

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

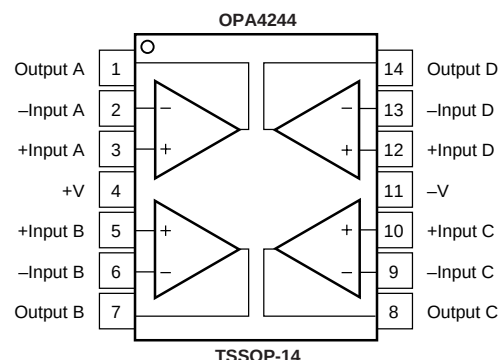
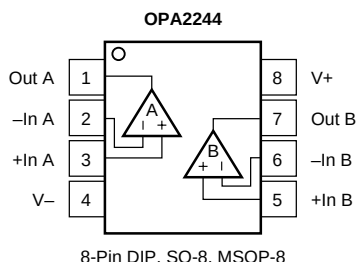
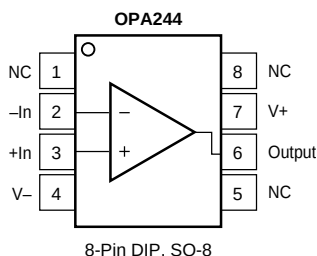
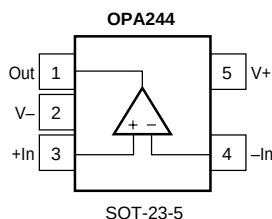
- **BATTERY POWERED SYSTEMS**
- **PORTABLE EQUIPMENT**
- **PCMCIA CARDS**
- **BATTERY PACKS AND POWER SUPPLIES**
- **CONSUMER PRODUCTS**

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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 Twx: 910-952-1111 • Internet: <http://www.burr-brown.com/> • Cable: BBRCORP • Telex: 066-6491 • FAX: (520) 889-1510 • Immediate Product Info: (800) 548-6132

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} dV_{OS}/dT $PSRR$	$V_S = \pm 7.5V, V_{CM} = 0$ $T_A = -40^{\circ}\text{C to } 85^{\circ}\text{C}$ $V_S = +2.6V \text{ to } +36V$ $V_S = +2.6V \text{ to } +36V$	 ± 0.7 ± 4 5	 ± 1.5 ± 2 50 50	 mV mV $\mu V/^{\circ}\text{C}$ $\mu V/V$ $\mu V/V$
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		 $\mu V/p$ $nV/\sqrt{Hz}$ $fA/\sqrt{Hz}$
INPUT VOLTAGE RANGE Common-Mode Voltage Range Common-Mode Rejection $T_A = -40^{\circ}\text{C to } 85^{\circ}\text{C}$	V_{CM} $CMRR$	$V_S = \pm 18V, V_{CM} = -18V \text{ to } +17.1V$ $V_S = \pm 18V, V_{CM} = -18V \text{ to } +17.1V$	0 84 84	 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 $T_A = -40^{\circ}\text{C to } 85^{\circ}\text{C}$	A_{OL}	$V_O = 0.5V \text{ to } (V+) - 0.9$ $V_O = 0.5V \text{ to } (V+) - 0.9$	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 I_{SC} C_{LOAD}	$A_{OL} \geq 80dB, R_L = 20k\Omega \text{ to } V_S/2$ $A_{OL} \geq 80dB, R_L = 20k\Omega \text{ to } V_S/2$ $A_{OL} \geq 80dB, R_L = 20k\Omega \text{ to } V_S/2$ $A_{OL} \geq 80dB, R_L = 20k\Omega \text{ to } V_S/2$ $A_{OL} \geq 80dB, R_L = 20k\Omega \text{ to Ground}$ $A_{OL} \geq 80dB, R_L = 20k\Omega \text{ to Ground}$ $A_{OL} \geq 80dB, R_L = 20k\Omega \text{ to Ground}$ $A_{OL} \geq 80dB, R_L = 20k\Omega \text{ to Ground}$ $A_{OL} \geq 80dB, R_L = 20k\Omega \text{ to Ground}$	(V+) - 0.9 (V+) - 0.9 0.5 0.5 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	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	$T_A = -40^{\circ}\text{C to } 85^{\circ}\text{C}$ $I_O = 0$ $I_O = 0$	+2.6 50	 +2.2 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	$^{\circ}\text{C}$ $^{\circ}\text{C}$ $^{\circ}\text{C}$ $^{\circ}\text{C/W}$ $^{\circ}\text{C/W}$ $^{\circ}\text{C/W}$

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 $T_A = +25^{\circ}\text{C}$, $R_I = 20\text{k}\Omega$ 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/ μs 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 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	 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 -65 100	 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.

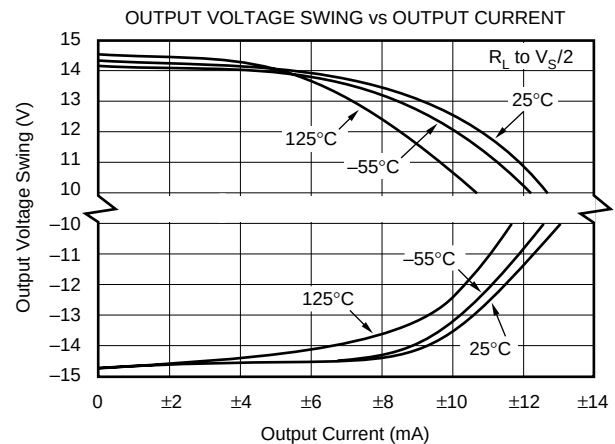
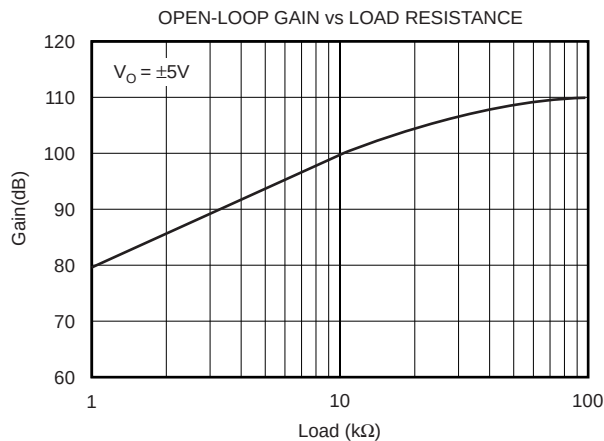
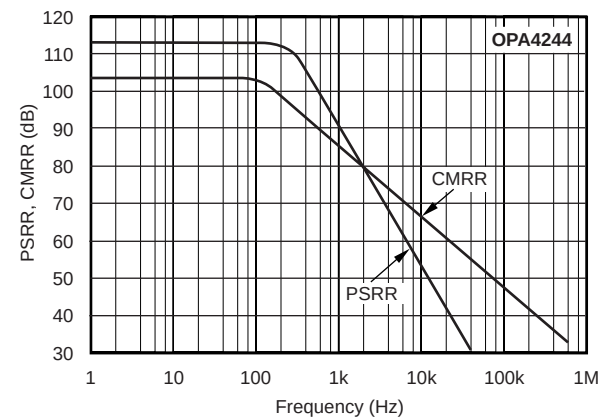
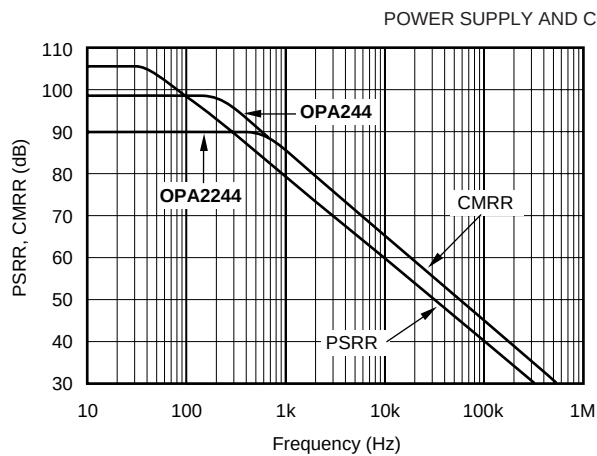
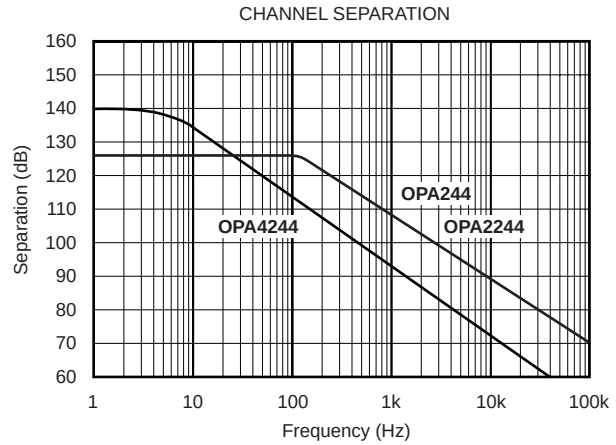
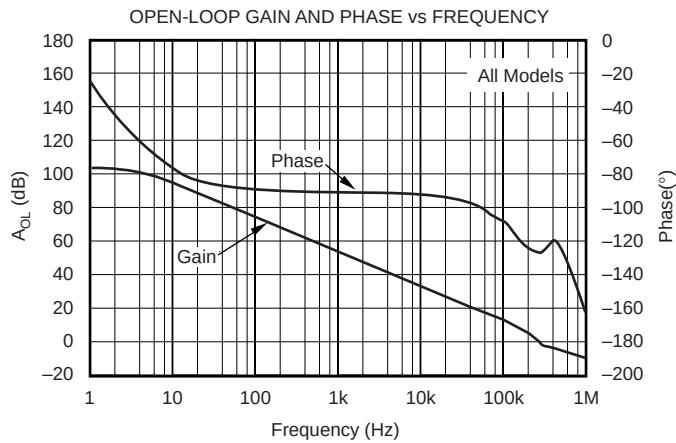
PACKAGE/ORDERING INFORMATION

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.

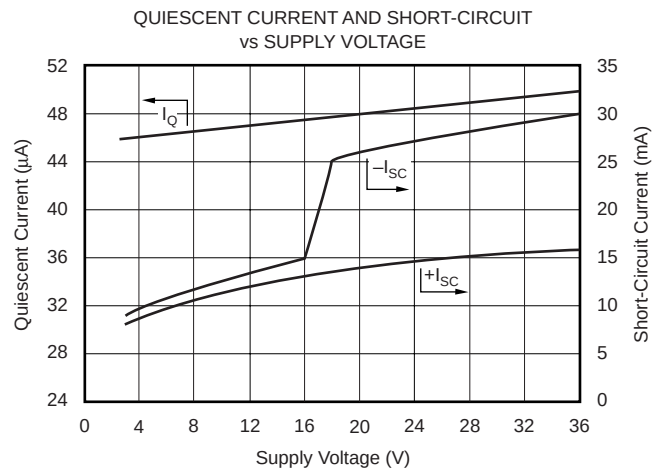
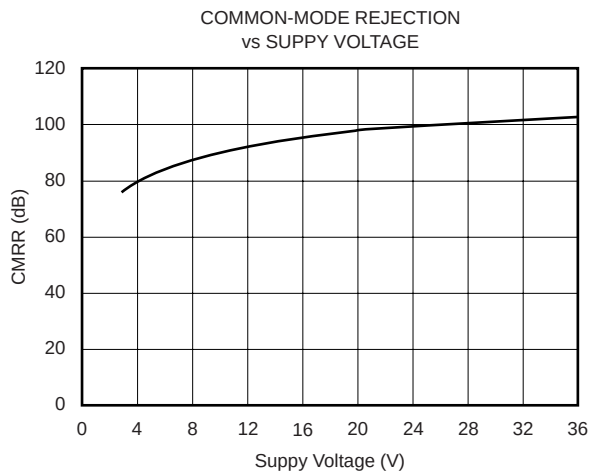
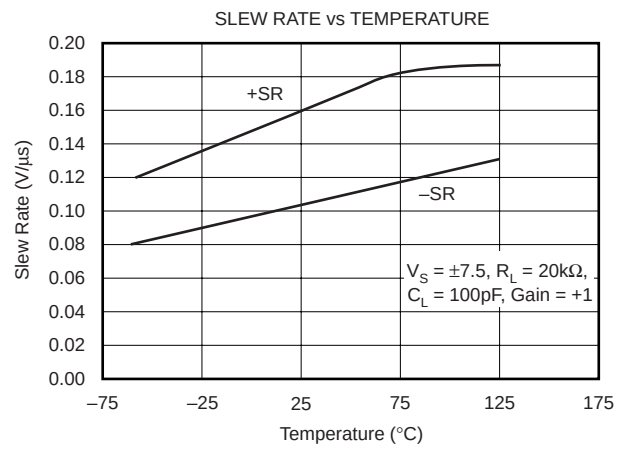
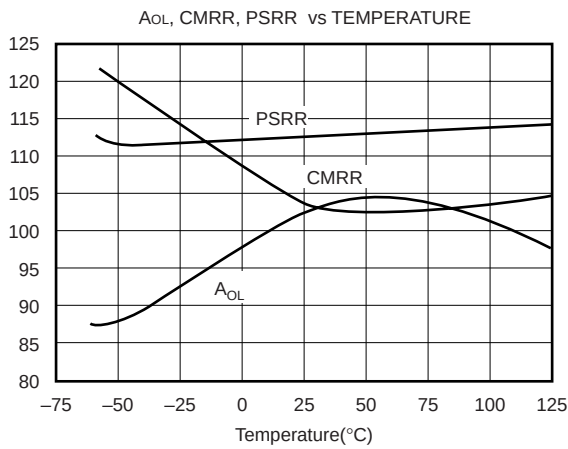
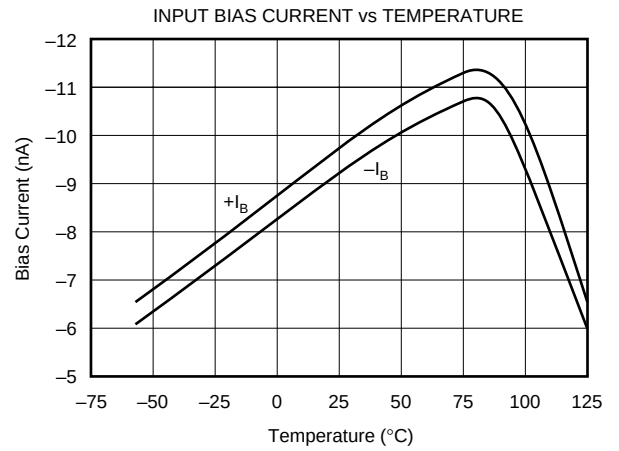
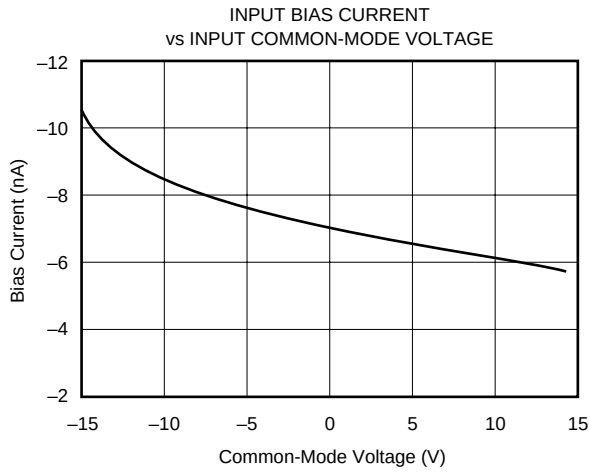
TYPICAL PERFORMANCE CURVES

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.)

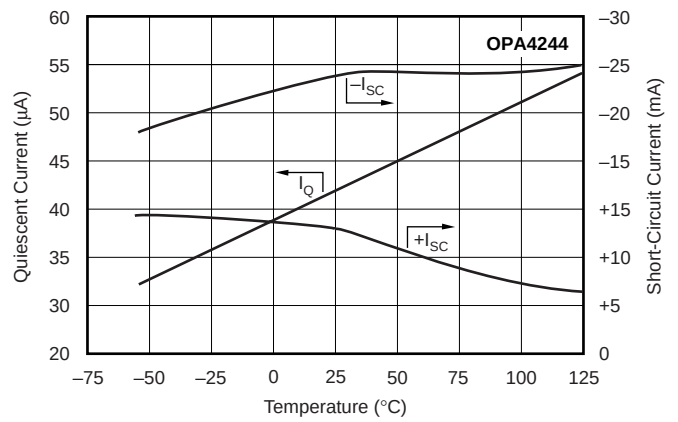
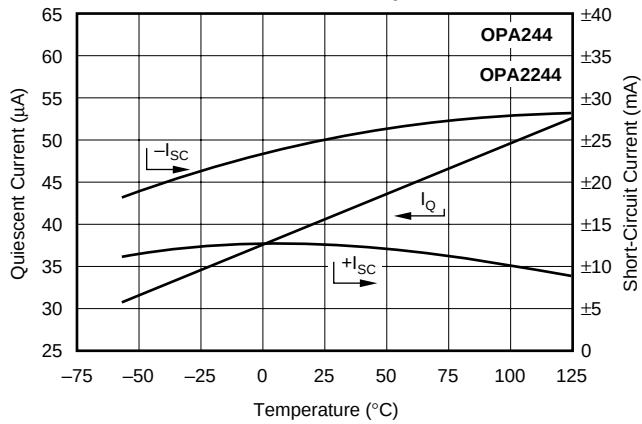
At $T_A = 25^\circ\text{C}$, $V_S = +15\text{V}$, and $R_L = 20\text{k}\Omega$ connected to Ground, unless otherwise noted.



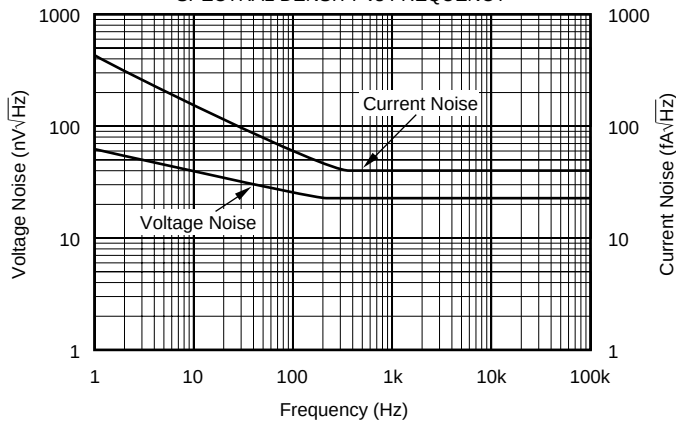
TYPICAL PERFORMANCE CURVES (Cont.)

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.

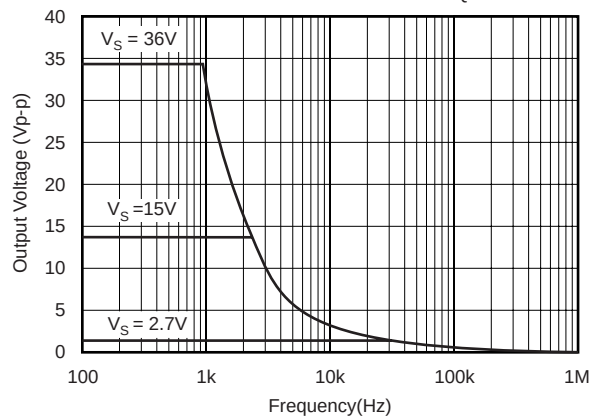
QUIESCENT AND SHORT-CIRCUIT CURRENT vs TEMPERATURE



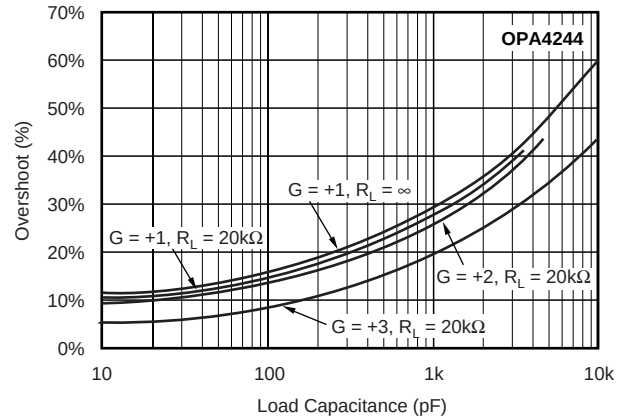
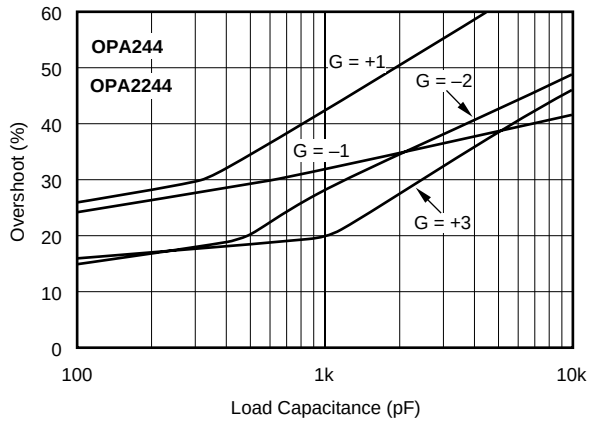
INPUT VOLTAGE AND CURRENT NOISE SPECTRAL DENSITY vs FREQUENCY



MAXIMUM OUTPUT VOLTAGE vs FREQUENCY



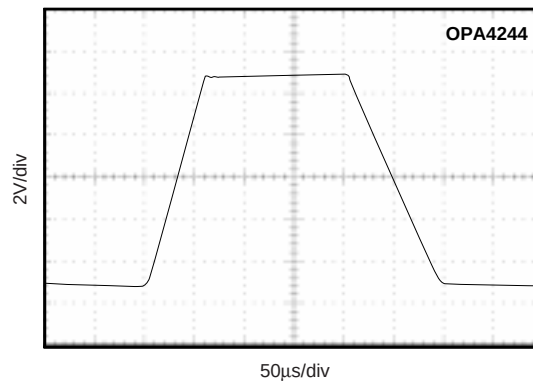
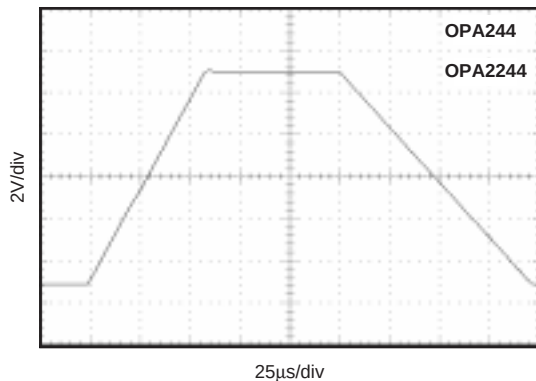
SMALL SIGNAL OVERSHOOT vs LOAD CAPACITANCE



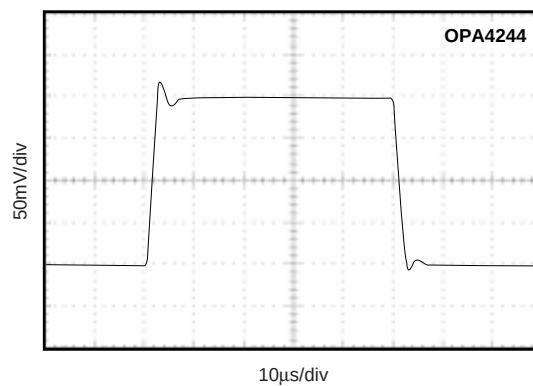
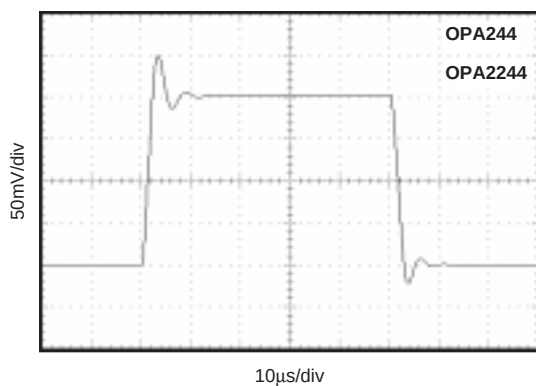
TYPICAL PERFORMANCE CURVES (Cont.)

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.

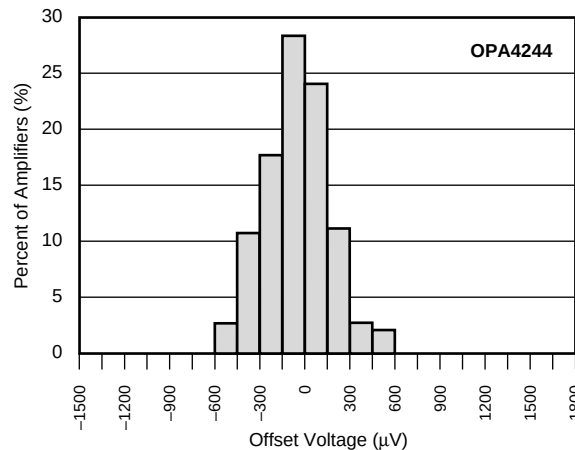
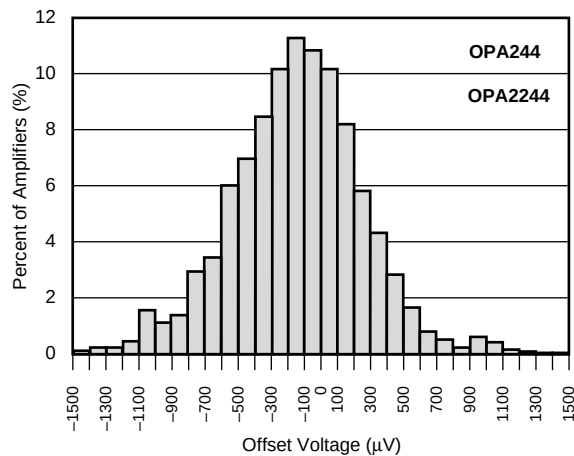
LARGE-SIGNAL STEP RESPONSE, $G = 1$, $C_L = 100\text{pF}$



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

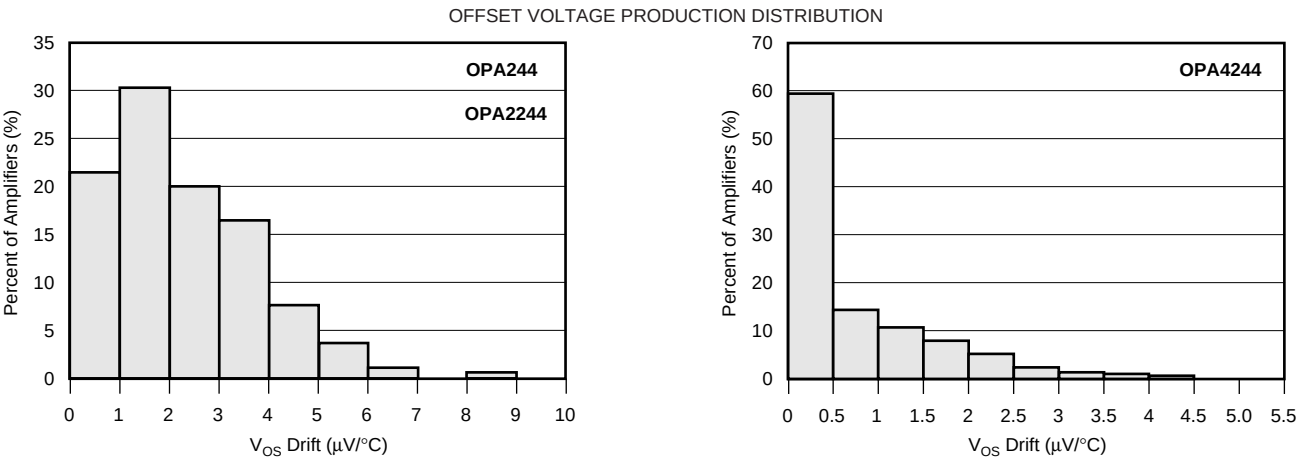


OFFSET VOLTAGE PRODUCTION DISTRIBUTION



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.



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>).

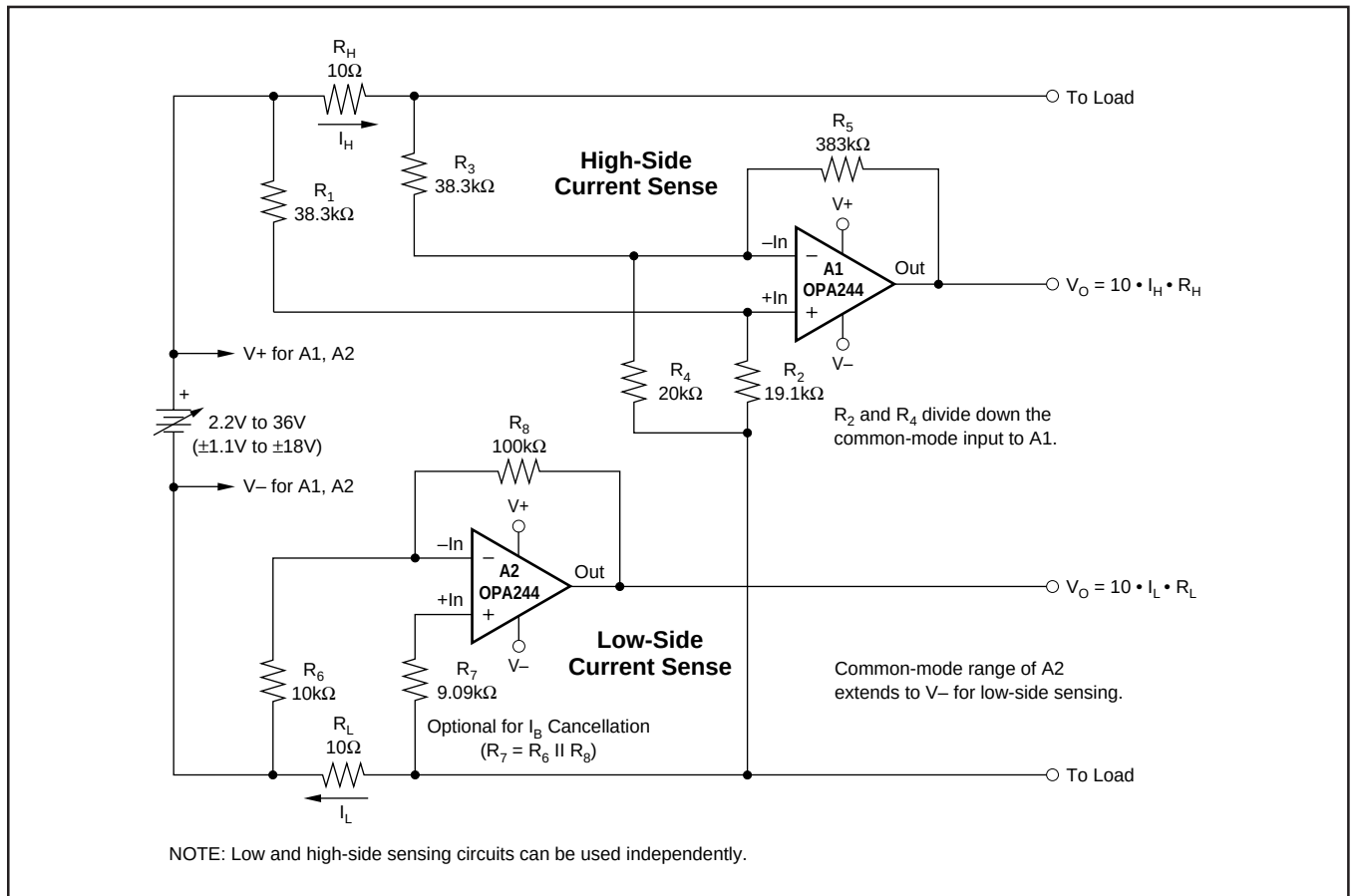


FIGURE 1. Low and High-Side Battery Current Sensing.

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package Pins	Package qty Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
OPA2244EA/250	Obsolete	Production	VSSOP (DGK) 8	-	-	Call TI	Call TI	-40 to 85	A44
OPA2244EA/2K5	Active	Production	VSSOP (DGK) 8	2500 LARGE T&R	Yes	Call TI Nipdau	Level-2-260C-1 YEAR	-40 to 85	A44
OPA2244EA/2K5.A	Active	Production	VSSOP (DGK) 8	2500 LARGE T&R	Yes	Call TI	Level-2-260C-1 YEAR	-40 to 85	A44
OPA2244EA/2K5G4	Active	Production	VSSOP (DGK) 8	2500 LARGE T&R	-	Call TI	Call TI	-40 to 85	
OPA2244PA	Active	Production	PDIP (P) 8	50 TUBE	Yes	NIPDAU	N/A for Pkg Type	-	OPA2244PA
OPA2244PA.A	Active	Production	PDIP (P) 8	50 TUBE	Yes	NIPDAU	N/A for Pkg Type	-40 to 85	OPA2244PA
OPA2244UA	Obsolete	Production	SOIC (D) 8	-	-	Call TI	Call TI	-	OPA 2244UA
OPA2244UA/2K5	Active	Production	SOIC (D) 8	2500 LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-	OPA 2244UA
OPA2244UA/2K5.A	Active	Production	SOIC (D) 8	2500 LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 85	OPA 2244UA
OPA244NA/250	Obsolete	Production	SOT-23 (DBV) 5	-	-	Call TI	Call TI	-40 to 85	A44
OPA244NA/3K	Active	Production	SOT-23 (DBV) 5	3000 LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	A44
OPA244NA/3K.A	Active	Production	SOT-23 (DBV) 5	3000 LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	A44
OPA244NA/3K1G4	Active	Production	SOT-23 (DBV) 5	3000 LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	A44
OPA244NA/3K1G4.A	Active	Production	SOT-23 (DBV) 5	3000 LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	A44
OPA244UA	Obsolete	Production	SOIC (D) 8	-	-	Call TI	Call TI	-40 to 85	OPA 244UA
OPA244UA/2K5	Active	Production	SOIC (D) 8	2500 LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 85	OPA 244UA
OPA244UA/2K5.A	Active	Production	SOIC (D) 8	2500 LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 85	OPA 244UA
OPA4244EA/250	Obsolete	Production	TSSOP (PW) 14	-	-	Call TI	Call TI	-40 to 85	OPA 4244EA
OPA4244EA/2K5	Active	Production	TSSOP (PW) 14	2500 LARGE T&R	Yes	Call TI Nipdau	Level-3-260C-168 HR	-40 to 85	OPA 4244EA
OPA4244EA/2K5.A	Active	Production	TSSOP (PW) 14	2500 LARGE T&R	Yes	Call TI	Level-3-260C-168 HR	-40 to 85	OPA 4244EA
OPA4244EA/2K5.B	Active	Production	TSSOP (PW) 14	2500 LARGE T&R	-	Call TI	Call TI	-40 to 85	

⁽¹⁾ Status: For more details on status, see our [product life cycle](#).

⁽²⁾ **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

⁽³⁾ **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

⁽⁴⁾ **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

⁽⁵⁾ **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

⁽⁶⁾ **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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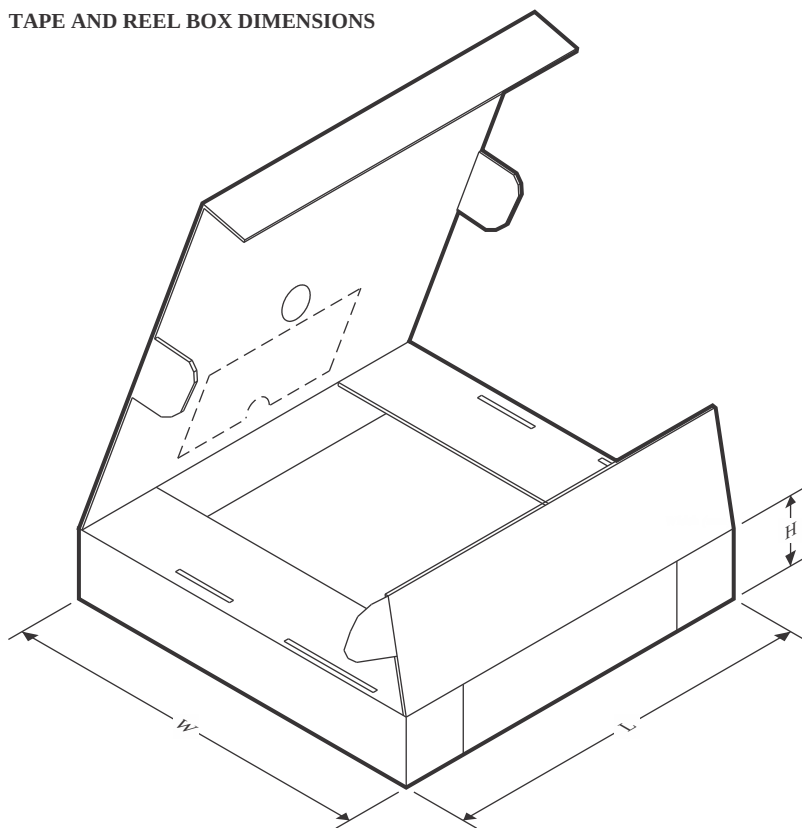
TAPE AND REEL INFORMATION



*All dimensions are nominal

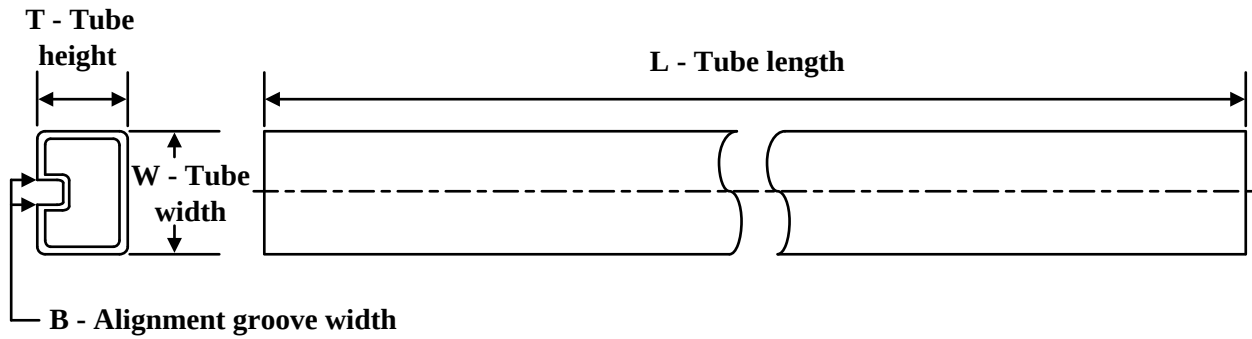
Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
OPA2244EA/2K5	VSSOP	DGK	8	2500	330.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1
OPA2244UA/2K5	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
OPA244NA/3K	SOT-23	DBV	5	3000	178.0	8.4	3.3	3.2	1.4	4.0	8.0	Q3
OPA244NA/3K1G4	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/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/2K5	VSSOP	DGK	8	2500	353.0	353.0	32.0
OPA2244UA/2K5	SOIC	D	8	2500	353.0	353.0	32.0
OPA244NA/3K	SOT-23	DBV	5	3000	565.0	140.0	75.0
OPA244NA/3K1G4	SOT-23	DBV	5	3000	565.0	140.0	75.0
OPA244UA/2K5	SOIC	D	8	2500	353.0	353.0	32.0
OPA4244EA/2K5	TSSOP	PW	14	2500	353.0	353.0	32.0

TUBE


*All dimensions are nominal

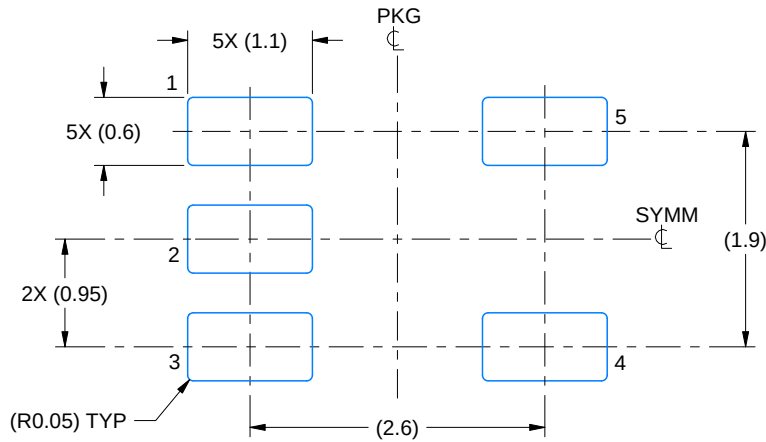
Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (μm)	B (mm)
OPA2244PA	P	PDIP	8	50	506	13.97	11230	4.32
OPA2244PA.A	P	PDIP	8	50	506	13.97	11230	4.32

EXAMPLE BOARD LAYOUT

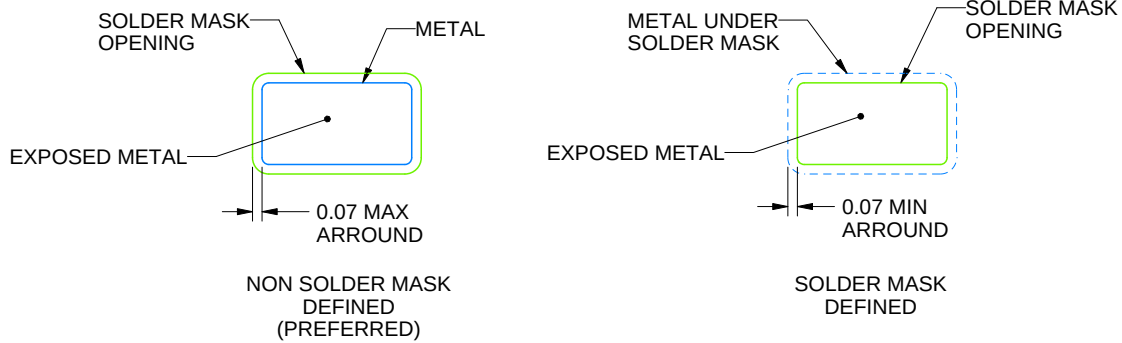
DBV0005A

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:15X



SOLDER MASK DETAILS

4214839/K 08/2024

NOTES: (continued)

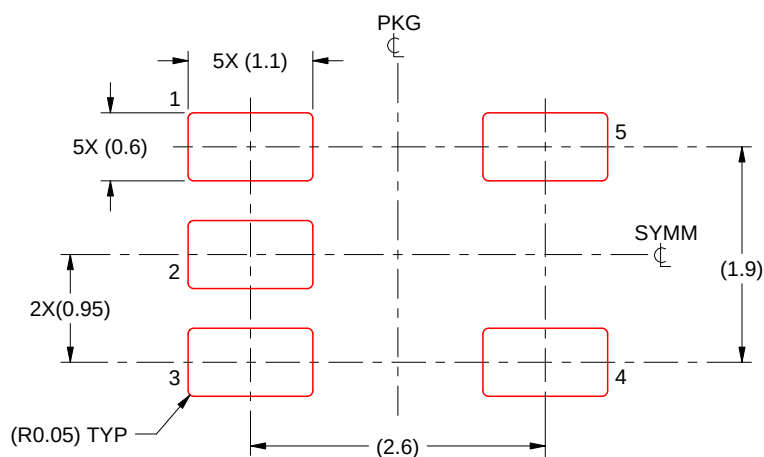
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

DBV0005A

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR

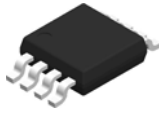


SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:15X

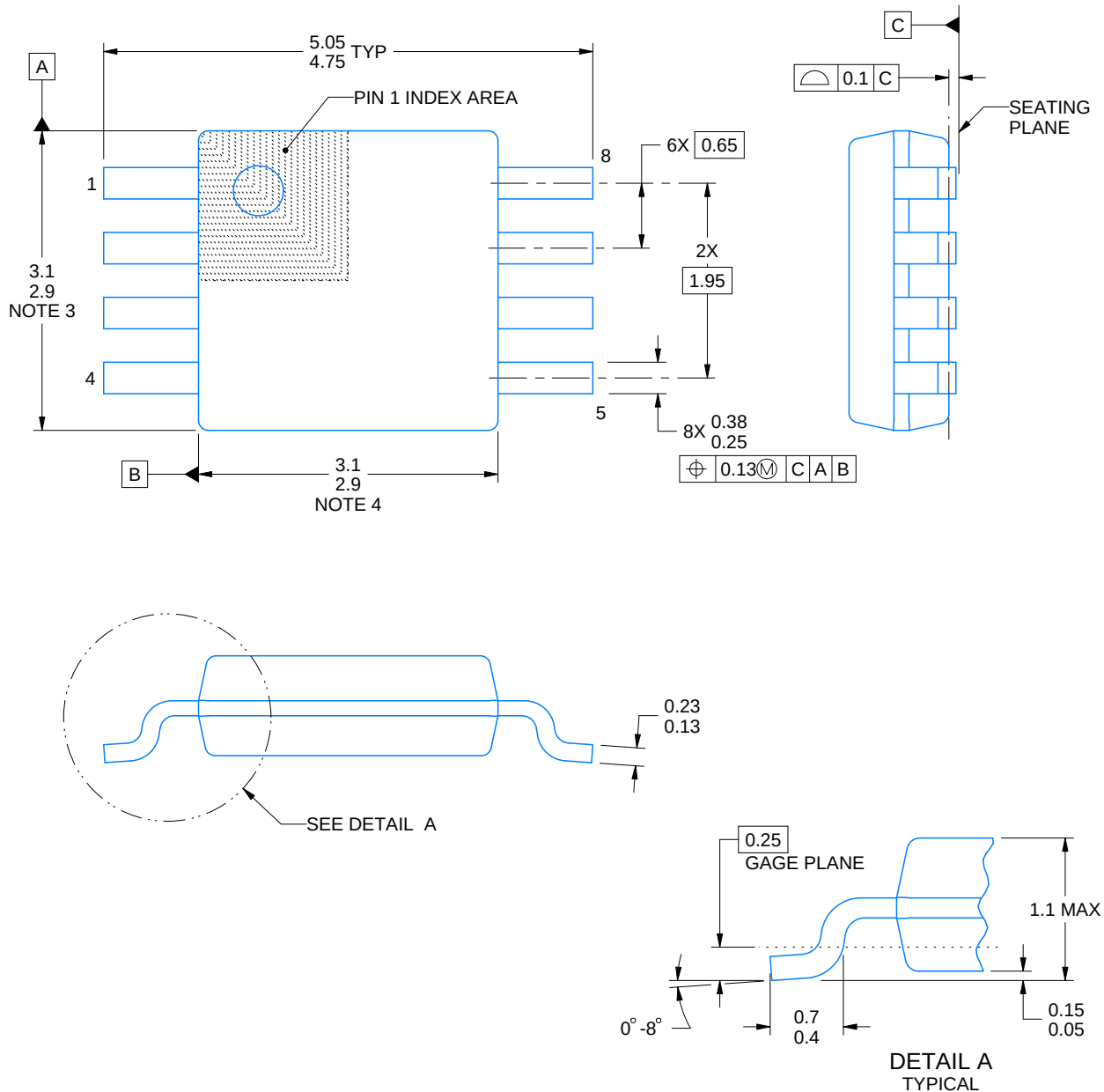
4214839/K 08/2024

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

DGK0008A**PACKAGE OUTLINE****VSSOP - 1.1 mm max height**

SMALL OUTLINE PACKAGE



4214862/A 04/2023

NOTES:

PowerPAD is a trademark of Texas Instruments.

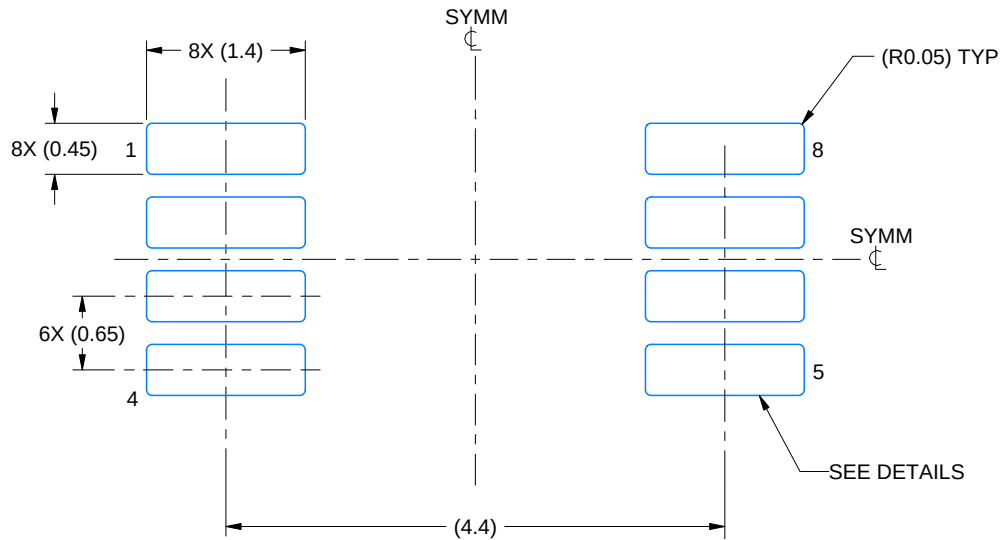
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-187.

EXAMPLE BOARD LAYOUT

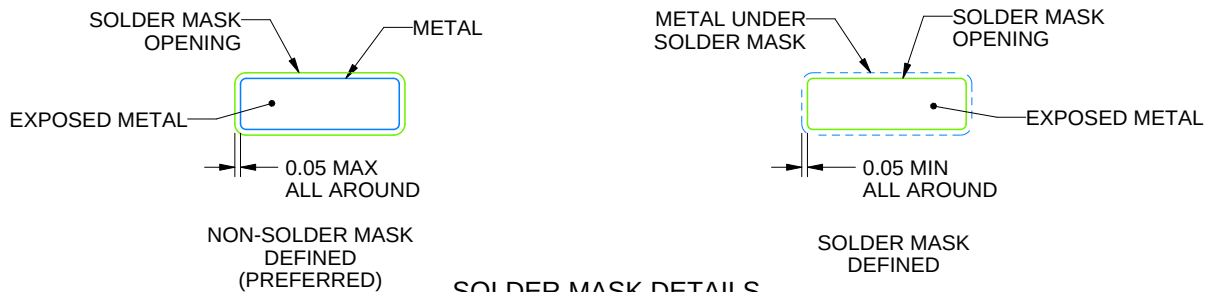
DGK0008A

TM VSSOP - 1.1 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 15X



SOLDER MASK DETAILS

4214862/A 04/2023

NOTES: (continued)

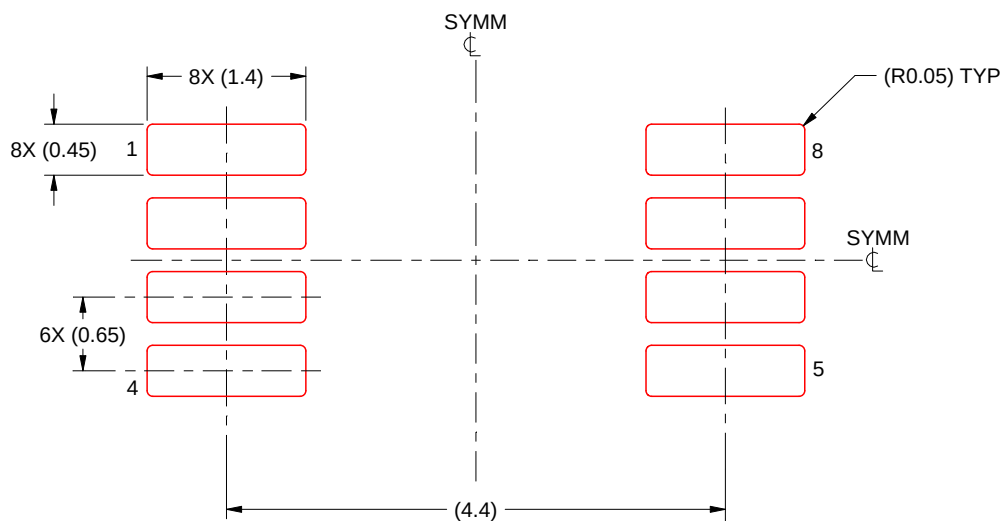
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.
8. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.
9. Size of metal pad may vary due to creepage requirement.

EXAMPLE STENCIL DESIGN

DGK0008A

TM VSSOP - 1.1 mm max height

SMALL OUTLINE PACKAGE

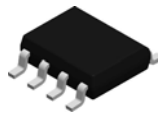


SOLDER PASTE EXAMPLE
SCALE: 15X

4214862/A 04/2023

NOTES: (continued)

11. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
12. Board assembly site may have different recommendations for stencil design.

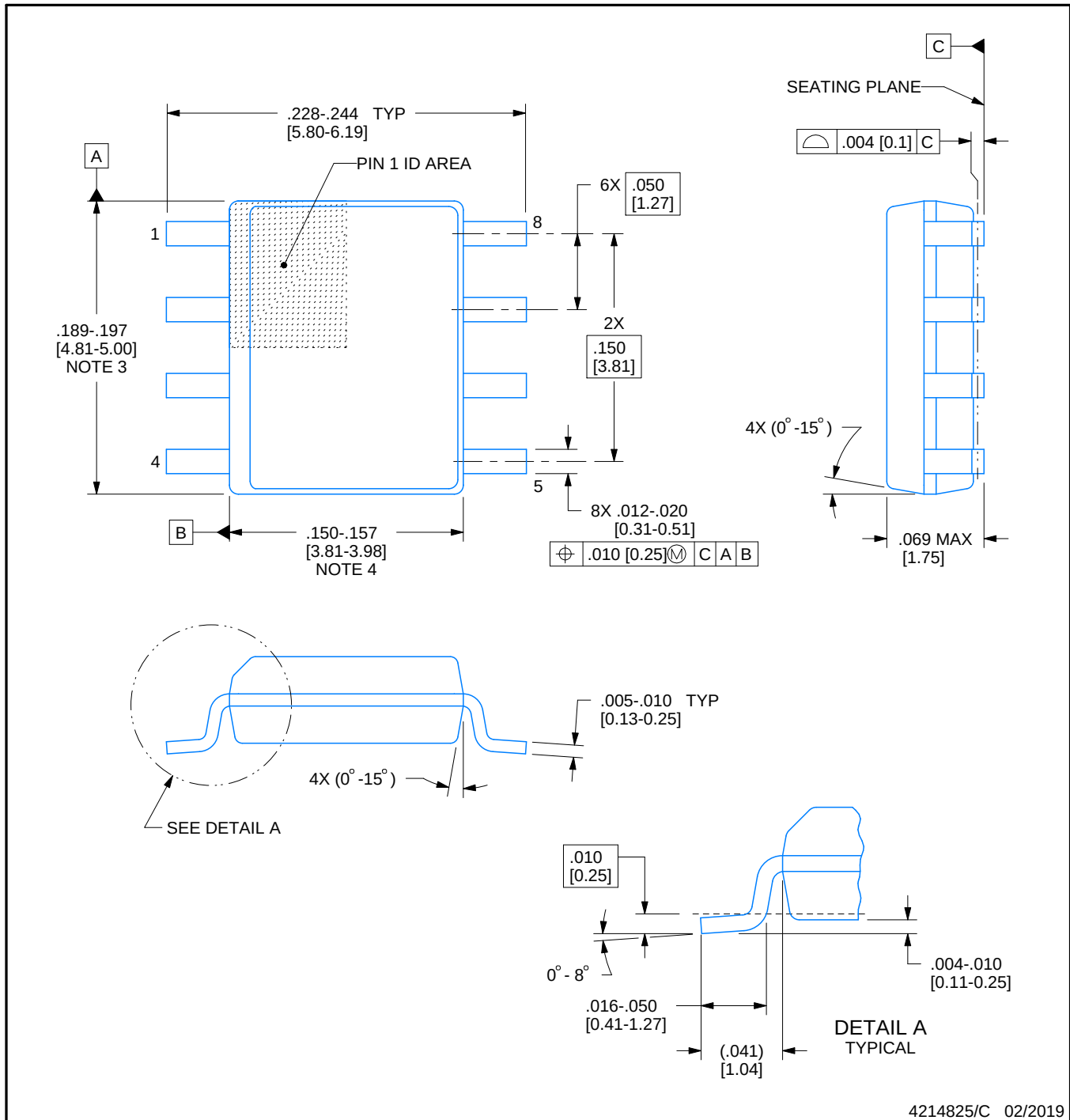


D0008A

PACKAGE OUTLINE

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



4214825/C 02/2019

NOTES:

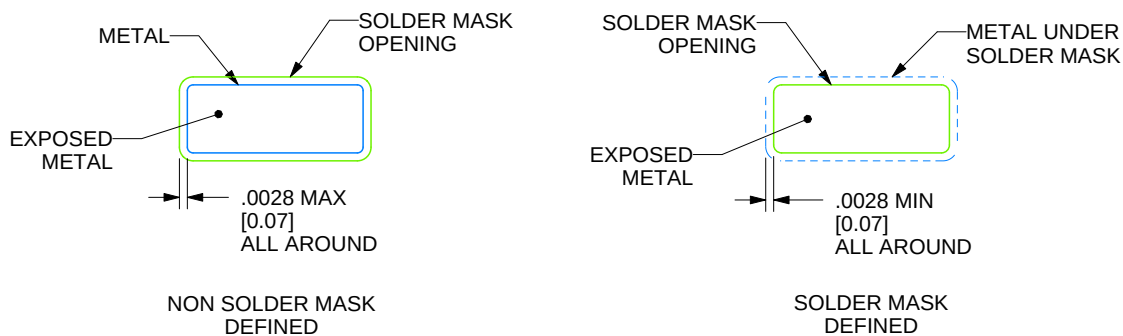
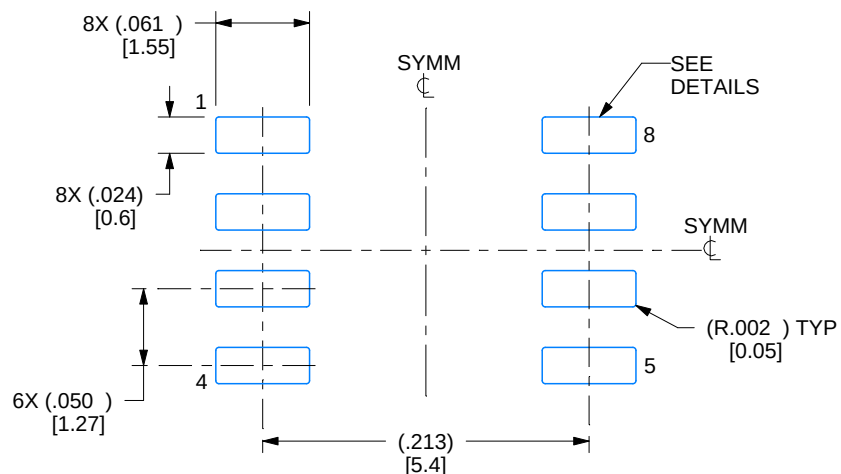
1. Linear dimensions are in inches [millimeters]. Dimensions in parenthesis are for reference only. Controlling dimensions are in inches. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 [0.15] per side.
4. This dimension does not include interlead flash.
5. Reference JEDEC registration MS-012, variation AA.

EXAMPLE BOARD LAYOUT

D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



4214825/C 02/2019

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

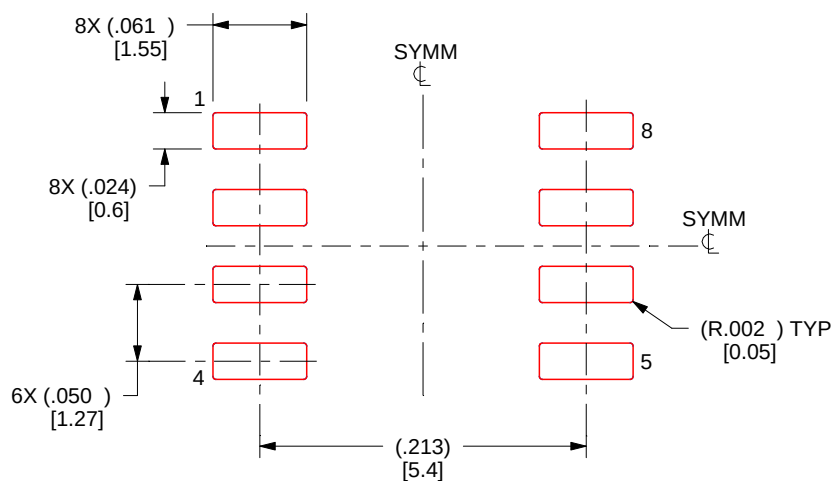
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



SOLDER PASTE EXAMPLE
BASED ON .005 INCH [0.125 MM] THICK STENCIL
SCALE:8X

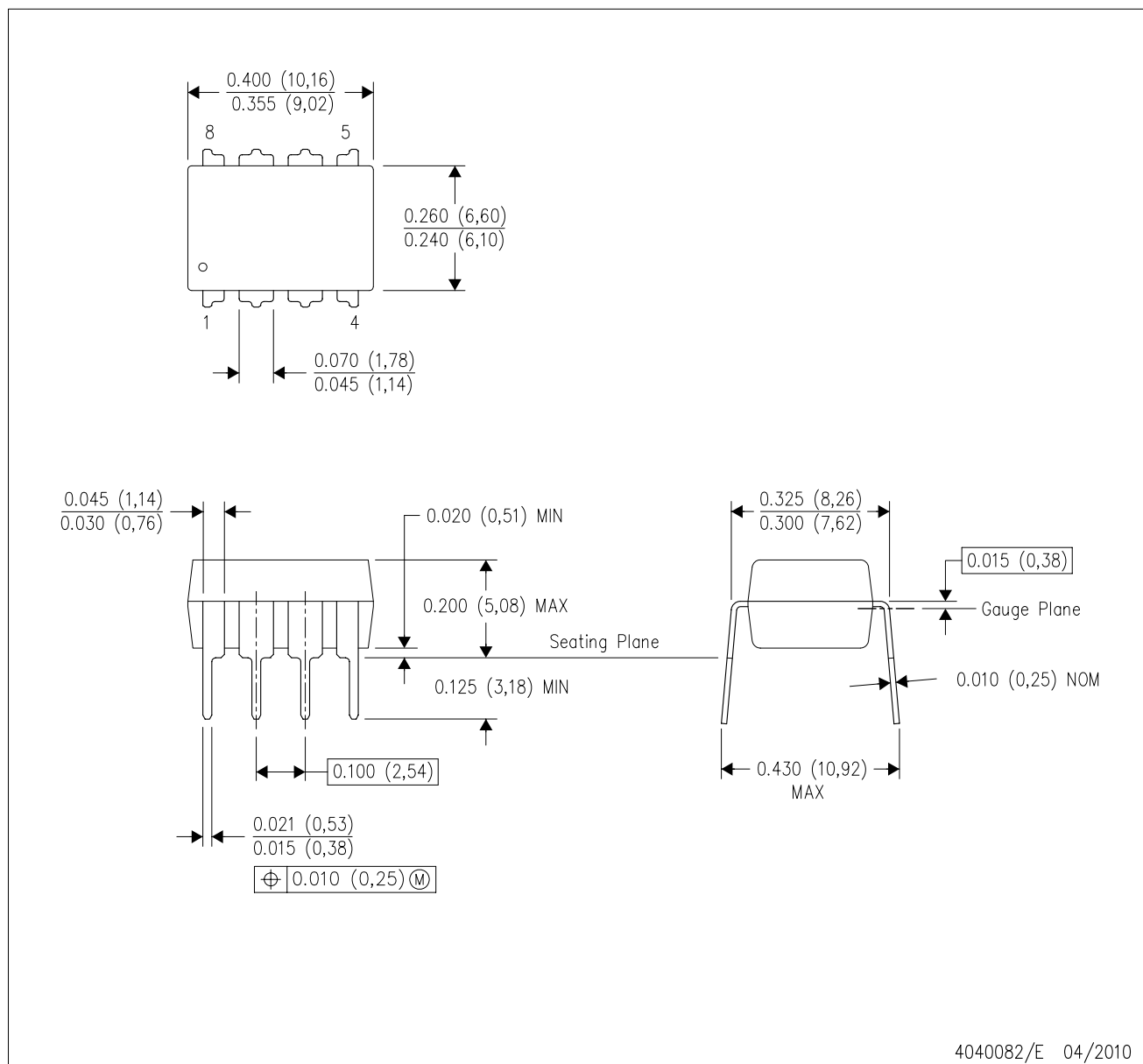
4214825/C 02/2019

NOTES: (continued)

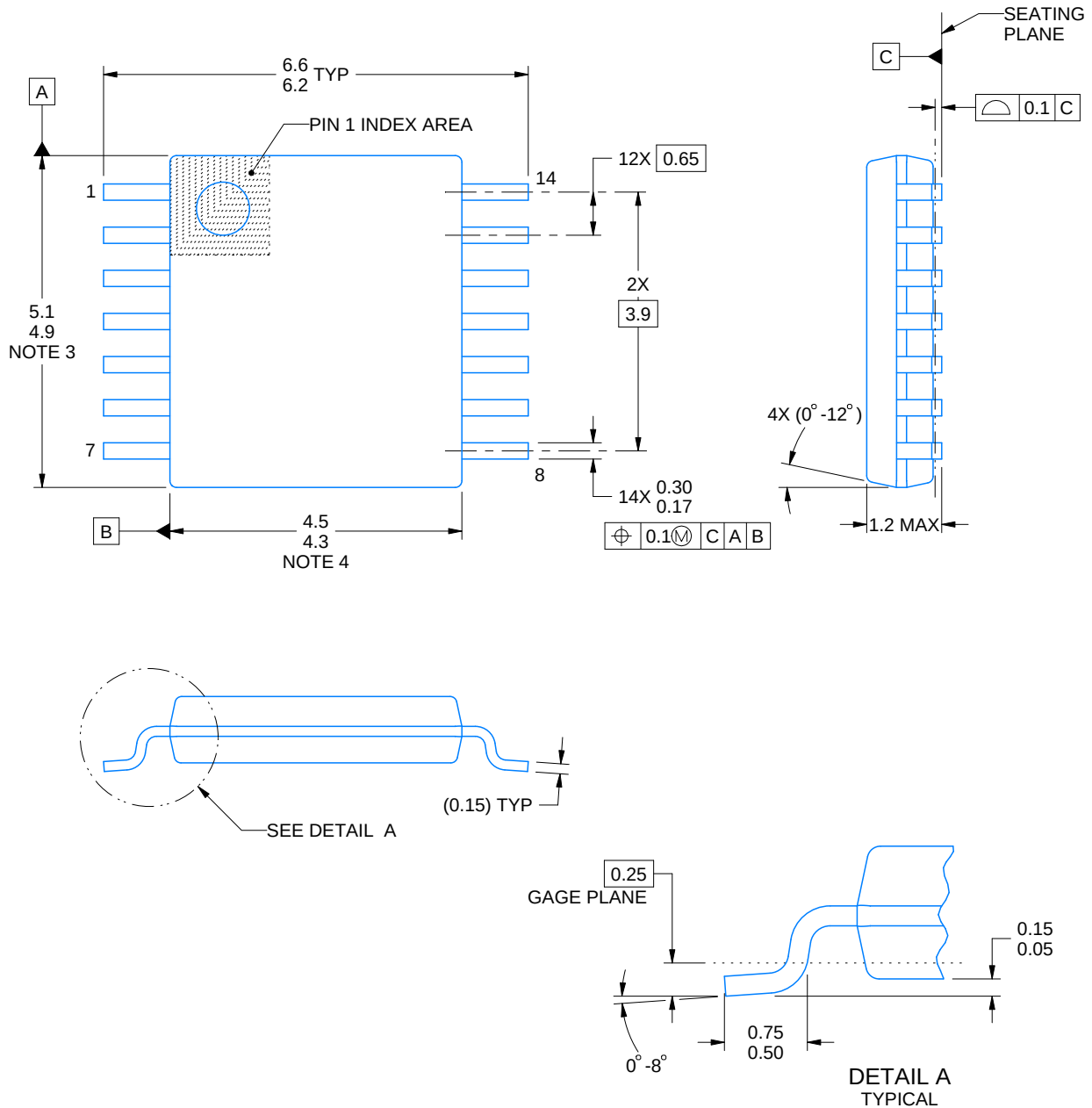
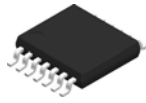
8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

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.



4220202/B 12/2023

NOTES:

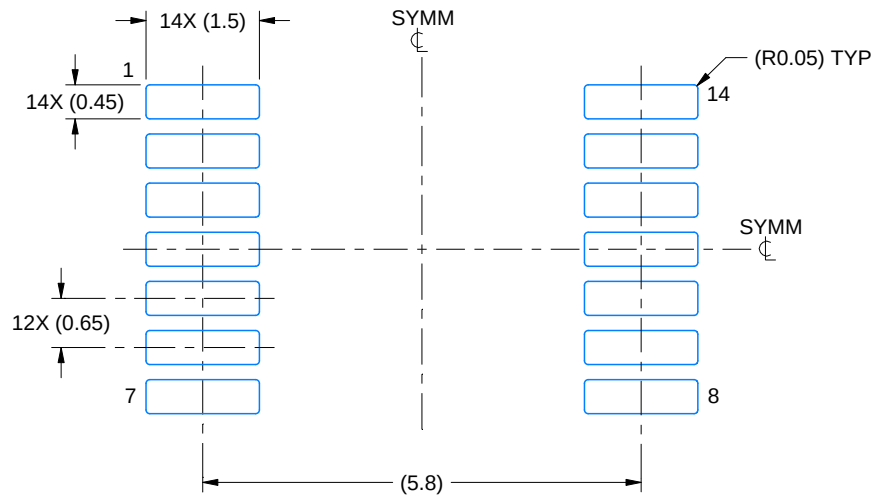
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-153.

EXAMPLE BOARD LAYOUT

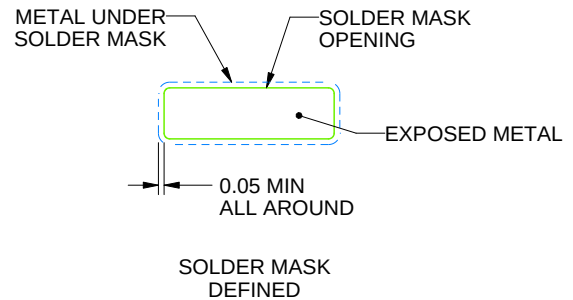
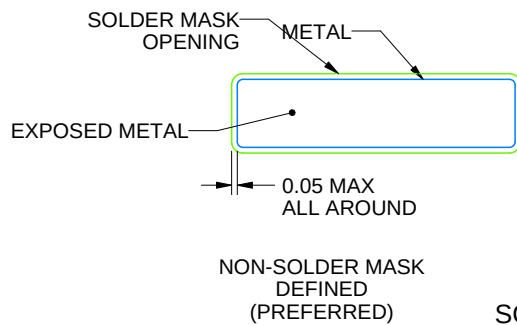
PW0014A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 10X



SOLDER MASK DETAILS

4220202/B 12/2023

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

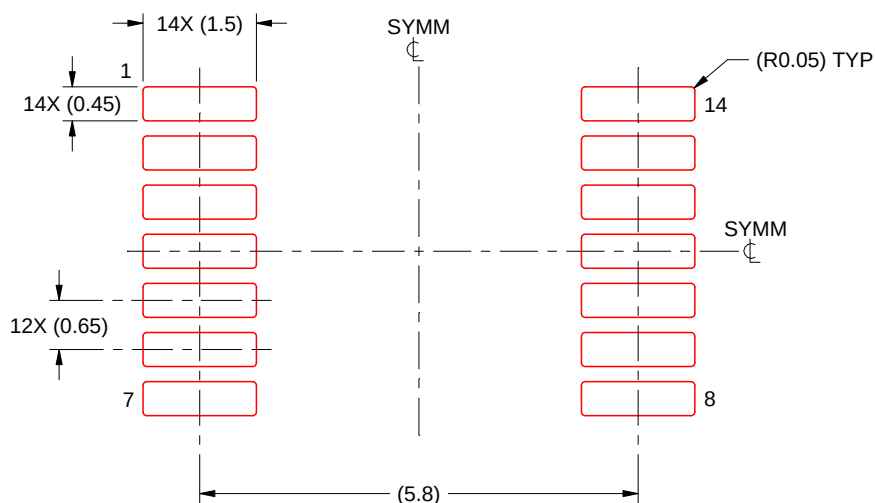
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

PW0014A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE: 10X

4220202/B 12/2023

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

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