$	+2.6 40	 +2.2 60 70	 V V μA μA
TEMPERATURE RANGE Specified Range Operating Range Storage Range Thermal Resistance TSSOP-14 Surface Mount		 θ_{JA}		-40 -55 -65	85 125 150	$^{\circ}\text{C}$ $^{\circ}\text{C}$ $^{\circ}\text{C}$ $^{\circ}\text{C/W}$

NOTE: (1) $V_S = +15V$.

ABSOLUTE MAXIMUM RATINGS⁽¹⁾

Supply Voltage, V+ to V-	36V
Input Voltage Range ⁽²⁾	(V-) – 0.3V to (V+) + 0.3V
Input Current ⁽²⁾	10mA
Output Short-Circuit ⁽³⁾	Continuous
Operating Temperature	–55°C to +125°C
Storage Temperature	–65°C to +150°C
Junction Temperature	150°C
Lead Temperature (soldering, 10s)	300°C
ESD Capability	2000V

NOTES: (1) Stresses above these ratings may cause permanent damage. Exposure to absolute maximum conditions for extended periods may degrade device reliability. (2) Inputs are diode-clamped to the supply rails and should be current-limited to 10mA or less if input voltages can exceed rails by more than 0.3V. (3) Short-circuit to ground, one amplifier per package.



ELECTROSTATIC DISCHARGE SENSITIVITY

This integrated circuit can be damaged by ESD. Burr-Brown 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.

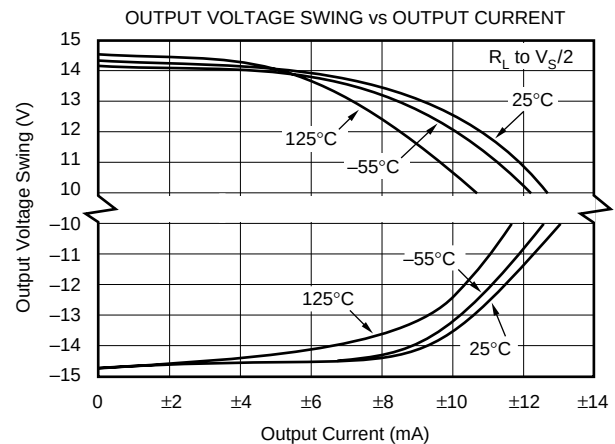
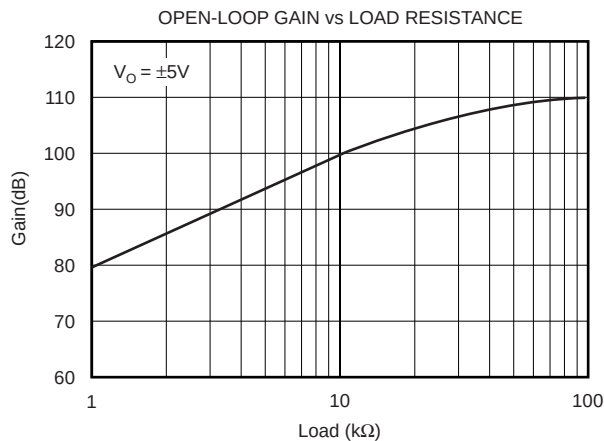
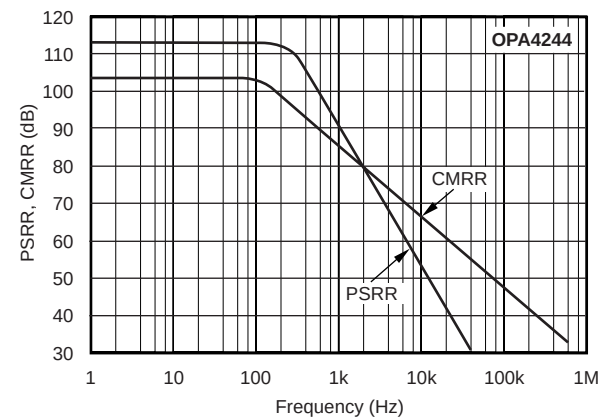
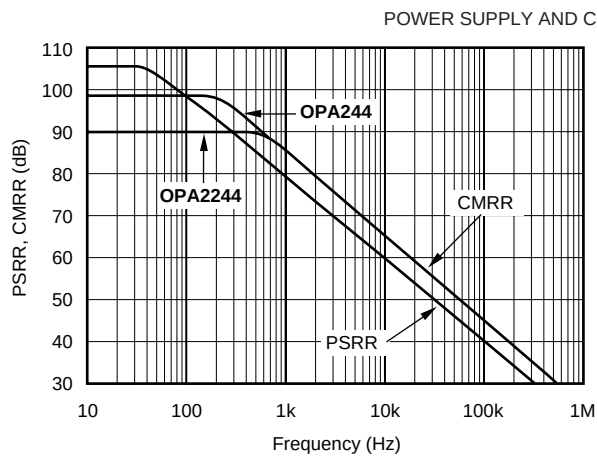
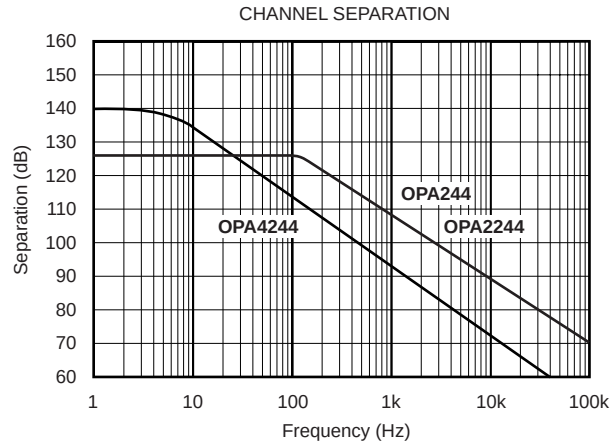
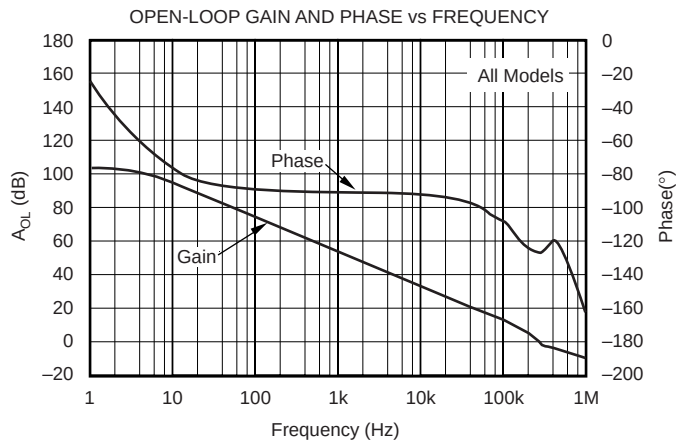
PACKAGE/ORDERING INFORMATION

PRODUCT	PACKAGE	PACKAGE DRAWING NUMBER	SPECIFIED TEMPERATURE RANGE	PACKAGE MARKING	ORDERING NUMBER ⁽¹⁾	TRANSPORT MEDIA
Single						
OPA244NA	SOT-23-5 Surface-Mount	331	–40°C to +85°C	A44	OPA244NA/250	Tape and Reel
"	"	"	"	"	OPA244NA/3K	Tape and Reel
OPA244PA	8-Pin DIP	006	–40°C to +85°C	OPA244PA	OPA244PA	Rails
OPA244UA	SO-8 Surface-Mount	182	–40°C to +85°C	OPA244UA	OPA244UA	Rails
"	"	"	"	"	OPA244UA/2K5	Tape and Reel
Dual						
OPA2244EA	MSOP-8 Surface-Mount	337	–40°C to +85°C	A44	OPA2244EA/250	Tape and Reel
"	"	"	"	"	OPA2244EA/2K5	Tape and Reel
OPA2244PA	8-Pin DIP	006	–40°C to +85°C	OPA2244PA	OPA2244PA	Rails
OPA2244UA	SO-8 Surface-Mount	182	–40°C to +85°C	OPA2244UA	OPA2244UA	Rails
"	"	"	"	"	OPA2244UA/2K5	Tape and Reel
Quad						
OPA4244EA	TSSOP-14 Surface-Mount	357	–40°C to +85°C	OPA4244EA	OPA4244EA/250	Tape and Reel
"	"	"	"	"	OPA4244EA/2K5	Tape and Reel

NOTE: (1) Products followed by a slash (/) are only available in Tape and Reel in the quantities indicated (e.g., /250 indicates 250 devices per reel). Ordering 3000 pieces of "OPA244NA/3K" will get a single 3000 piece Tape and Reel.

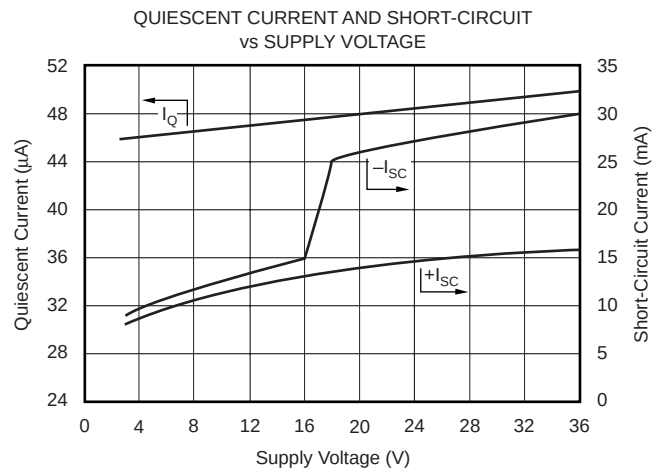
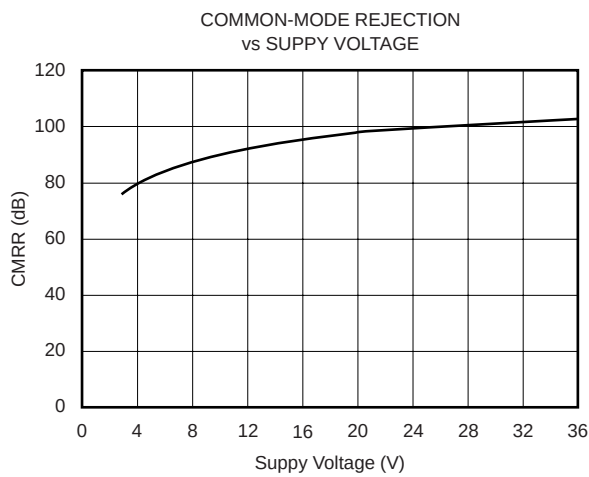
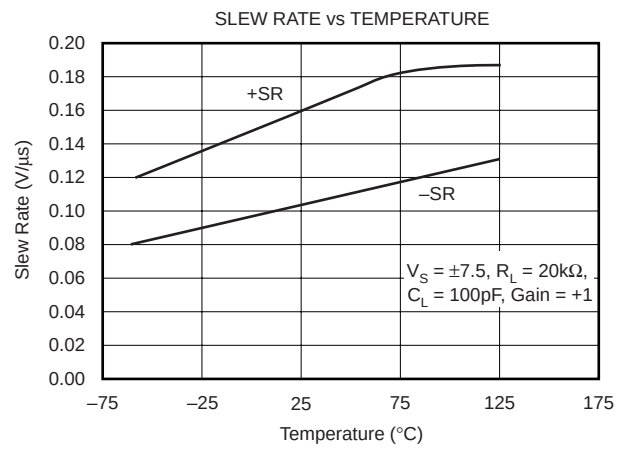
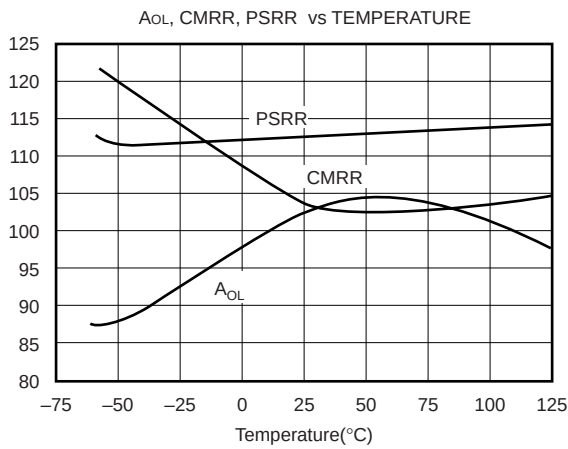
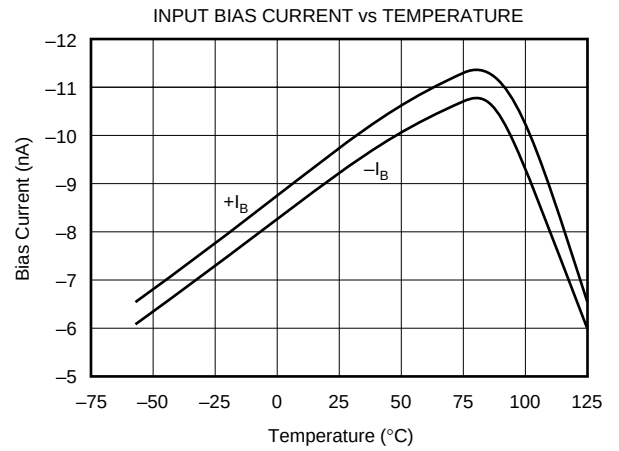
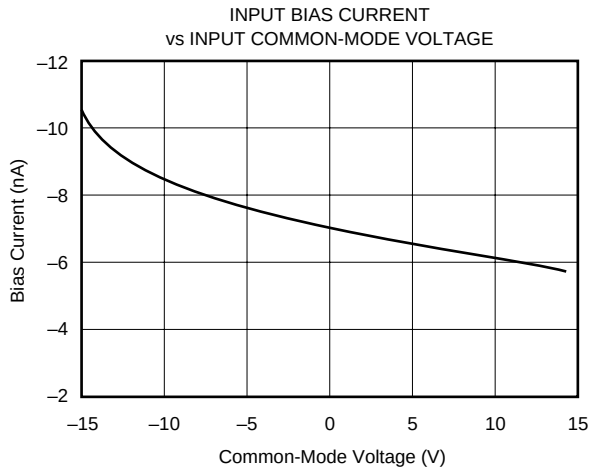
TYPICAL PERFORMANCE CURVES

At $T_A = 25^\circ\text{C}$, $V_S = +15\text{V}$, and $R_L = 20\text{k}\Omega$ connected to Ground, unless otherwise noted.



TYPICAL PERFORMANCE CURVES (Cont.)

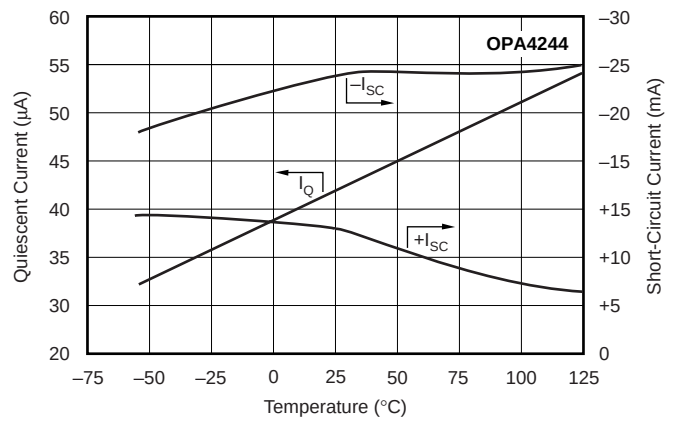
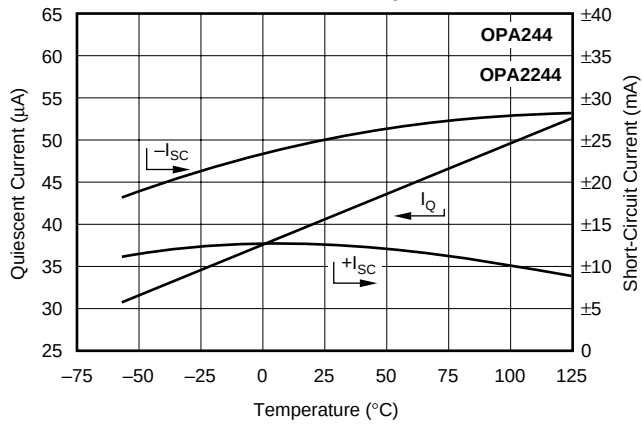
At $T_A = 25^\circ\text{C}$, $V_S = +15\text{V}$, and $R_L = 20\text{k}\Omega$ connected to Ground, unless otherwise noted.



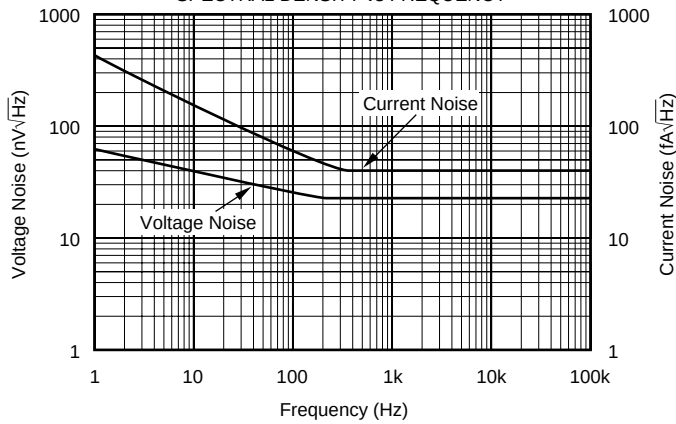
TYPICAL PERFORMANCE CURVES (Cont.)

At $T_A = 25^\circ\text{C}$, $V_S = +15\text{V}$, and $R_L = 20\text{k}\Omega$ connected to Ground, unless otherwise noted.

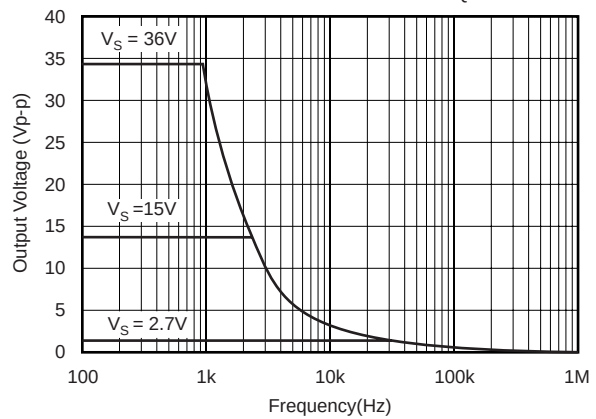
QUIESCENT AND SHORT-CIRCUIT CURRENT vs TEMPERATURE



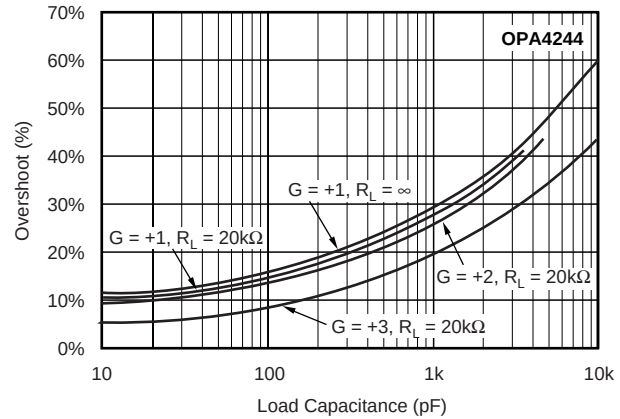
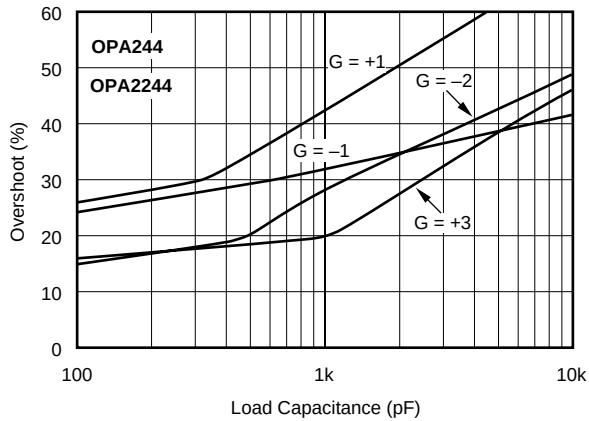
INPUT VOLTAGE AND CURRENT NOISE SPECTRAL DENSITY vs FREQUENCY



MAXIMUM OUTPUT VOLTAGE vs FREQUENCY



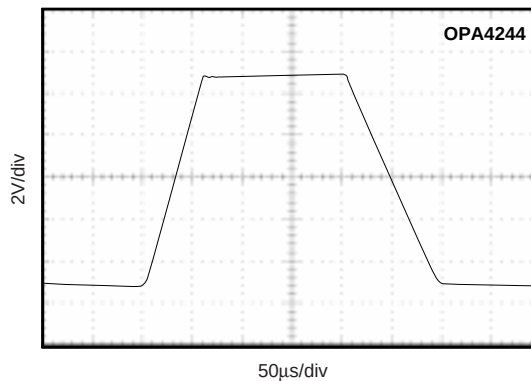
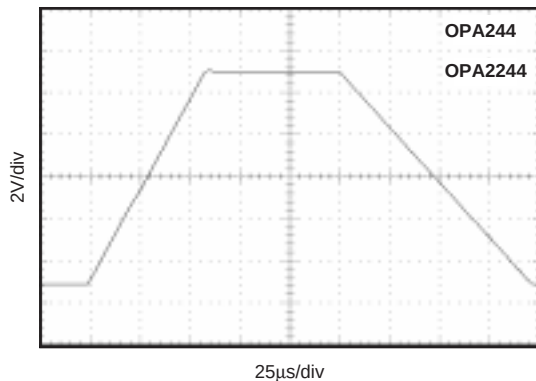
SMALL SIGNAL OVERSHOOT vs LOAD CAPACITANCE



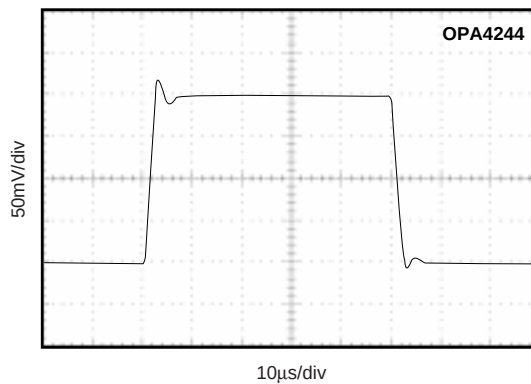
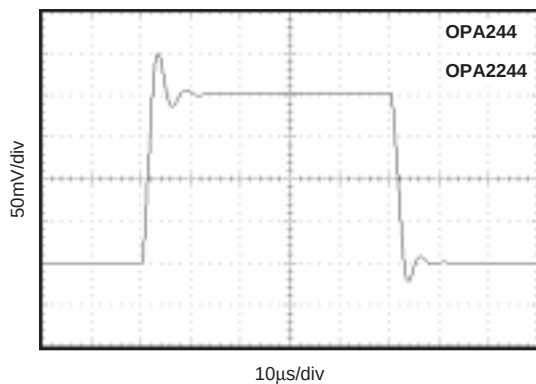
TYPICAL PERFORMANCE CURVES (Cont.)

At $T_A = 25^\circ\text{C}$, $V_S = +15\text{V}$, and $R_L = 20\text{k}\Omega$ connected to Ground, unless otherwise noted.

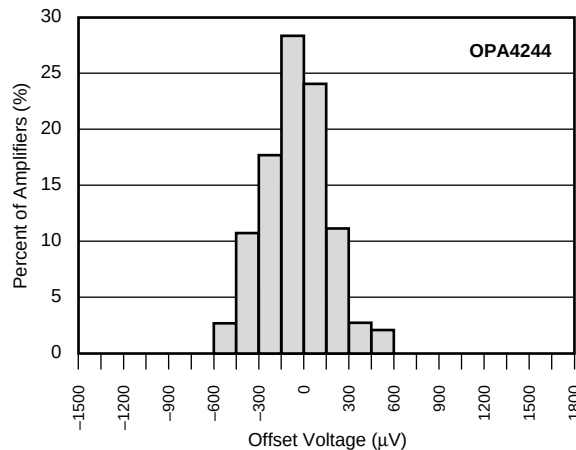
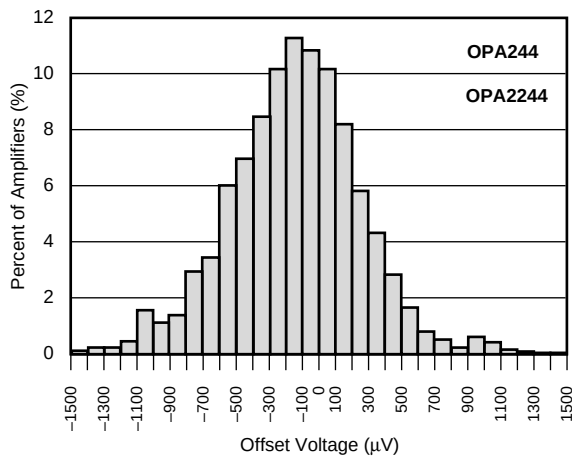
LARGE-SIGNAL STEP RESPONSE, $G = 1$, $C_L = 100\text{pF}$



SMALL-SIGNAL STEP RESPONSE, $G = 1$, $C_L = 100\text{pF}$



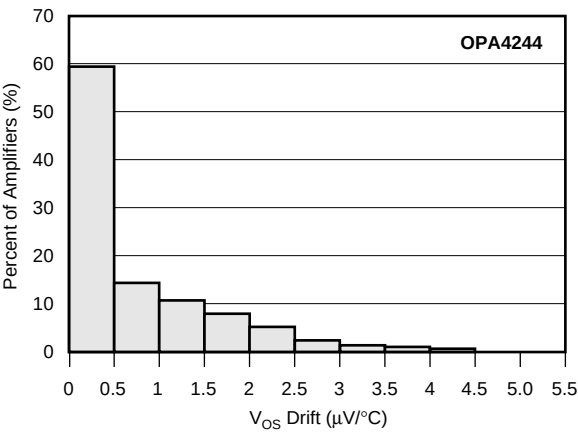
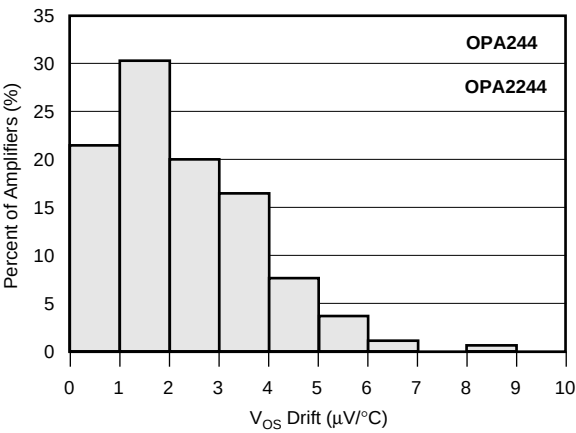
OFFSET VOLTAGE PRODUCTION DISTRIBUTION



TYPICAL PERFORMANCE CURVES (Cont.)

At $T_A = 25^{\circ}\text{C}$, $V_S = +15\text{V}$, and $R_L = 20\text{k}\Omega$ connected to Ground, unless otherwise noted.

OFFSET VOLTAGE PRODUCTION DISTRIBUTION



APPLICATIONS INFORMATION

The OPA244 is unity-gain stable and suitable for a wide range of general purpose applications. Power supply pins should be bypassed with 0.01μF ceramic capacitors.

OPERATING VOLTAGE

The OPA244 can operate from single supply (+2.2V to +36V) or dual supplies (±1.1 to ±18V) with excellent performance. Unlike most op amps which are specified at only one supply voltage, the OPA244 is specified for real world applications; a single set of specifications applies throughout the +2.6V to +36V (±1.3 to ±18V) supply range.

This allows a designer to have the same assured performance at any supply voltage within this range. In addition, many key parameters are guaranteed over the specified temperature range, -40°C to +85°C. Most behavior remains unchanged throughout the full operating voltage range. Parameters which vary significantly with operating voltage or temperature are shown in typical performance curves.

Useful information on solder pad design for printed circuit boards can be found in Burr-Brown's Application Bulletin AB-132B, "Solder Pad Recommendations for Surface-Mount Devices," easily found at Burr-Brown's web site (<http://www.burr-brown.com>).

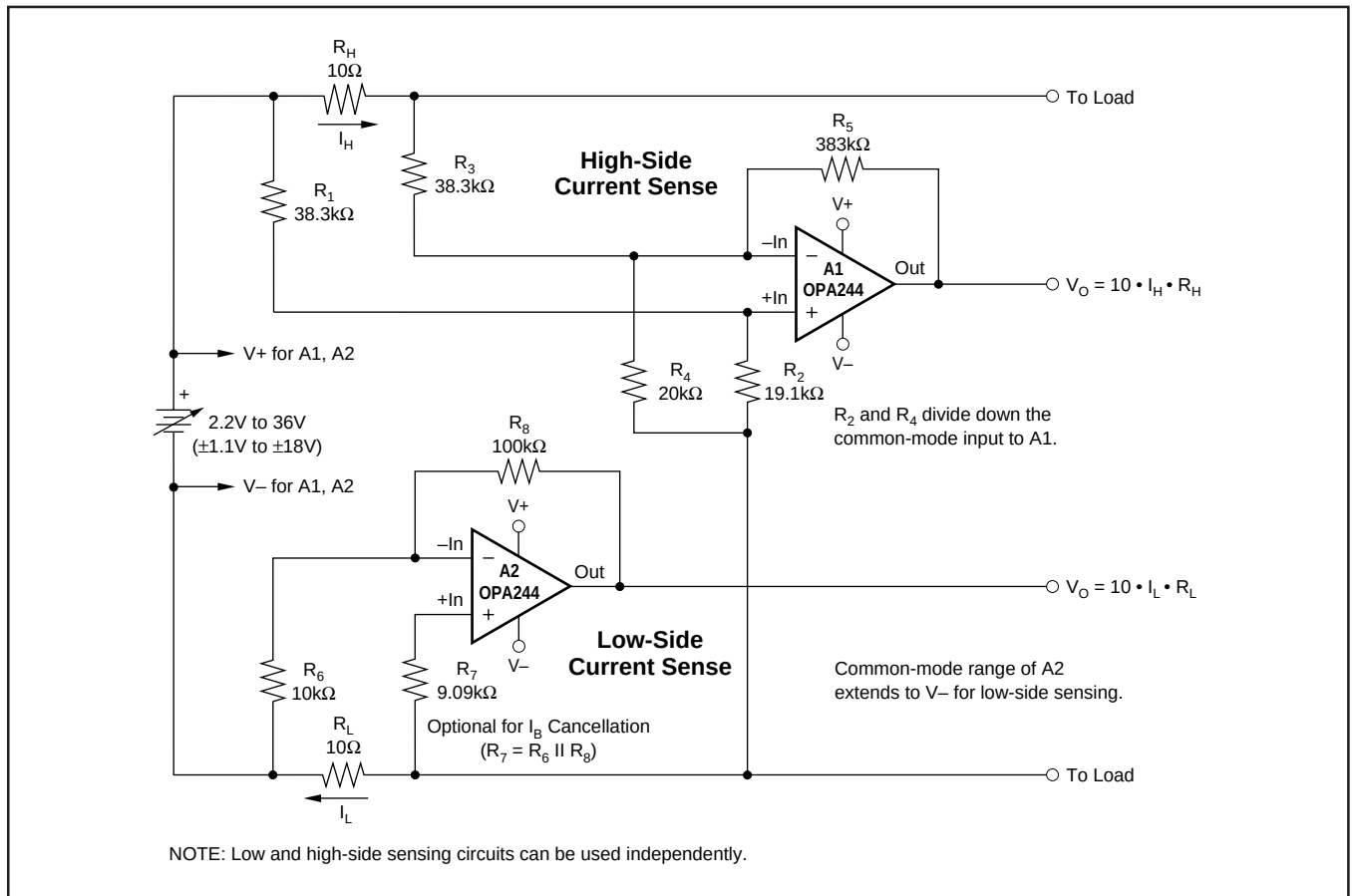


FIGURE 1. Low and High-Side Battery Current Sensing.

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
OPA2244EA/250	ACTIVE	VSSOP	DGK	8	250	Green (RoHS & no Sb/Br)	CU NIPDAU CU NIPDAUAG	Level-2-260C-1 YEAR	-40 to 85	A44	Samples
OPA2244EA/250G4	ACTIVE	VSSOP	DGK	8	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	A44	Samples
OPA2244EA/2K5	ACTIVE	VSSOP	DGK	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU CU NIPDAUAG	Level-2-260C-1 YEAR	-40 to 85	A44	Samples
OPA2244EA/2K5G4	ACTIVE	VSSOP	DGK	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	A44	Samples
OPA2244PA	ACTIVE	PDIP	P	8	50	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type		OPA2244PA	Samples
OPA2244PAG4	ACTIVE	PDIP	P	8	50	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type		OPA2244PA	Samples
OPA2244UA	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR		OPA 2244UA	Samples
OPA2244UA/2K5	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR		OPA 2244UA	Samples
OPA2244UA/2K5G4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR		OPA 2244UA	Samples
OPA2244UAG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR		OPA 2244UA	Samples
OPA244NA/250	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR		A44	Samples
OPA244NA/250G4	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR		A44	Samples
OPA244NA/3K	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR		A44	Samples
OPA244NA/3KG4	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR		A44	Samples
OPA244PA	ACTIVE	PDIP	P	8	50	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type		OPA244PA	Samples
OPA244PAG4	ACTIVE	PDIP	P	8	50	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type		OPA244PA	Samples
OPA244UA	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR		OPA 244UA	Samples

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
OPA244UA/2K5	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR		OPA 244UA	Samples
OPA244UAE4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR		OPA 244UA	Samples
OPA4244EA/250	ACTIVE	TSSOP	PW	14	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR		OPA 4244EA	Samples
OPA4244EA/250E4	ACTIVE	TSSOP	PW	14	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR		OPA 4244EA	Samples
OPA4244EA/2K5	ACTIVE	TSSOP	PW	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR		OPA 4244EA	Samples

(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.

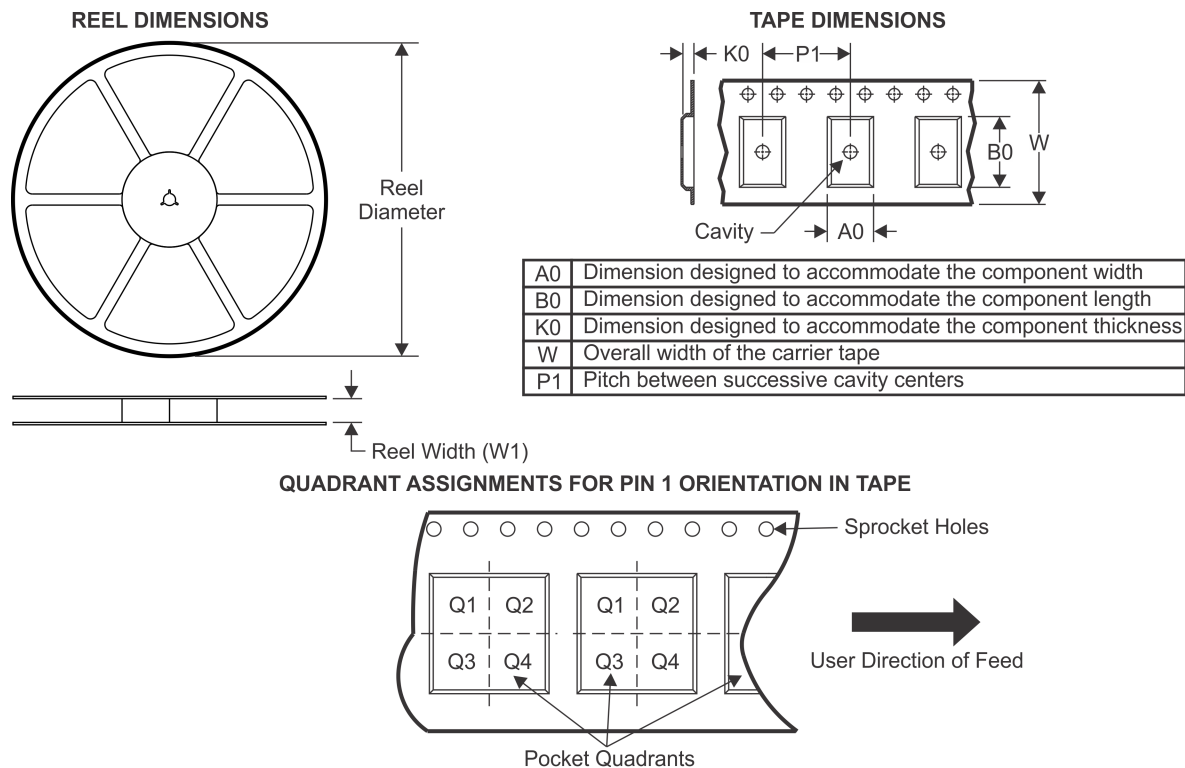
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(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.

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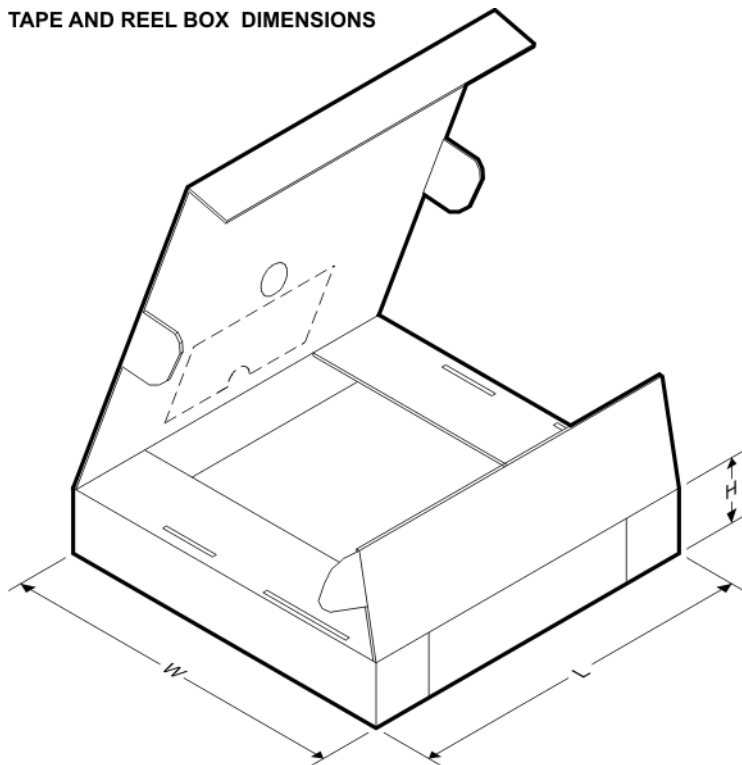
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TAPE AND REEL INFORMATION


*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
OPA2244EA/250	VSSOP	DGK	8	250	180.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1
OPA2244EA/2K5	VSSOP	DGK	8	2500	330.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1
OPA2244UA/2K5	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
OPA244NA/250	SOT-23	DBV	5	250	178.0	8.4	3.3	3.2	1.4	4.0	8.0	Q3
OPA244NA/3K	SOT-23	DBV	5	3000	178.0	8.4	3.3	3.2	1.4	4.0	8.0	Q3
OPA244UA/2K5	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
OPA4244EA/250	TSSOP	PW	14	250	180.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
OPA4244EA/2K5	TSSOP	PW	14	2500	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1

TAPE AND REEL BOX DIMENSIONS

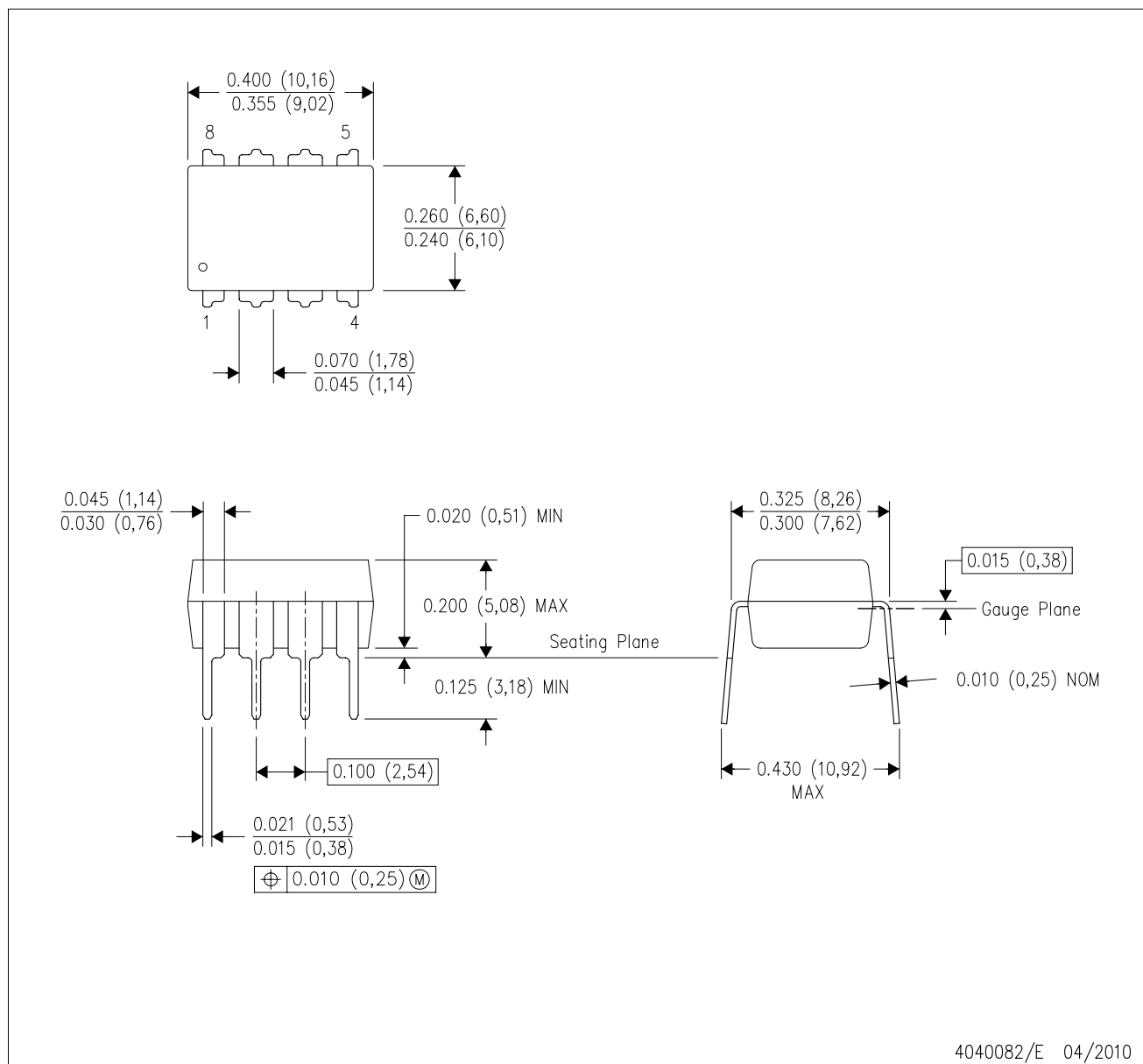


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
OPA2244EA/250	VSSOP	DGK	8	250	210.0	185.0	35.0
OPA2244EA/2K5	VSSOP	DGK	8	2500	367.0	367.0	35.0
OPA2244UA/2K5	SOIC	D	8	2500	367.0	367.0	35.0
OPA244NA/250	SOT-23	DBV	5	250	565.0	140.0	75.0
OPA244NA/3K	SOT-23	DBV	5	3000	565.0	140.0	75.0
OPA244UA/2K5	SOIC	D	8	2500	367.0	367.0	35.0
OPA4244EA/250	TSSOP	PW	14	250	210.0	185.0	35.0
OPA4244EA/2K5	TSSOP	PW	14	2500	367.0	367.0	35.0

P (R-PDIP-T8)

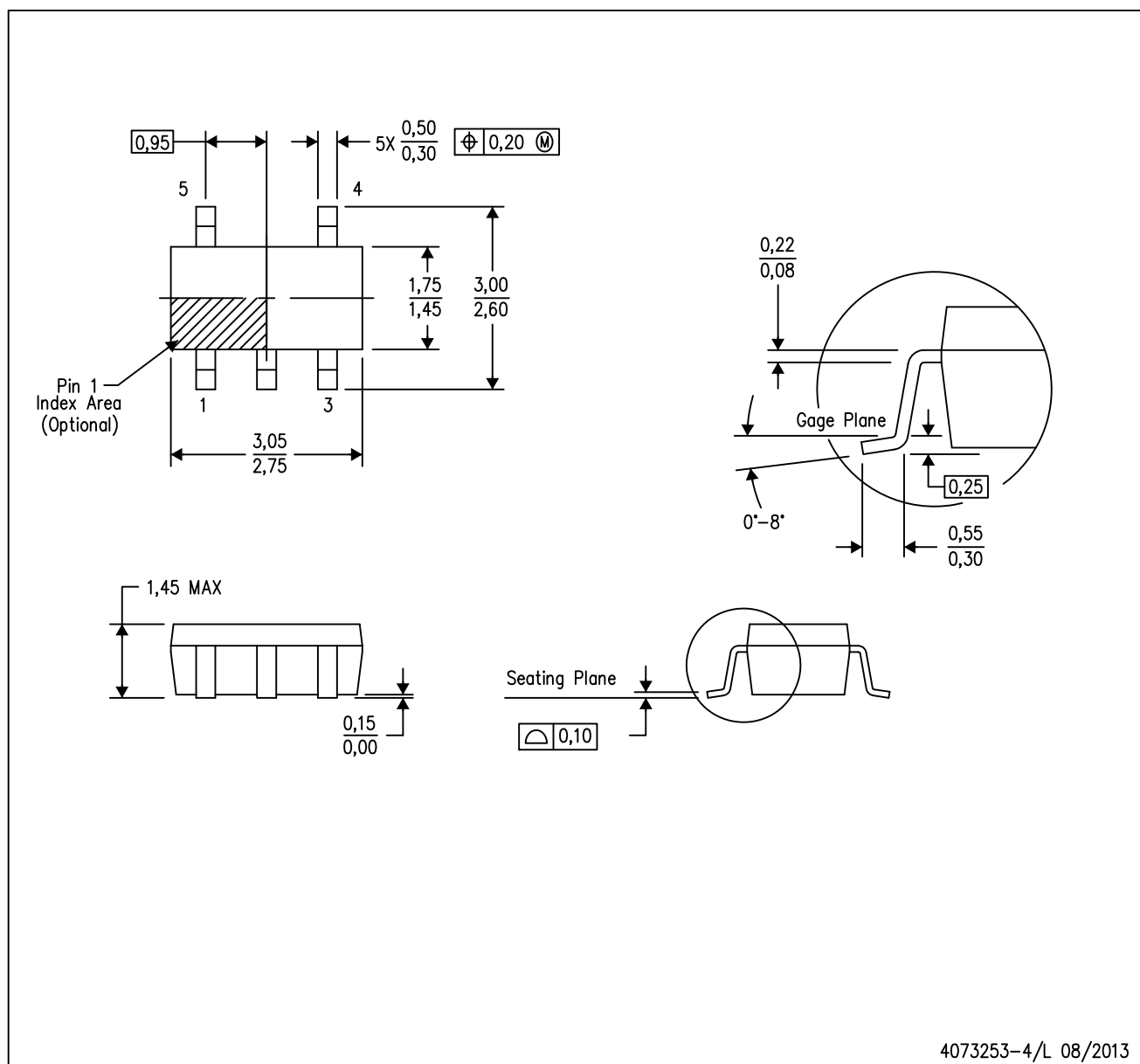
PLASTIC DUAL-IN-LINE PACKAGE



- 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.

DBV (R-PDSO-G5)

PLASTIC SMALL-OUTLINE PACKAGE

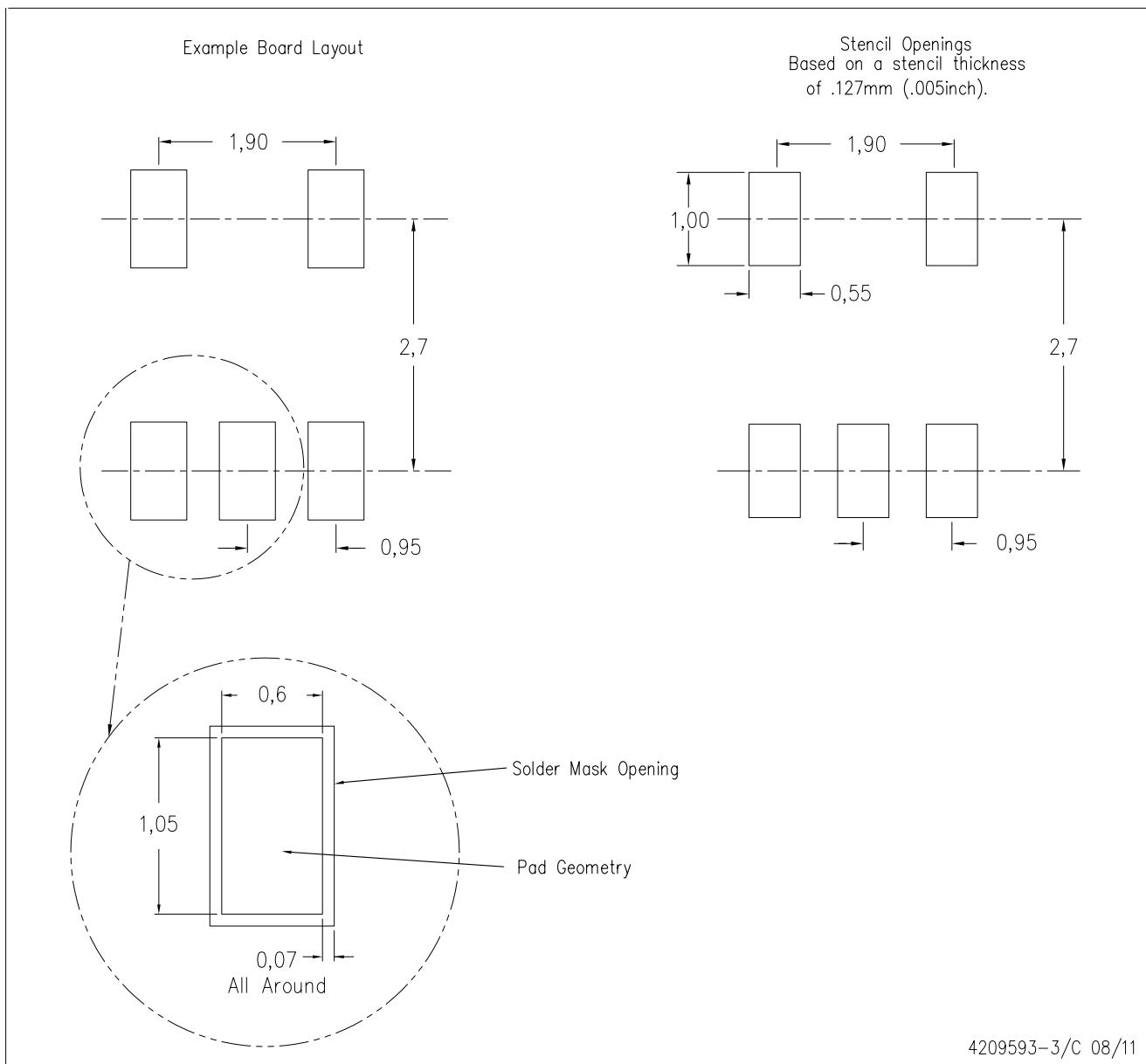


4073253-4/L 08/2013

- 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. Mold flash and protrusion shall not exceed 0.15 per side.
 - D. Falls within JEDEC MO-178 Variation AA.

DBV (R-PDSO-G5)

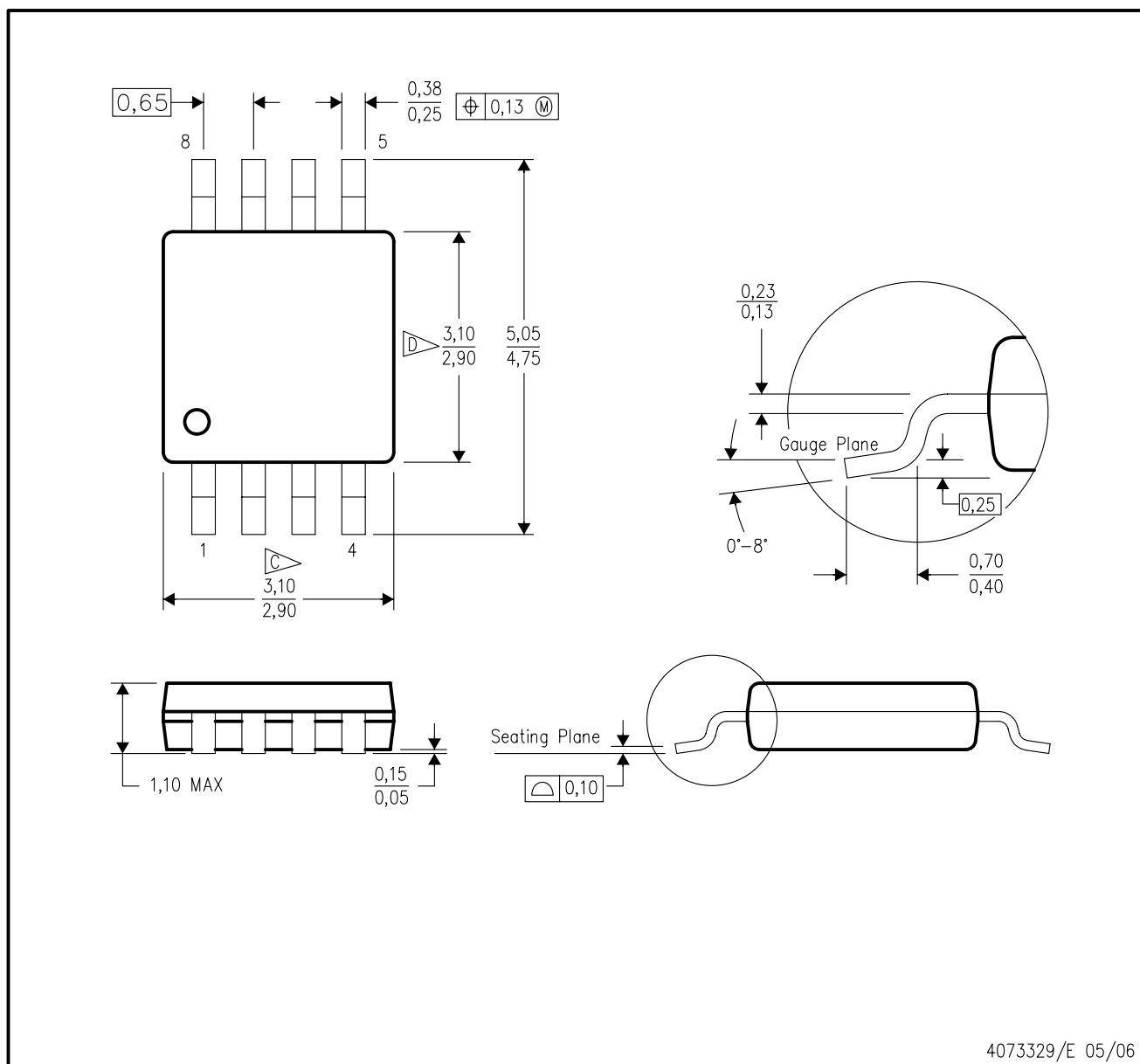
PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
 - D. Publication IPC-7351 is recommended for alternate designs.
 - E. 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. Example stencil design based on a 50% volumetric metal load solder paste. Refer to IPC-7525 for other stencil recommendations.

DGK (S-PDSO-G8)

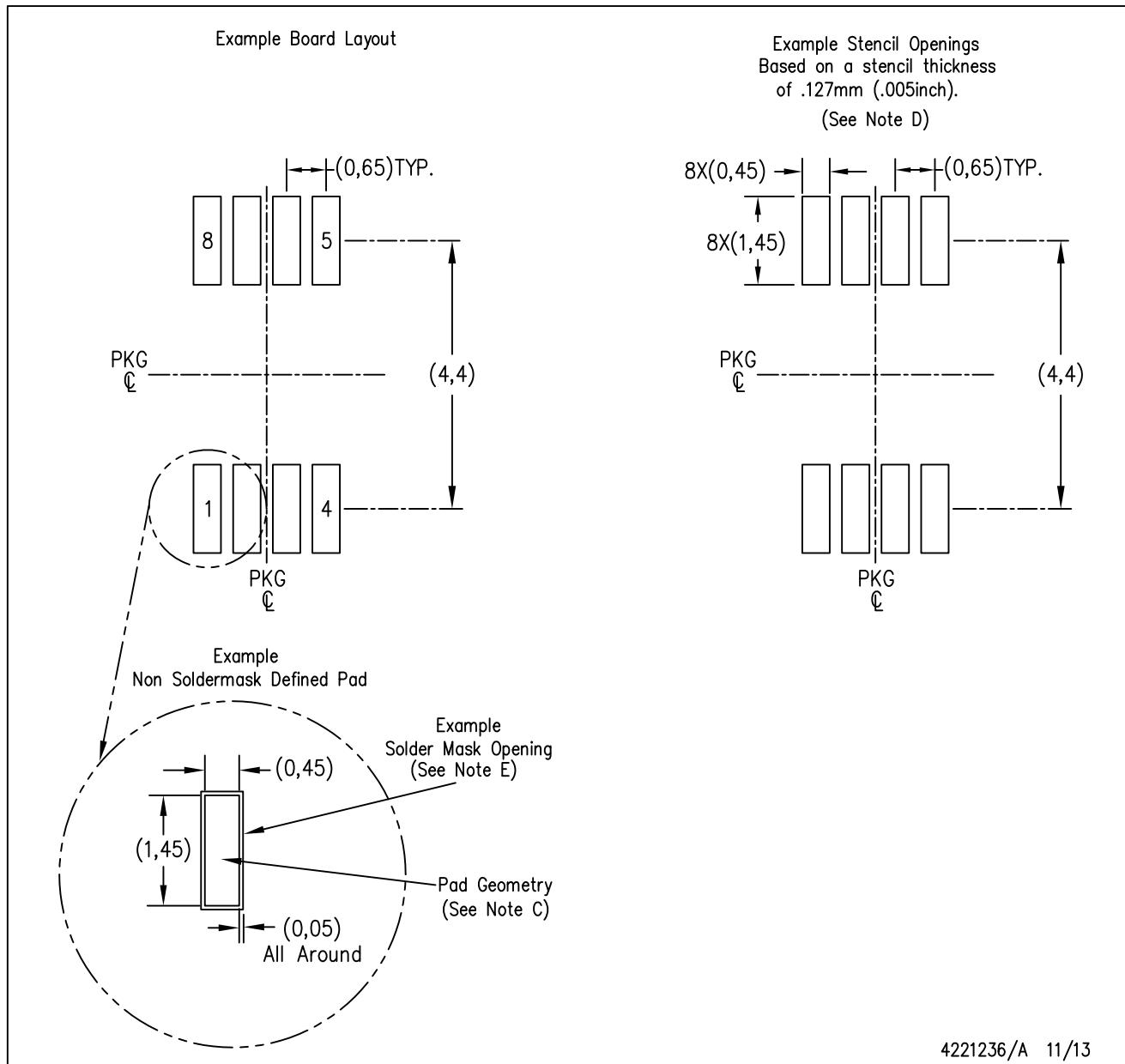
PLASTIC SMALL-OUTLINE PACKAGE



4073329/E 05/06

DGK (S-PDSO-G8)

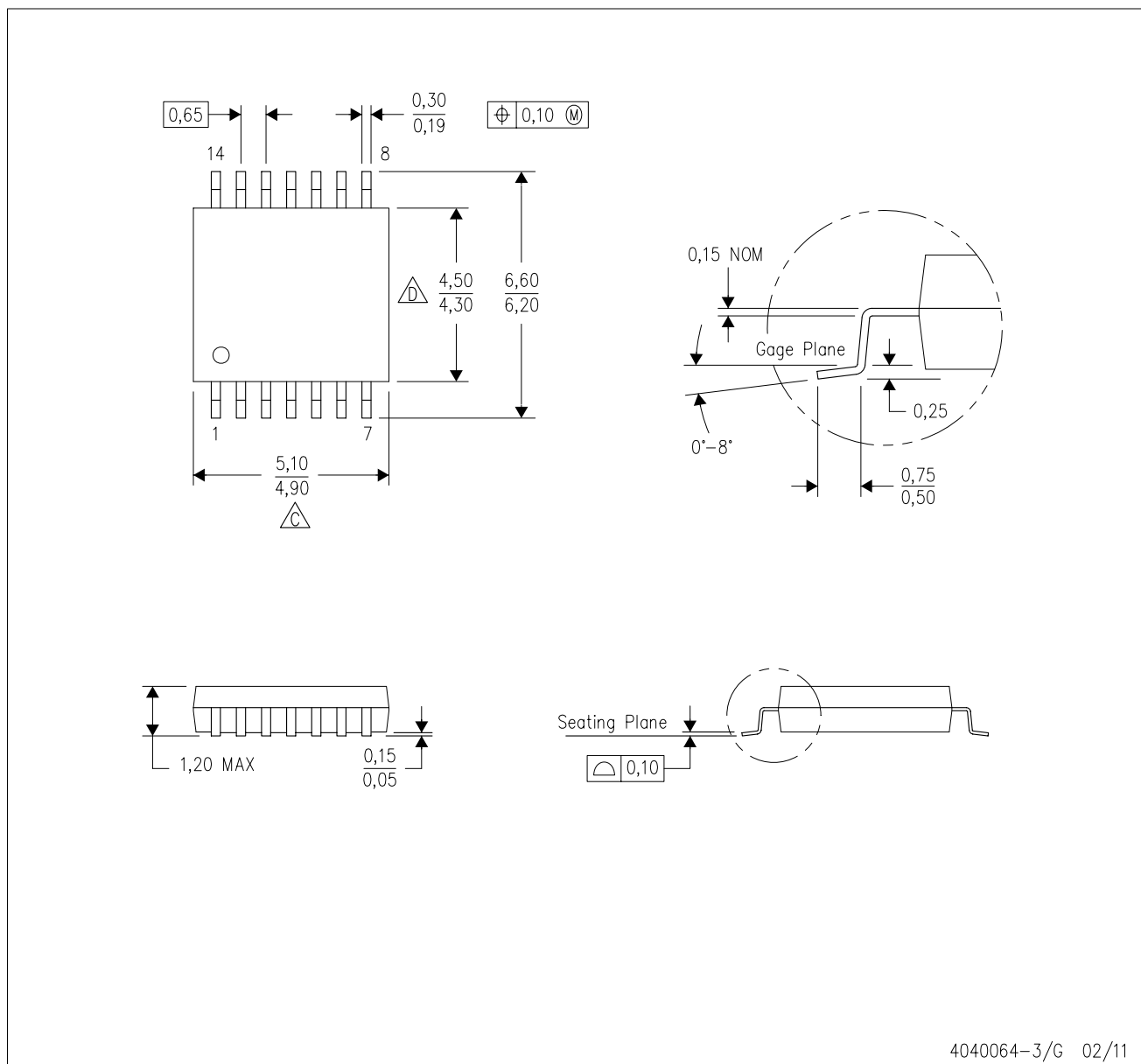
PLASTIC SMALL OUTLINE PACKAGE



- NOTES:
- All linear dimensions are in millimeters.
 - This drawing is subject to change without notice.
 - Publication IPC-7351 is recommended for alternate designs.
 - 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.
 - Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

PW (R-PDSO-G14)

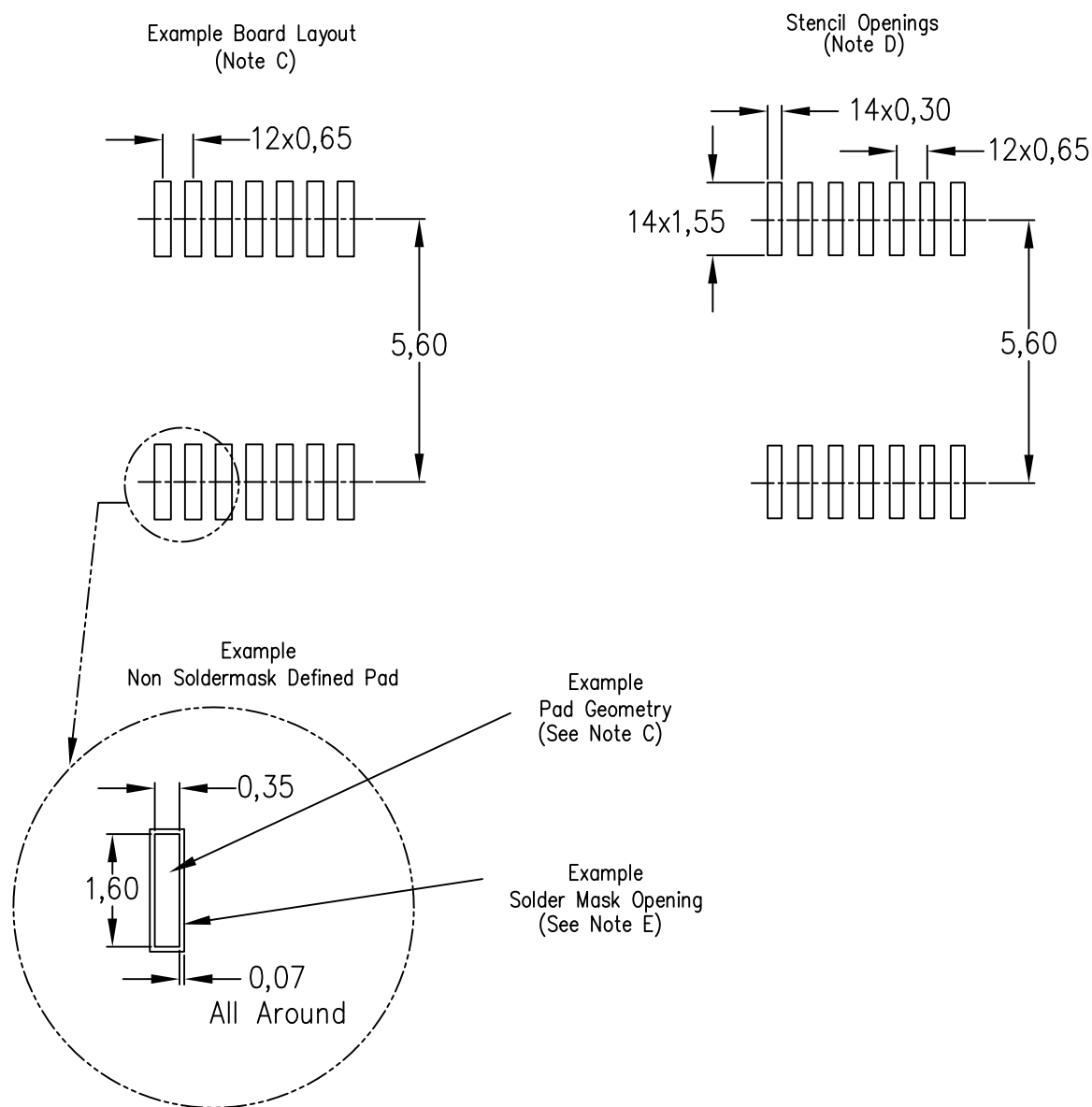
PLASTIC SMALL OUTLINE



- 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. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each side.
 - D. Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
 - E. Falls within JEDEC MO-153

PW (R-PDSO-G14)

PLASTIC SMALL OUTLINE

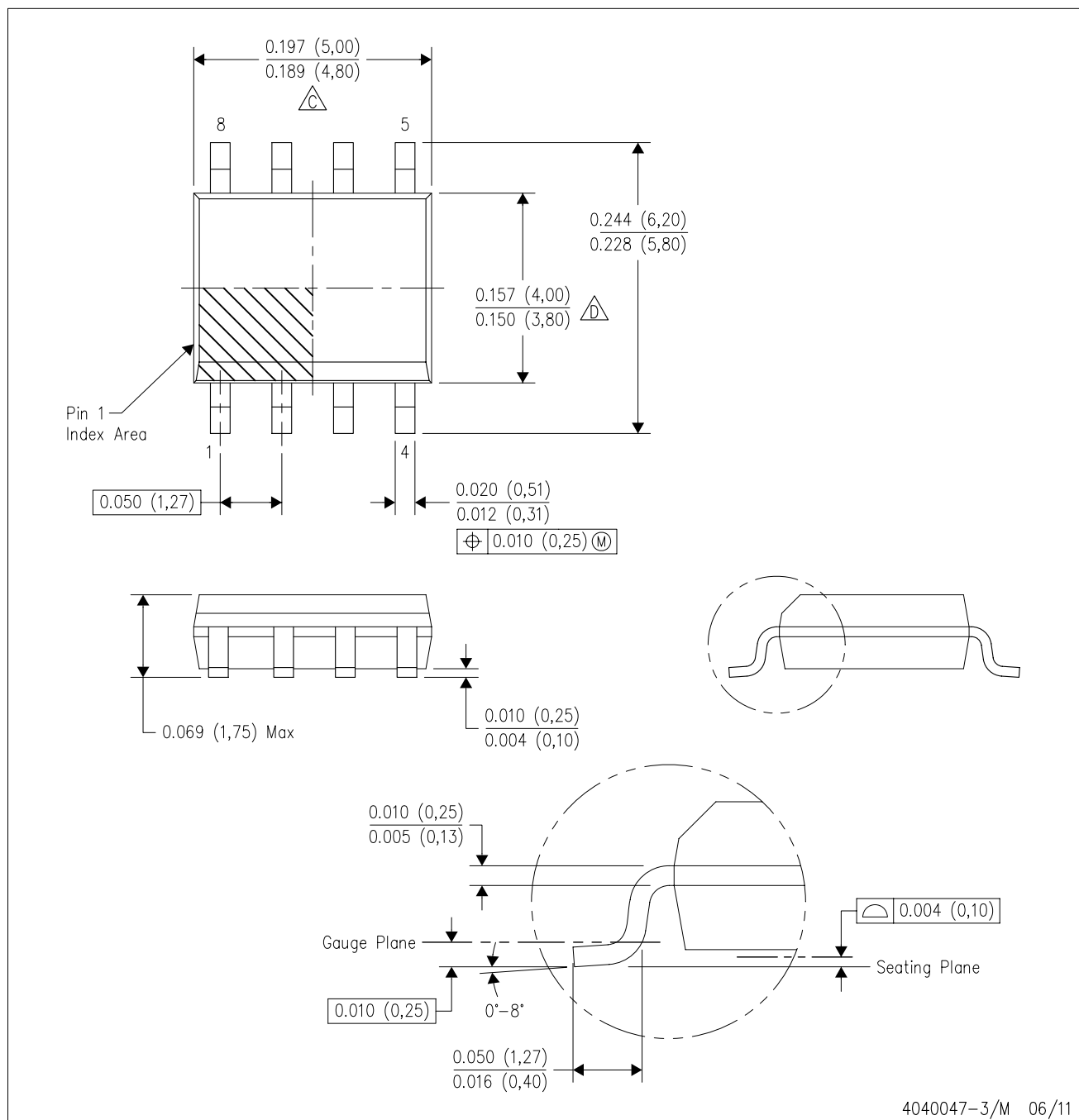


4211284-2/F 12/12

- 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.

D (R-PDSO-G8)

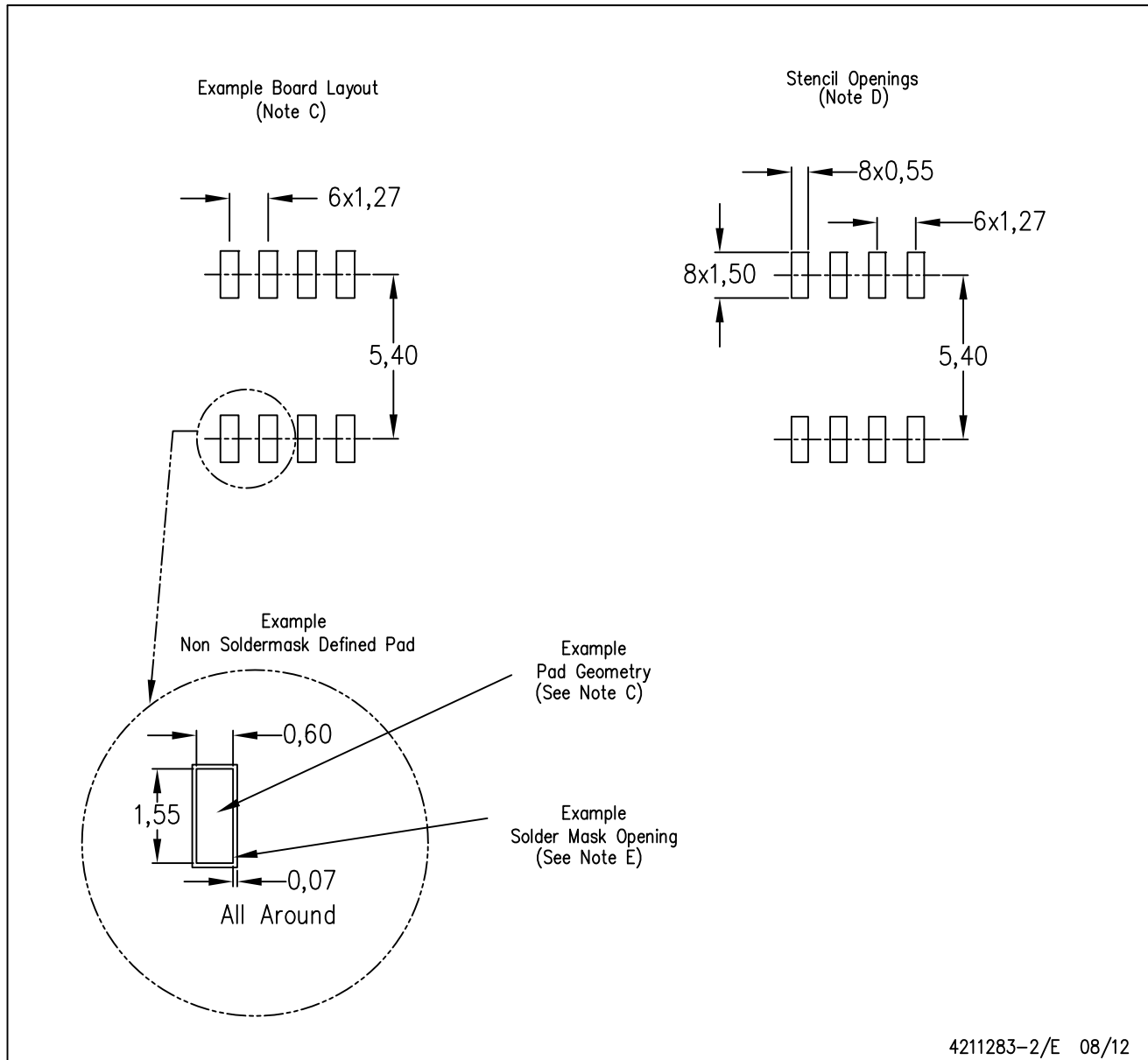
PLASTIC SMALL OUTLINE



- 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.

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.

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