

OPAx317 零漂移、低偏移、轨到轨 I/O 运算放大器 精密产品目录

1 特性

- 电源电压：1.8V 至 5.5V
- 微型封装：
 - 单通道：SOT23-5、SC-70、SOIC-8
 - 双通道：VSSOP-8、SOIC-8
 - 四通道：SOIC-14、TSSOP-14
- 低偏移电压：20 μ V（典型值）
- 共模抑制比 (CMRR)：108dB（典型值）电源抑制比 (PSRR)
- 静态电流：35 μ A（最大值）
- 增益带宽：300kHz
- 轨到轨输入和输出
- 内部电磁干扰 (EMI) 和内部射频干扰 (RFI) 滤波功能

2 应用

- 电池供电仪器
- 温度测量
- 传感器应用
- 电子称
- 医疗仪表
- 手持测试设备
- 电流感测

3 说明

OPA317 系列 CMOS 运算放大器不但具备精密的性能，而且价格极具竞争力。这些器件属于采用专有自动校准技术的零漂移系列放大器，在整个时间和温度范围内的偏移电压非常低（最大 90 μ V）且几乎零漂移，并且静态电流只有 35 μ A（最大值）。

OPA317 系列放大器具有轨到轨输入和输出以及几乎不变的 1/f 噪声特性，因此是许多应用应用的理想选择，更容易设计到系统中。此类器件经过优化，适合在 1.8V (± 0.9 V) 至 5.5V (± 2.75 V) 的低电压状态下工作。

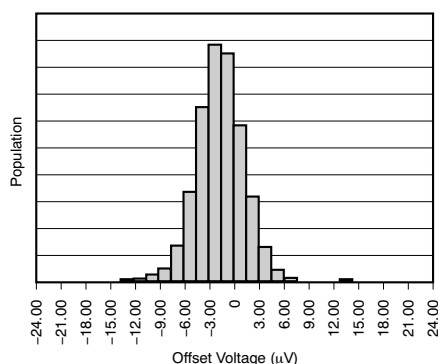
OPA317（单通道版本）提供 SC70-5、SOT23-5 和 SOIC-8 三种封装。OPA2317（双通道版本）提供 VSSOP-8 和 SOIC-8 两种封装。OPA4317 提供标准 SOIC-14 和 TSSOP-14 两种封装。所有器件版本的额定工作温度范围均为 -40 $^{\circ}$ C 至 +125 $^{\circ}$ C。

器件信息(1)

产品型号	封装	封装尺寸 (标称值)
OPA317	SOIC (8)	3.91mm x 4.90mm
	SOT-23 (5)	1.60mm x 2.90mm
	SC70 (5)	1.25mm x 2.00mm
OPA2317	SOIC (8)	3.91mm x 4.90mm
	VSSOP (8)	3.00mm x 3.00mm
OPA4317	SOIC (14)	3.91mm x 8.65mm
	TSSOP (14)	4.40mm x 5.00mm

(1) 要了解所有可用封装，请见数据表末尾的可订购产品附录。

偏移电压分布



目录

1	特性	1	8.4	Device Functional Modes	14
2	应用	1	9	Application and Implementation	15
3	说明	1	9.1	Application Information.....	15
4	修订历史记录	2	9.2	Typical Applications	16
5	Pin Configuration and Functions	3	9.3	System Example	18
6	Specifications	5	10	Power Supply Recommendations	18
6.1	Absolute Maximum Ratings	5	11	Layout	19
6.2	ESD Ratings.....	5	11.1	Layout Guidelines	19
6.3	Recommended Operating Conditions	5	11.2	Layout Example	19
6.4	Thermal Information: OPA317	6	12	器件和文档支持	20
6.5	Thermal Information: OPA2317	6	12.1	文档支持	20
6.6	Thermal Information: OPA4317	6	12.2	接收文档更新通知	20
6.7	Electrical Characteristics: $V_S = 1.8\text{ V to }5.5\text{ V}$	7	12.3	相关链接	20
6.8	Typical Characteristics	8	12.4	社区资源	20
7	Parameter Measurement Information	11	12.5	商标	20
8	Detailed Description	12	12.6	静电放电警告	20
8.1	Overview	12	12.7	Glossary	20
8.2	Functional Block Diagram	12	13	机械、封装和可订购信息	20
8.3	Feature Description.....	12			

4 修订历史记录

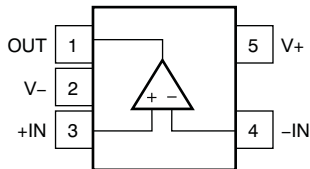
注：之前版本的页码可能与当前版本有所不同。

Changes from Revision A (June 2013) to Revision B	Page
• 已添加 ESD 额定值表，特性 说明部分，器件功能模式，应用和实施部分，电源相关建议部分，布局部分，器件和文档支持部分以及机械、封装和可订购信息部分	1

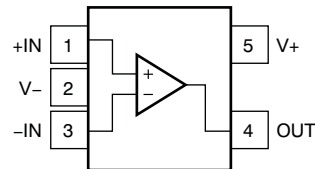
Changes from Original (May 2013) to Revision A	Page
• 已删除 订购信息表；请参见数据表末尾的 POA	1
• 已删除 PSRR 特性要点	1
• 已更改 静态电流特性要点	1
• 已更改 第二句（说明部分）	1
• Changed PSRR maximum value	7

5 Pin Configuration and Functions

**OPA317: DBV Package
5-Pin SOT-23
Top View**



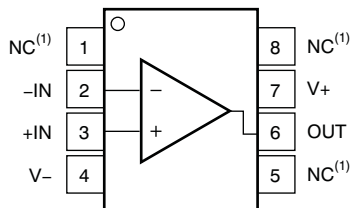
**OPA317: DCK Package
5-Pin SC70
Top View**



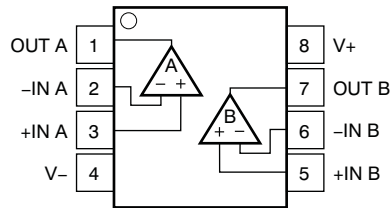
Pin Functions (5-Pin Packages)

NAME	PIN		I/O	DESCRIPTION
	SOT-23	SC70		
+IN	3	1	I	Noninverting input
-IN	4	3	I	Inverting input
OUT	1	4	O	Output
V+	5	5	—	Positive (highest) power supply
V-	2	2	—	Negative (lowest) power supply

**OPA317: D Package
8-Pin SOIC
Top View**



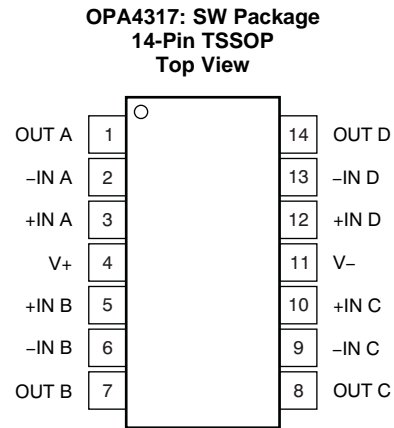
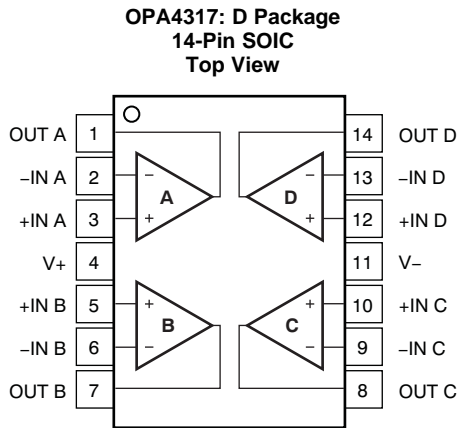
**OPA2317: D and DGK Packages
8-Pin SOIC and VSSOP
Top View**



(1) NC - No internal connection

Pin Functions (8-Pin Packages)

NAME	PIN		I/O	DESCRIPTION
	OPA317 SOIC	OPA2317 SOIC and VSSOP		
+IN	3	—	I	Noninverting input
-IN	2	—	I	Inverting input
+IN A	—	3	I	Noninverting input, channel A
-IN A	—	2	I	Inverting input, channel A
+IN B	—	5	I	Noninverting input, channel B
-IN B	—	6	I	Inverting input, channel B
NC	1	—	—	No internal connection
	5			
	8			
OUT	6	—	O	Output
OUT A	—	1	O	Output, channel A
OUT B	—	7	O	Output, channel B
V+	7	8	—	Positive (highest) power supply
V-	4	4	—	Negative (lowest) power supply



Pin Functions (14-Pin Packages)

PIN		I/O	DESCRIPTION
NAME	SOIC, TSSOP		
+IN A	3	I	Noninverting input, channel A
-IN A	2	I	Inverting input, channel A
+IN B	5	I	Noninverting input, channel B
-IN B	6	I	Inverting input, channel B
+IN C	10	I	Noninverting input, channel C
-IN C	9	I	Inverting input, channel C
+IN D	12	I	Noninverting input, channel D
-IN D	13	I	Inverting input, channel D
OUT A	1	O	Output, channel A
OUT B	7	O	Output, channel B
OUT C	8	O	Output, channel C
OUT D	14	O	Output, channel D
V+	4	—	Positive (highest) power supply
V-	11	—	Negative (lowest) power supply

6 Specifications

6.1 Absolute Maximum Ratings

Over operating free-air temperature range, unless otherwise noted.⁽¹⁾

		MIN	MAX	UNIT
$V_S = (V+) - (V-)$	Supply voltage		7	V
	Signal input terminals ⁽²⁾	$(V-) - 0.3$	$(V+) + 0.3$	V
	Signal input terminals ⁽²⁾	-10	10	mA
	Output short circuit ⁽³⁾	Continuous		
T_A	Operating temperature	-40	150	°C
T_J	Junction temperature		150	°C
T_{stg}	Storage temperature	-65	150	°C

- (1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- (2) Input terminals are diode-clamped to the power-supply rails. Input signals that can swing more than 0.3 V beyond the supply rails must be current-limited to 10 mA or less.
- (3) Short-circuit to ground, one amplifier per package.

6.2 ESD Ratings

		VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 ⁽¹⁾	±4000
		Charged-device model (CDM), per JEDEC specification JESD22-C101 ⁽²⁾	±1000
		Machine model (MM)	±400

- (1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
- (2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

6.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted).

		MIN	MAX	UNIT
$(V+ - V-)$	Supply voltage	1.8 (±0.9)	5.5 (±2.25)	V
T_A	Specified temperature	-40	125	°C

6.4 Thermal Information: OPA317

THERMAL METRIC ⁽¹⁾		OPA317			UNIT
		D (SOIC)	DBV (SOT-23)	DCK (SC70)	
		8 PINS	5 PINS	5 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	140.1	220.8	298.4	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	89.8	97.5	65.4	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	80.6	61.7	97.1	°C/W
Ψ_{JT}	Junction-to-top characterization parameter	28.7	7.6	0.8	°C/W
Ψ_{JB}	Junction-to-board characterization parameter	80.1	61.1	95.5	°C/W
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	—	—	—	°C/W

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

6.5 Thermal Information: OPA2317

THERMAL METRIC ⁽¹⁾		OPA2317		UNIT
		D (SOIC)	DGK (VSSOP)	
		8 PINS	8 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	124	180.3	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	73.7	48.1	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	64.4	100.9	°C/W
Ψ_{JT}	Junction-to-top characterization parameter	18	2.4	°C/W
Ψ_{JB}	Junction-to-board characterization parameter	63.9	99.3	°C/W
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	—	—	°C/W

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

6.6 Thermal Information: OPA4317

THERMAL METRIC ⁽¹⁾		OPA4317		UNIT
		D (SOIC)	PW (TSSOP)	
		14 PINS	14 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	83.8	120.8	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	70.7	34.3	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	59.5	62.8	°C/W
Ψ_{JT}	Junction-to-top characterization parameter	11.6	1	°C/W
Ψ_{JB}	Junction-to-board characterization parameter	37.7	56.5	°C/W
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	—	—	°C/W

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

6.7 Electrical Characteristics: $V_S = 1.8\text{ V to }5.5\text{ V}$

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

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
OFFSET VOLTAGE					
V_{OS}	Input offset voltage	$V_S = 5\text{ V}$	20	± 90	μV
		$T_A = -40^\circ\text{C to }+125^\circ\text{C}$, $V_S = 5\text{ V}$		± 100	
dV_{OS}/dT	Input offset voltage vs temperature	$T_A = -40^\circ\text{C to }+125^\circ\text{C}$	0.05		$\mu\text{V}/^\circ\text{C}$
PSRR	Input offset voltage vs power supply	$T_A = -40^\circ\text{C to }+125^\circ\text{C}$, $V_S = 1.8\text{ V to }5.5\text{ V}$	1	10	$\mu\text{V/V}$
			Long-term stability ⁽¹⁾		
	Channel separation, DC		5		$\mu\text{V/V}$
INPUT BIAS CURRENT					
I_B	Input bias current		± 275		pA
		OPA4317	± 155		
		$T_A = -40^\circ\text{C to }+125^\circ\text{C}$	± 300		
I_{OS}	Input offset current		± 400		pA
		OPA4317	± 140		
NOISE					
e_n	Input voltage noise density	$f = 1\text{ kHz}$	55		$\text{nV}/\sqrt{\text{Hz}}$
	Input voltage noise	$f = 0.01\text{ Hz to }1\text{ Hz}$	0.3		μV_{PP}
		$f = 0.1\text{ Hz to }10\text{ Hz}$	1.1		
i_n	Input current noise	$f = 10\text{ Hz}$	100		$\text{fA}/\sqrt{\text{Hz}}$
INPUT VOLTAGE RANGE					
V_{CM}	Common-mode voltage		$(V-) - 0.1$	$(V+) + 0.1$	V
CMRR	Common-mode rejection ratio	$T_A = -40^\circ\text{C to }+125^\circ\text{C}$ $(V-) - 0.1\text{ V} < V_{CM} < (V+) + 0.1\text{ V}$	95	108	dB
		OPA4317 $T_A = -40^\circ\text{C to }+125^\circ\text{C}$ $(V-) - 0.1\text{ V} < V_{CM} < (V+) + 0.1\text{ V}$, $V_S = 5.5\text{ V}$	95	108	
INPUT CAPACITANCE					
	Differential		2		pF
	Common-mode		4		pF
OPEN-LOOP GAIN					
A_{OL}	Open-loop voltage gain	$T_A = -40^\circ\text{C to }+125^\circ\text{C}$, $R_L = 10\text{ k}\Omega$ $(V-) + 100\text{ mV} < V_O < (V+) - 100\text{ mV}$	100	110	dB
FREQUENCY RESPONSE					
GBW	Gain-bandwidth product	$C_L = 100\text{ pF}$	300		kHz
SR	Slew rate	$G = 1$	0.15		V/ μs
OUTPUT					
	Voltage output swing from rail	$T_A = -40^\circ\text{C to }+125^\circ\text{C}$	30	100	mV
I_{SC}	Short-circuit current		± 5		mA
C_L	Capacitive load drive		See the Typical Characteristics section		
	Open-loop output impedance	$f = 350\text{ kHz}$, $I_O = 0$	2		k Ω
POWER SUPPLY					
V_S	Specified voltage		1.8	5.5	V
I_Q	Quiescent current per amplifier	$T_A = -40^\circ\text{C to }+125^\circ\text{C}$, $I_O = 0$	21	35	μA
			Turnon time		

(1) 300-hour life test at 150°C demonstrated randomly distributed variation of approximately $1\ \mu\text{V}$.

OPA317, OPA2317, OPA4317

ZHCSB44B –MAY 2013–REVISED JUNE 2016

www.ti.com.cn

6.8 Typical Characteristics

At $T_A = 25^\circ\text{C}$, $C_L = 0\text{ pF}$, $R_L = 10\text{ k}\Omega$ connected to midsupply, $V_{CM} = V_{OUT} = \text{midsupply}$, unless otherwise noted.

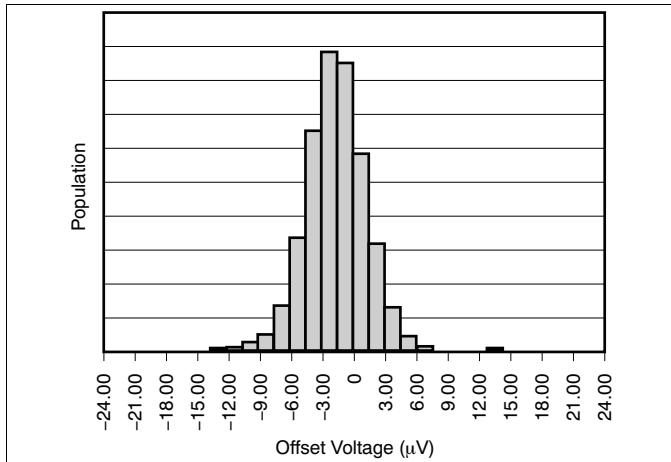


Figure 1. Offset Voltage Production Distribution

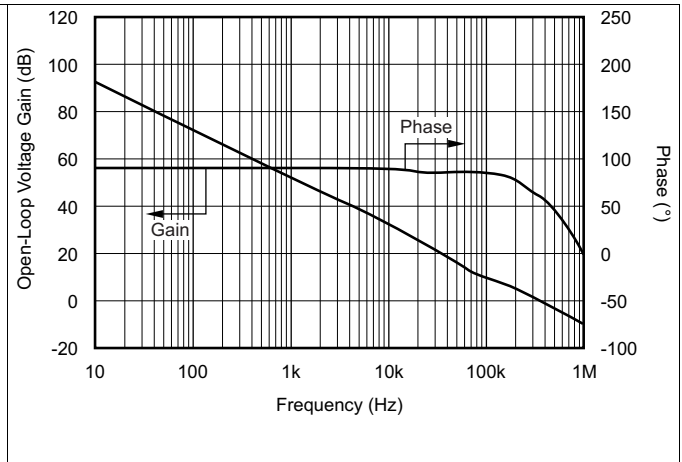


Figure 2. Open-Loop Gain vs Frequency

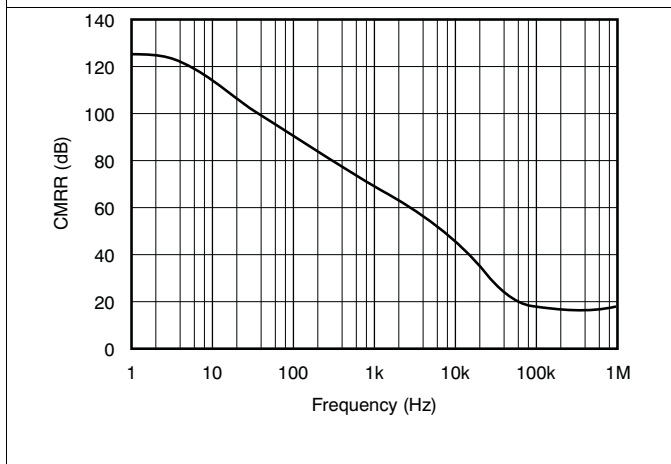


Figure 3. Common-Mode Rejection Ratio vs Frequency

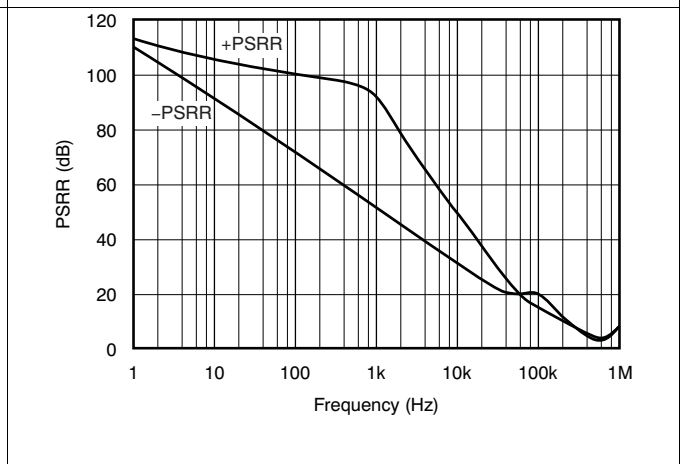


Figure 4. Power-Supply Rejection Ratio vs Frequency

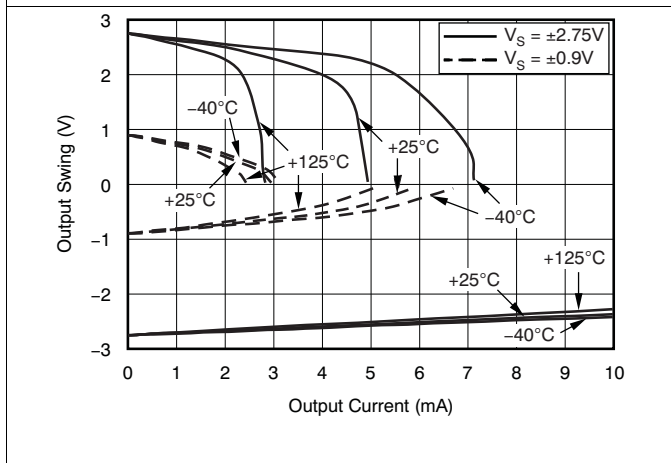


Figure 5. Output Voltage Swing vs Output Current

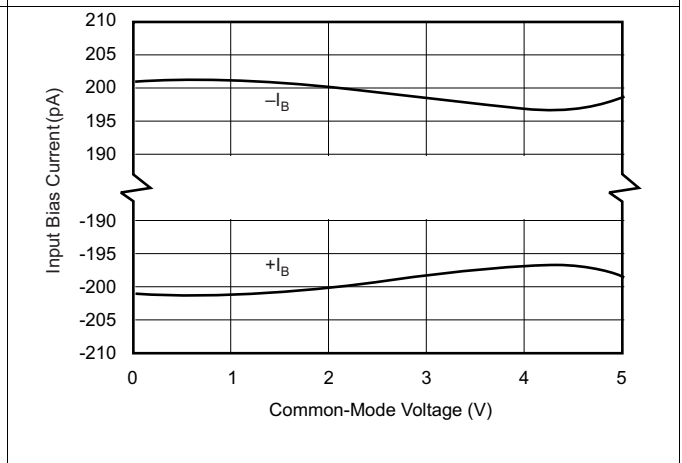


Figure 6. Input Bias Current vs Common-Mode Voltage

Typical Characteristics (continued)

At $T_A = 25^\circ\text{C}$, $C_L = 0\text{ pF}$, $R_L = 10\text{ k}\Omega$ connected to midsupply, $V_{CM} = V_{OUT} = \text{midsupply}$, unless otherwise noted.

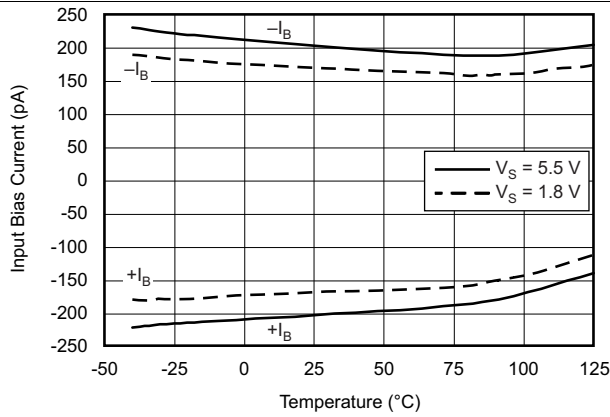


Figure 7. Input Bias Current vs Temperature

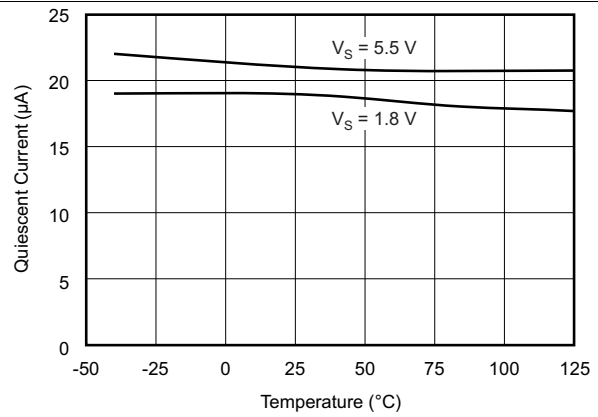


Figure 8. Quiescent Current vs Temperature

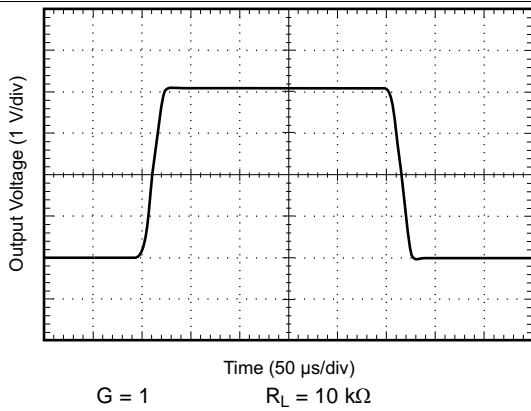


Figure 9. Large-Signal Step Response

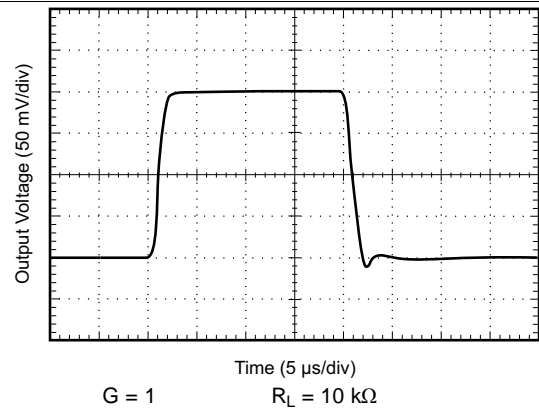


Figure 10. Small-Signal Step Response

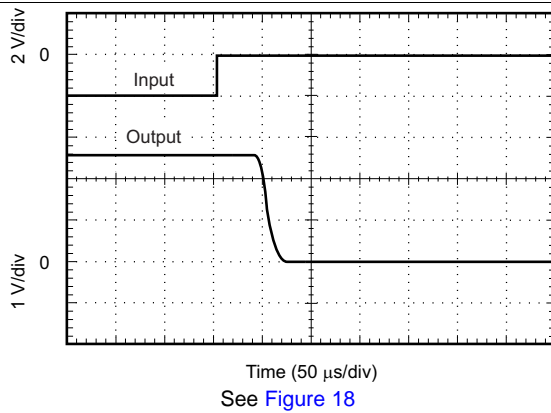


Figure 11. Positive Overvoltage Recovery

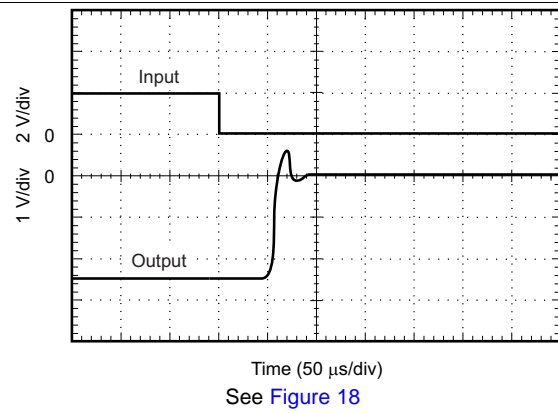


Figure 12. Negative Overvoltage Recovery

Typical Characteristics (continued)

At $T_A = 25^\circ\text{C}$, $C_L = 0\text{ pF}$, $R_L = 10\text{ k}\Omega$ connected to midsupply, $V_{CM} = V_{OUT} = \text{midsupply}$, unless otherwise noted.

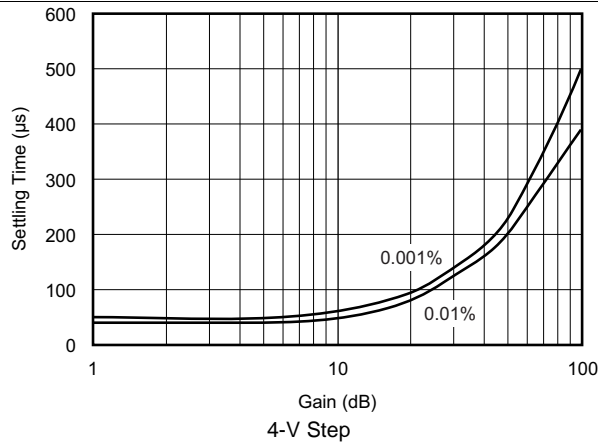


Figure 13. Settling Time vs Closed-Loop Gain

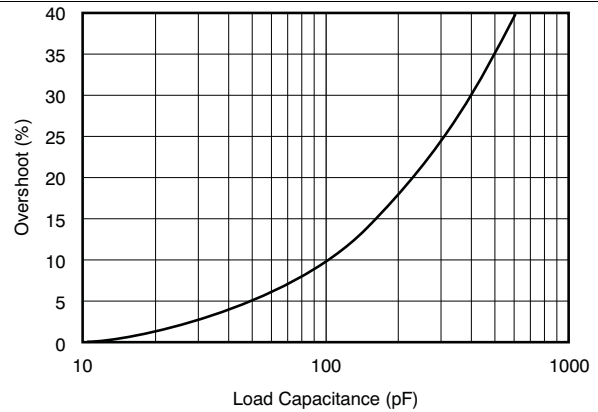


Figure 14. Small-Signal Overshoot vs Load Capacitance

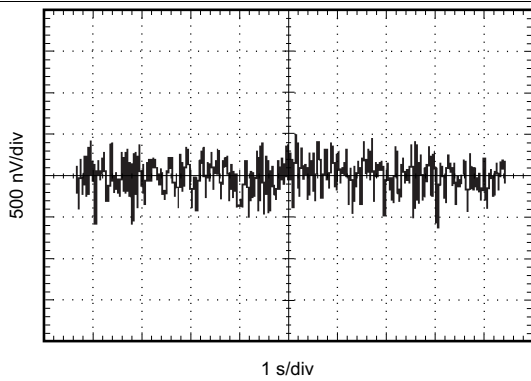


Figure 15. 0.1-Hz to 10-Hz Noise

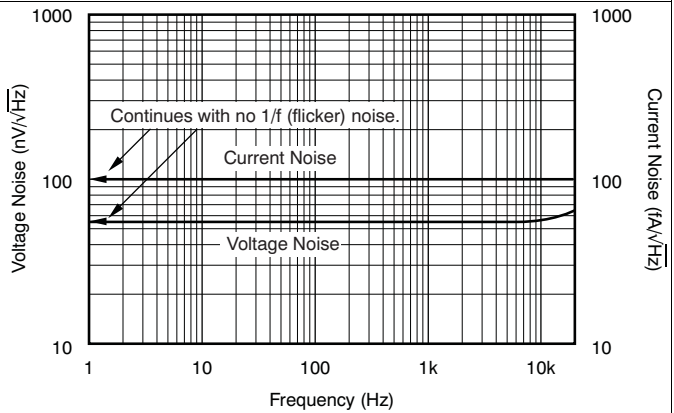
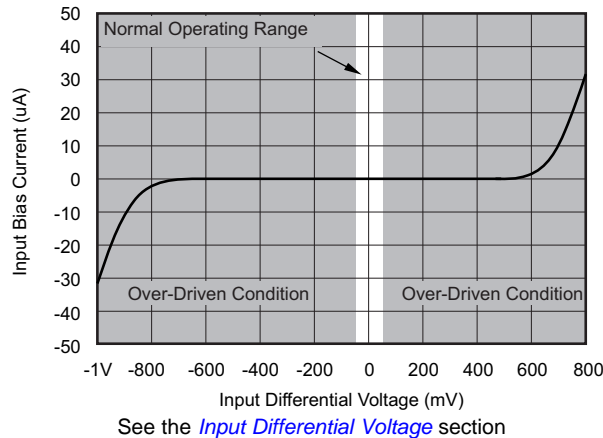


Figure 16. Current and Voltage Noise Spectral Density vs Frequency



See the [Input Differential Voltage](#) section

Figure 17. Input Bias Current vs Input Differential Voltage

7 Parameter Measurement Information

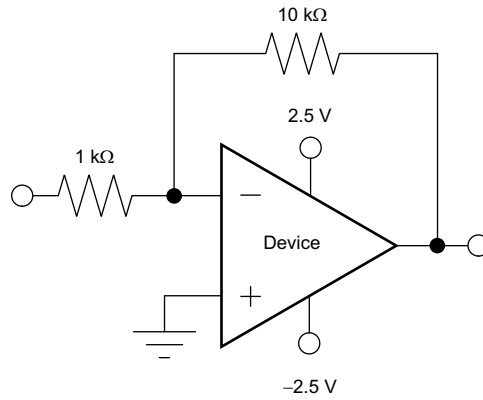


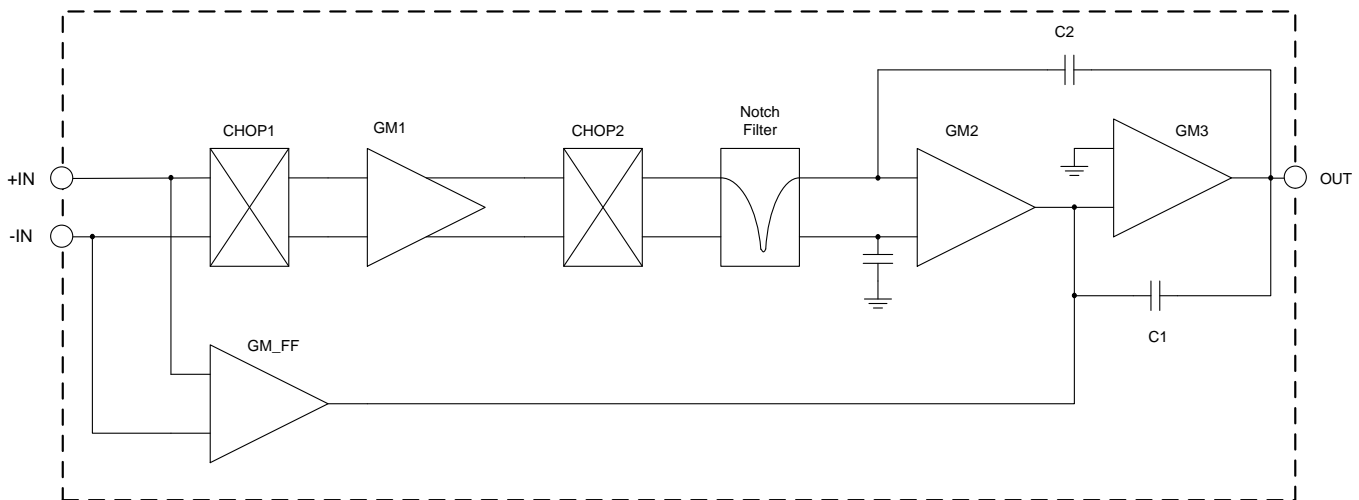
Figure 18. Overvoltage Recovery Circuit

8 Detailed Description

8.1 Overview

The OPAx317 series is a family of low-power, rail-to-rail input and output operational amplifiers. These devices operate from 1.8 V to 5.5 V, are unity-gain stable, and are suitable for a wide range of general-purpose applications. The class AB output stage is capable of driving $\leq 10\text{-k}\Omega$ loads connected to any point between $V+$ and ground. The input common-mode voltage range includes both rails and allows the OPA317 series to be used in virtually any single-supply application. Rail-to-rail input and output swing significantly increases dynamic range, especially in low-supply applications, and makes them ideal for driving sampling analog-to-digital converters (ADCs).

8.2 Functional Block Diagram



Copyright © 2016, Texas Instruments Incorporated

8.3 Feature Description

8.3.1 Operating Voltage

The OPA317 series of operational amplifiers can be used with single or dual supplies from an operating range of $V_S = 1.8\text{ V} (\pm 0.9\text{ V})$ up to $5.5\text{ V} (\pm 2.75\text{ V})$.

CAUTION

Supply voltages greater than 7 V can permanently damage the device.

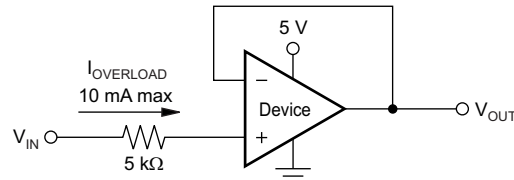
See the [Absolute Maximum Ratings](#) table. Key parameters that vary over the supply voltage or temperature range are shown in the [Typical Characteristics](#) section.

Feature Description (continued)

8.3.2 Input Voltage

The OPA317, OPA2317, and OPA4317 input common-mode voltage range extends 0.1 V beyond the supply rails. The OPA317 device is designed to cover the full range without the troublesome transition region found in some other rail-to-rail amplifiers.

Typically, input bias current is about 200 pA; however, input voltages exceeding the power supplies can cause excessive current to flow into or out of the input pins. Momentary voltages greater than the power supply can be tolerated if the input current is limited to 10 mA. This limitation is easily accomplished with an input resistor, as shown in Figure 19.



NOTE: Current limiting resistor required if input voltage exceeds supply rails by ≥ 0.3 V.

Figure 19. Input Current Protection

8.3.3 Input Differential Voltage

The typical input bias current of the OPA317 during normal operation is approximately 200 pA. In overdriven conditions, the bias current can increase significantly (see Figure 17). The most common cause of an overdriven condition occurs when the operational amplifier is outside of the linear range of operation. When the output of the operational amplifier is driven to one of the supply rails, the feedback loop requirements cannot be satisfied, and a differential input voltage develops across the input pins. This differential input voltage results in activation of parasitic diodes inside the front-end input chopping switches that combine with 10-k Ω electromagnetic interference (EMI) filter resistors to create the equivalent circuit shown in Figure 20.

NOTE

The input bias current remains within specification within the linear region.

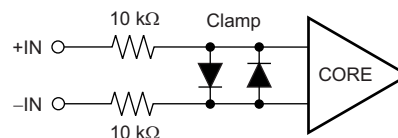


Figure 20. Equivalent Input Circuit

8.3.4 Internal Offset Correction

The OPA317, OPA2317, and OPA4317 operational amplifiers use an auto-calibration technique with a time-continuous, 125-kHz operational amplifier in the signal path. This amplifier is zero-corrected every 8 μ s using a proprietary technique. Upon power up, the amplifier requires approximately 100 μ s to achieve specified V_{OS} accuracy. This design has no aliasing or flicker noise.

8.3.5 EMI Susceptibility and Input Filtering

Operational amplifiers vary in susceptibility to EMI. If conducted EMI enters the operational amplifier, the DC offset observed at the amplifier output may shift from its nominal value while the EMI is present. This shift is a result of signal rectification associated with the internal semiconductor junctions. While all operational amplifier pin functions can be affected by EMI, the input pins are likely to be the most susceptible. The OPA317 operational amplifier family incorporates an internal input low-pass filter that reduces the amplifier response to EMI. Both common-mode and differential mode filtering are provided by the input filter. The filter is designed for a cutoff frequency of approximately 8 MHz (-3 dB), with a roll-off of 20 dB per decade.

8.4 Device Functional Modes

The OPAx317 family of devices are powered on when the supply is connected. The device can be operated as a single-supply operational amplifier or a dual-supply amplifier, depending on the application.

9 Application and Implementation

NOTE

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

9.1 Application Information

The OPA317, OPA2317, and OPA4317 are unity-gain stable, precision operational amplifiers free from unexpected output and phase reversal. Proprietary Zero-Drift circuitry gives the benefit of low input offset voltage over time and temperature, as well as lowering the 1/f noise component. As a result of the high PSRR, these devices work well in applications that run directly from battery power without regulation. The OPA317 family is optimized for low-voltage, single-supply operation. These miniature, high-precision, low quiescent current amplifiers offer high impedance inputs that have a common-mode range 100 mV beyond the supplies, and a rail-to-rail output that swings within 100 mV of the supplies under normal test conditions. The OPA317 series are precision amplifiers for cost-sensitive applications.

9.1.1 Achieving Output Swing to the Op Amp Negative Rail

Some applications require output voltage swings from 0 V to a positive full-scale voltage (such as 2.5 V) with excellent accuracy. With most single-supply operational amplifiers, problems arise when the output signal approaches 0 V, near the lower output swing limit of a single-supply operational amplifier. A good single-supply operational amplifier may swing close to single-supply ground, but does not reach ground. The output of the OPA317, OPA2317, and OPA4317 can be made to swing to ground, or slightly below, on a single-supply power source. To do so requires the use of another resistor and an additional, more negative power supply than the operational amplifier negative supply. A pulldown resistor can be connected between the output and the additional negative supply to pull the output down below the value that the output would otherwise achieve, as shown in [Figure 21](#).

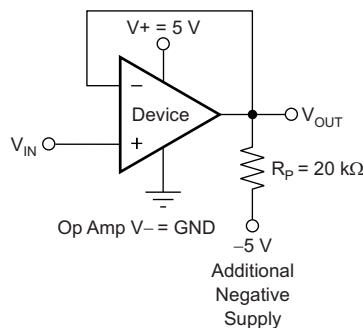
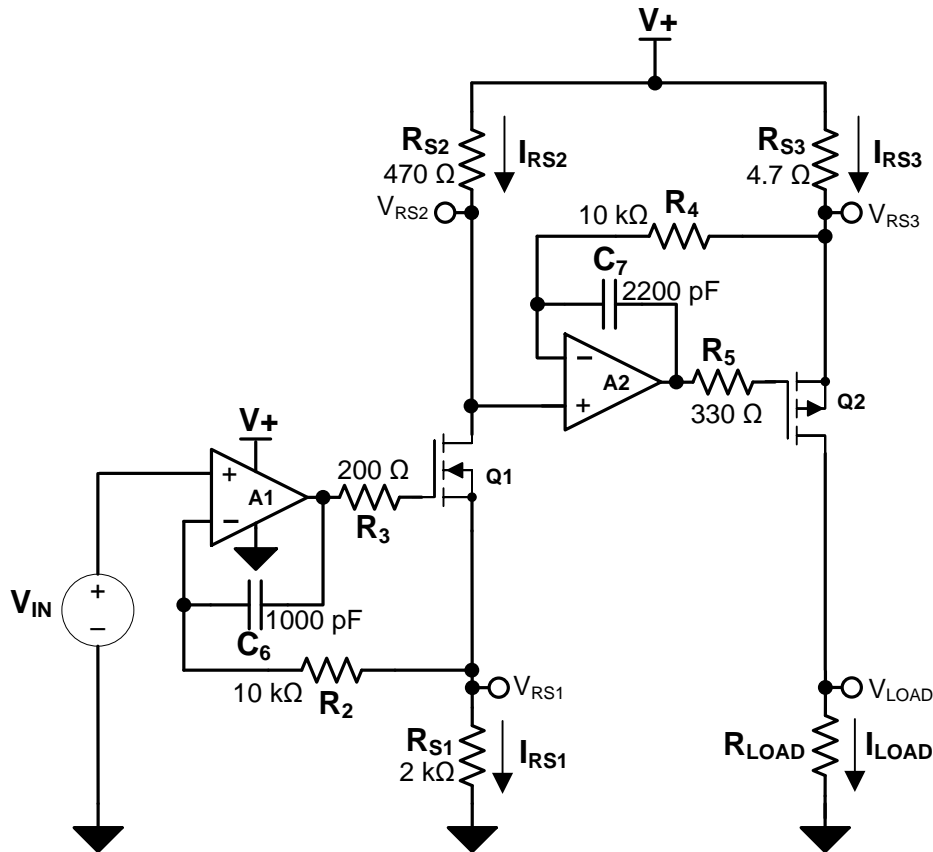


Figure 21. For V_{OUT} Range to Ground

The OPA317, OPA2317, and OPA4317 have an output stage that allows the output voltage to be pulled to its negative supply rail, or slightly below, using the technique previously described. This technique only works with some types of output stages. The OPA317, OPA2317, and OPA4317 have been characterized to perform with this technique; the recommended resistor value is approximately 20 kΩ. This configuration increases the current consumption by several hundreds of microamps. Accuracy is excellent down to 0 V and as low as -2 mV. Limiting and nonlinearity occur below -2 mV, but excellent accuracy returns as the output drives back up above -2 mV. Lowering the resistance of the pulldown resistor allows the operational amplifier to swing even further below the negative rail. Use resistances as low as 10 kΩ to achieve excellent accuracy down to -10 mV.

9.2 Typical Applications

The circuit shown in Figure 22 is a high-side voltage-to-current (V-I) converter. It translates an input voltage of 0 V to 2 V to an output current of 0 mA to 100 mA. Figure 23 shows the measured transfer function for this circuit. The low offset voltage and offset drift of the OPA317 facilitate excellent DC accuracy for the circuit.



Copyright © 2016, Texas Instruments Incorporated

Figure 22. High-Side Voltage-to-Current (V-I) Converter

9.2.1 Design Requirements

The design requirements are as follows:

- Supply Voltage: 5-V DC
- Input: 0-V to 2-V DC
- Output: 0-mA to 100-mA DC

9.2.2 Detailed Design Procedure

The V-I transfer function of the circuit is based on the relationship between the input voltage, V_{IN} , and the three current-sensing resistors: R_{S1} , R_{S2} , and R_{S3} . The relationship between V_{IN} and R_{S1} determines the current that flows through the first stage of the design. The current gain from the first stage to the second stage is based on the relationship between R_{S2} and R_{S3} .

Typical Applications (continued)

For a successful design, pay close attention to the DC characteristics of the operational amplifier chosen for the application. To meet the performance goals, this application benefits from an operational amplifier with low offset voltage, low temperature drift, and rail-to-rail output. The OPA2317 CMOS operational amplifier is a high-precision, 5- μ V offset, 0.05- μ V/ $^{\circ}$ C drift amplifier optimized for low-voltage, single-supply operation with an output swing to within 50 mV of the positive rail. The OPA2317 family uses chopping techniques to provide low initial offset voltage and near-zero drift over time and temperature. Low offset voltage and low drift reduce the offset error in the system, making these devices appropriate for precise DC control. The rail-to-rail output stage of the OPA2317 ensures that the output swing of the operational amplifier is able to fully control the gate of the MOSFET devices within the supply rails.

9.2.3 Application Curve

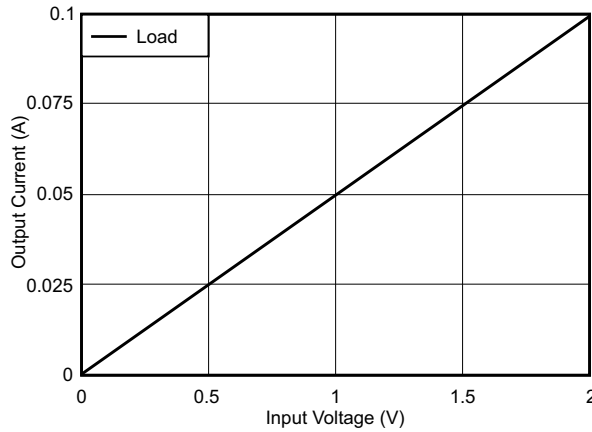
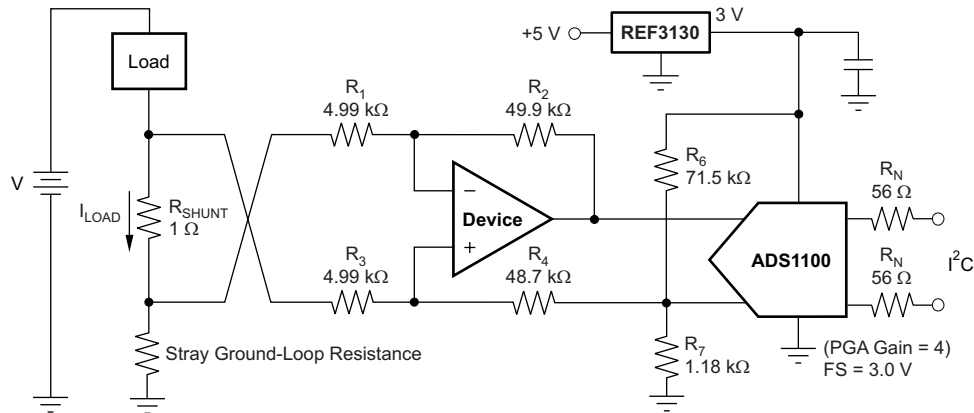


Figure 23. Measured Transfer Function for High-Side V-I Converter

9.3 System Example

R_N are operational resistors used to isolate the [ADS1100](#) from the noise of the digital I²C bus. The ADS1100 device is a 16-bit converter; therefore, a precise reference is essential for maximum accuracy. If absolute accuracy is not required and the 5-V power supply is sufficiently stable, the [REF3130](#) device may be omitted.



Copyright © 2016, Texas Instruments Incorporated

NOTE: 1% resistors provide adequate common-mode rejection at small ground-loop errors.

Figure 24. Low-Side Current Monitor

10 Power Supply Recommendations

The OPAx317 device is specified for operation from 1.8 V to 5.5 V (± 0.9 V to ± 2.75 V); many specifications apply from -40°C to $+125^\circ\text{C}$. The [Electrical Characteristics: \$V_S = 1.8\$ V to 5.5 V](#) table presents parameters that can exhibit significant variance with regard to operating voltage or temperature.

CAUTION

Supply voltages larger than 7 V can permanently damage the device (see the [Absolute Maximum Ratings](#) table).

Place 0.1- μF bypass capacitors close to the power-supply pins to reduce errors coupling in from noisy or high-impedance power supplies. For more detailed information on bypass capacitor placement, see the [Layout Guidelines](#) section.

11 Layout

11.1 Layout Guidelines

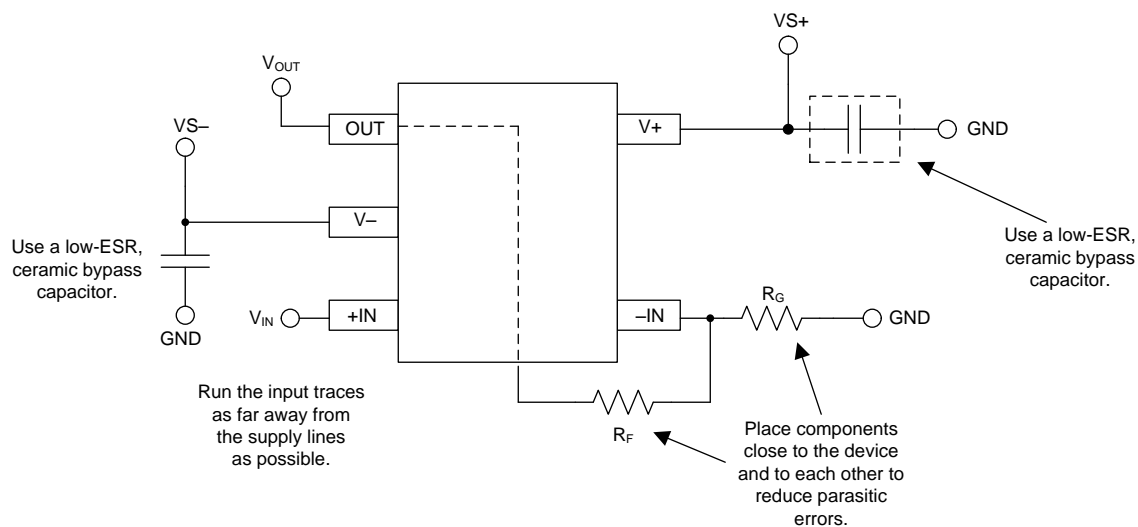
Attention to good layout practice is always recommended. Keep traces short and, when possible, use a printed-circuit board (PCB) ground plane with surface-mount components placed as close to the device pins as possible. Place a 0.1- μ F capacitor closely across the supply pins. Apply these guidelines throughout the analog circuit to improve performance and provide benefits, such as reducing the electromagnetic interference (EMI) susceptibility.

Optimize circuit layout and mechanical conditions for lowest offset voltage and precision performance. Avoid temperature gradients that create thermoelectric (Seebeck) effects in the thermocouple junctions formed from connecting dissimilar conductors. These thermally-generated potentials can be made to cancel by assuring they are equal on both input terminals. Other layout and design considerations include:

- Use low thermoelectric-coefficient conditions (avoid dissimilar metals).
- Thermally isolate components from power supplies or other heat sources.
- Shield operational amplifier and input circuitry from air currents, such as cooling fans.

Following these guidelines reduces the likelihood of junctions being at different temperatures, which can cause thermoelectric voltage drift of 0.1 μ V/ $^{\circ}$ C or higher, depending on the materials used.

11.2 Layout Example



Copyright © 2016, Texas Instruments Incorporated

Figure 25. OPAx317 Layout Example

12 器件和文档支持

12.1 文档支持

12.1.1 相关文档

相关文档如下：

- 《自校准 16 位模数转换器》，
- 《最大 15ppm/°C、100μA，SOT23-3 系列电压基准》，

12.2 接收文档更新通知

如需接收文档更新通知，请访问 ti.com 上的器件产品文件夹。点击右上角的提醒我 (Alert me) 注册后，即可每周定期收到已更改的产品信息。有关更改的详细信息，请查阅已修订文档中包含的修订历史记录。

12.3 相关链接

表 1 列出了快速访问链接。范围包括技术文档、支持与社区资源、工具和软件，并且可以快速访问样片或购买链接。

表 1. 相关链接

器件	产品文件夹	样片与购买	技术文档	工具与软件	支持与社区
OPA317	请单击此处	请单击此处	请单击此处	请单击此处	请单击此处
OPA2317	请单击此处	请单击此处	请单击此处	请单击此处	请单击此处
OPA4317	请单击此处	请单击此处	请单击此处	请单击此处	请单击此处

12.4 社区资源

The following links connect to TI community resources. Linked contents are provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's [Terms of Use](#).

TI E2E™ Online Community *TI's Engineer-to-Engineer (E2E) Community*. Created to foster collaboration among engineers. At e2e.ti.com, you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

Design Support *TI's Design Support* Quickly find helpful E2E forums along with design support tools and contact information for technical support.

12.5 商标

E2E is a trademark of Texas Instruments.

All other trademarks are the property of their respective owners.

12.6 静电放电警告



ESD 可能会损坏该集成电路。德州仪器 (TI) 建议通过适当的预防措施处理所有集成电路。如果不遵守正确的处理措施和安装程序，可能会损坏集成电路。

ESD 的损坏小至导致微小的性能降级，大至整个器件故障。精密的集成电路可能更容易受到损坏，这是因为非常细微的参数更改都可能会导致器件与其发布的规格不相符。

12.7 Glossary

SLYZ022 — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

13 机械、封装和可订购信息

以下页中包括机械、封装和可订购信息。这些信息是针对指定器件可提供的最新数据。这些数据会在无通知且不对本文档进行修订的情况下发生改变。欲获得该数据表的浏览器版本，请查阅左侧的导航栏。

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)
OPA2317ID	Active	Production	SOIC (D) 8	75 TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	O2317A
OPA2317ID.B	Active	Production	SOIC (D) 8	75 TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	O2317A
OPA2317IDGKR	Active	Production	VSSOP (DGK) 8	2500 LARGE T&R	Yes	NIPDAU SN NIPDAUAG	Level-2-260C-1 YEAR	-40 to 125	OVBQ
OPA2317IDGKR.B	Active	Production	VSSOP (DGK) 8	2500 LARGE T&R	Yes	SN	Level-2-260C-1 YEAR	-40 to 125	OVBQ
OPA2317IDGKRG4	Active	Production	VSSOP (DGK) 8	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	OVBQ
OPA2317IDGKRG4.B	Active	Production	VSSOP (DGK) 8	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	OVBQ
OPA2317IDGKT	Active	Production	VSSOP (DGK) 8	250 SMALL T&R	Yes	NIPDAU SN NIPDAUAG	Level-2-260C-1 YEAR	-40 to 125	OVBQ
OPA2317IDGKT.B	Active	Production	VSSOP (DGK) 8	250 SMALL T&R	Yes	SN	Level-2-260C-1 YEAR	-40 to 125	OVBQ
OPA2317IDR	Active	Production	SOIC (D) 8	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	O2317A
OPA2317IDR.B	Active	Production	SOIC (D) 8	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	O2317A
OPA2317IDRG4	Active	Production	SOIC (D) 8	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	O2317A
OPA2317IDRG4.B	Active	Production	SOIC (D) 8	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	O2317A
OPA317ID	Active	Production	SOIC (D) 8	75 TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	O317A
OPA317ID.B	Active	Production	SOIC (D) 8	75 TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	O317A
OPA317IDBVR	Active	Production	SOT-23 (DBV) 5	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	OVCQ
OPA317IDBVR.B	Active	Production	SOT-23 (DBV) 5	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	OVCQ
OPA317IDBVT	Active	Production	SOT-23 (DBV) 5	250 SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	OVCQ
OPA317IDBVT.B	Active	Production	SOT-23 (DBV) 5	250 SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	OVCQ
OPA317IDBVTG4	Active	Production	SOT-23 (DBV) 5	250 SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	OVCQ
OPA317IDBVTG4.B	Active	Production	SOT-23 (DBV) 5	250 SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	OVCQ
OPA317IDCKR	Active	Production	SC70 (DCK) 5	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	SJP
OPA317IDCKR.B	Active	Production	SC70 (DCK) 5	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	SJP
OPA317IDCKRG4	Active	Production	SC70 (DCK) 5	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	SJP
OPA317IDCKRG4.B	Active	Production	SC70 (DCK) 5	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	SJP
OPA317IDCKT	Active	Production	SC70 (DCK) 5	250 SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	SJP
OPA317IDCKT.B	Active	Production	SC70 (DCK) 5	250 SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	SJP
OPA317IDR	Active	Production	SOIC (D) 8	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	O317A
OPA317IDR.B	Active	Production	SOIC (D) 8	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	O317A

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)
OPA4317ID	Active	Production	SOIC (D) 14	50 TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	O4317A
OPA4317ID.A	Active	Production	SOIC (D) 14	50 TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	O4317A
OPA4317IDR	Active	Production	SOIC (D) 14	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	O4317A
OPA4317IDR.A	Active	Production	SOIC (D) 14	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	O4317A
OPA4317IPW	Active	Production	TSSOP (PW) 14	90 TUBE	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 125	O4317A
OPA4317IPW.A	Active	Production	TSSOP (PW) 14	90 TUBE	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 125	O4317A
OPA4317IPWR	Active	Production	TSSOP (PW) 14	2000 LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 125	O4317A
OPA4317IPWR.A	Active	Production	TSSOP (PW) 14	2000 LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 125	O4317A

(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.

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.

OTHER QUALIFIED VERSIONS OF OPA2317, OPA317 :

- Automotive : [OPA2317-Q1](#), [OPA317-Q1](#)

NOTE: Qualified Version Definitions:

- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects

TAPE AND REEL INFORMATION

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE


*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
OPA2317IDGKR	VSSOP	DGK	8	2500	330.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1
OPA2317IDGKRG4	VSSOP	DGK	8	2500	330.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1
OPA2317IDGKT	VSSOP	DGK	8	250	330.0	12.4	5.25	3.35	1.25	8.0	12.0	Q1
OPA2317IDGKT	VSSOP	DGK	8	250	330.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1
OPA2317IDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
OPA2317IDRG4	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
OPA317IDBVR	SOT-23	DBV	5	3000	180.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
OPA317IDBVT	SOT-23	DBV	5	250	180.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
OPA317IDBVT	SOT-23	DBV	5	250	178.0	9.0	3.3	3.2	1.4	4.0	8.0	Q3
OPA317IDBVTG4	SOT-23	DBV	5	250	178.0	9.0	3.3	3.2	1.4	4.0	8.0	Q3
OPA317IDCKR	SC70	DCK	5	3000	178.0	9.0	2.4	2.5	1.2	4.0	8.0	Q3
OPA317IDCKRG4	SC70	DCK	5	3000	178.0	9.0	2.4	2.5	1.2	4.0	8.0	Q3
OPA317IDCKT	SC70	DCK	5	250	178.0	9.0	2.4	2.5	1.2	4.0	8.0	Q3
OPA317IDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
OPA4317IDR	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
OPA4317IPWR	TSSOP	PW	14	2000	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)
OPA2317IDGKR	VSSOP	DGK	8	2500	353.0	353.0	32.0
OPA2317IDGKRG4	VSSOP	DGK	8	2500	353.0	353.0	32.0
OPA2317IDGKT	VSSOP	DGK	8	250	366.0	364.0	50.0
OPA2317IDGKT	VSSOP	DGK	8	250	353.0	353.0	32.0
OPA2317IDR	SOIC	D	8	2500	353.0	353.0	32.0
OPA2317IDRG4	SOIC	D	8	2500	353.0	353.0	32.0
OPA317IDBVR	SOT-23	DBV	5	3000	210.0	185.0	35.0
OPA317IDBVT	SOT-23	DBV	5	250	210.0	185.0	35.0
OPA317IDBVT	SOT-23	DBV	5	250	180.0	180.0	18.0
OPA317IDBVTG4	SOT-23	DBV	5	250	180.0	180.0	18.0
OPA317IDCKR	SC70	DCK	5	3000	180.0	180.0	18.0
OPA317IDCKRG4	SC70	DCK	5	3000	180.0	180.0	18.0
OPA317IDCKT	SC70	DCK	5	250	180.0	180.0	18.0
OPA317IDR	SOIC	D	8	2500	353.0	353.0	32.0
OPA4317IDR	SOIC	D	14	2500	353.0	353.0	32.0
OPA4317IPWR	TSSOP	PW	14	2000	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)
OPA2317ID	D	SOIC	8	75	506.6	8	3940	4.32
OPA2317ID.B	D	SOIC	8	75	506.6	8	3940	4.32
OPA317ID	D	SOIC	8	75	506.6	8	3940	4.32
OPA317ID.B	D	SOIC	8	75	506.6	8	3940	4.32
OPA4317ID	D	SOIC	14	50	506.6	8	3940	4.32
OPA4317ID.A	D	SOIC	14	50	506.6	8	3940	4.32
OPA4317IPW	PW	TSSOP	14	90	530	10.2	3600	3.5
OPA4317IPW.A	PW	TSSOP	14	90	530	10.2	3600	3.5

EXAMPLE BOARD LAYOUT

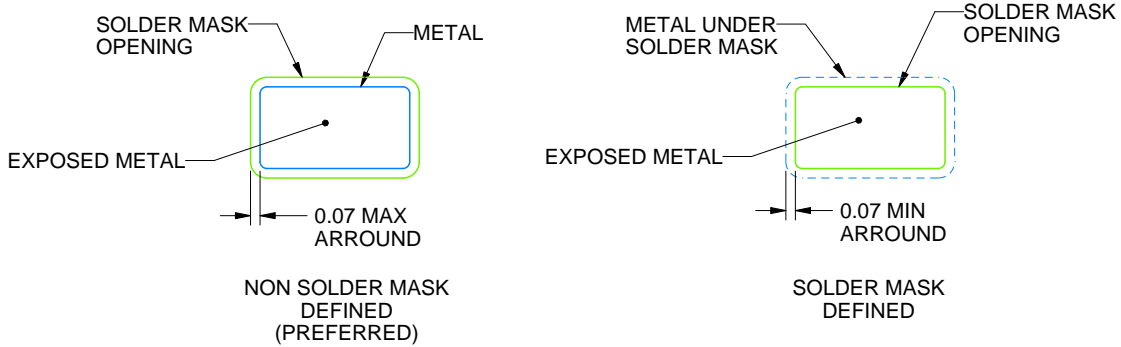
DBV0005A

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.

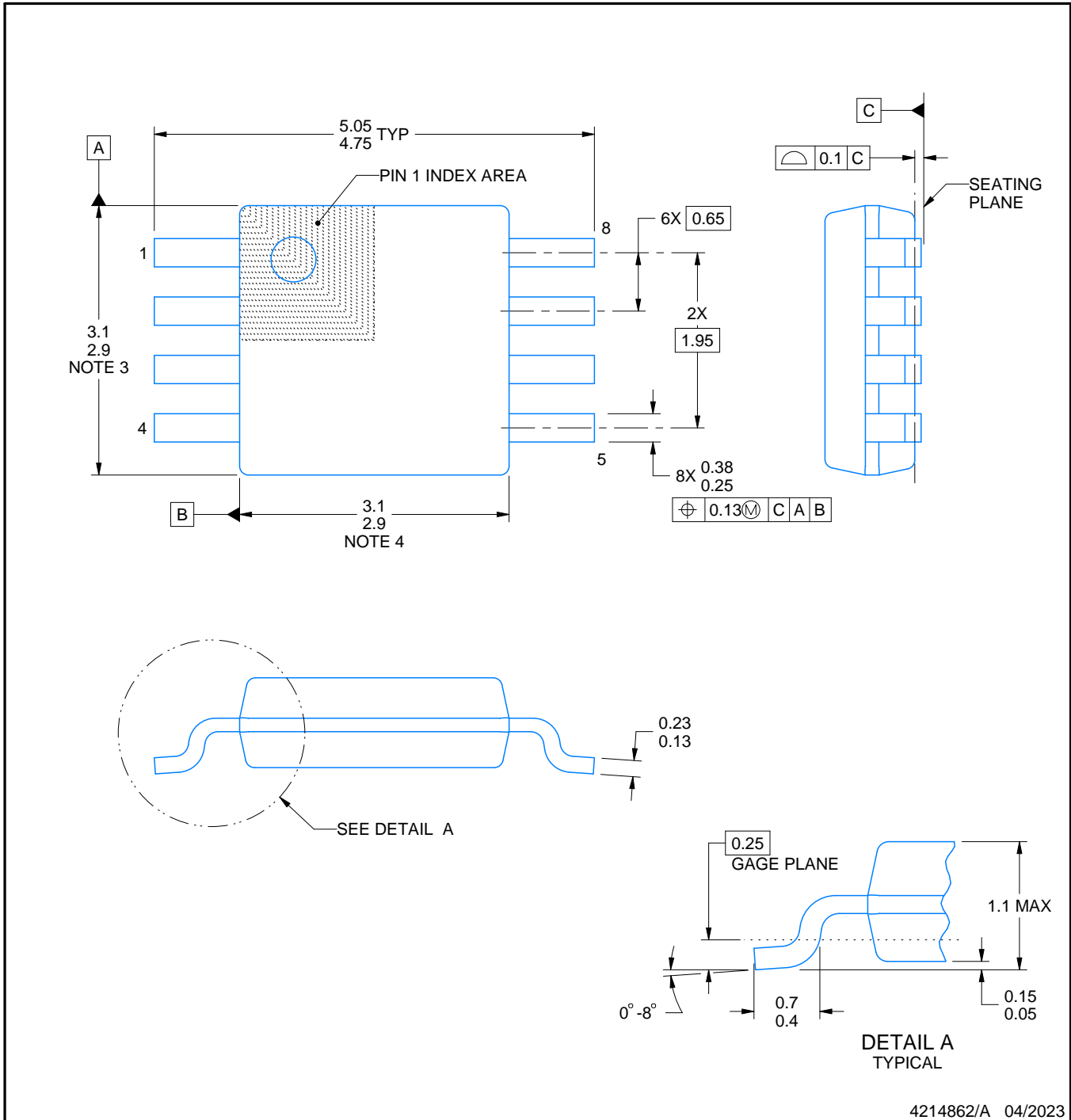
DGK0008A



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

™ VSSOP - 1.1 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 15X



4214862/A 04/2023

NOTES: (continued)

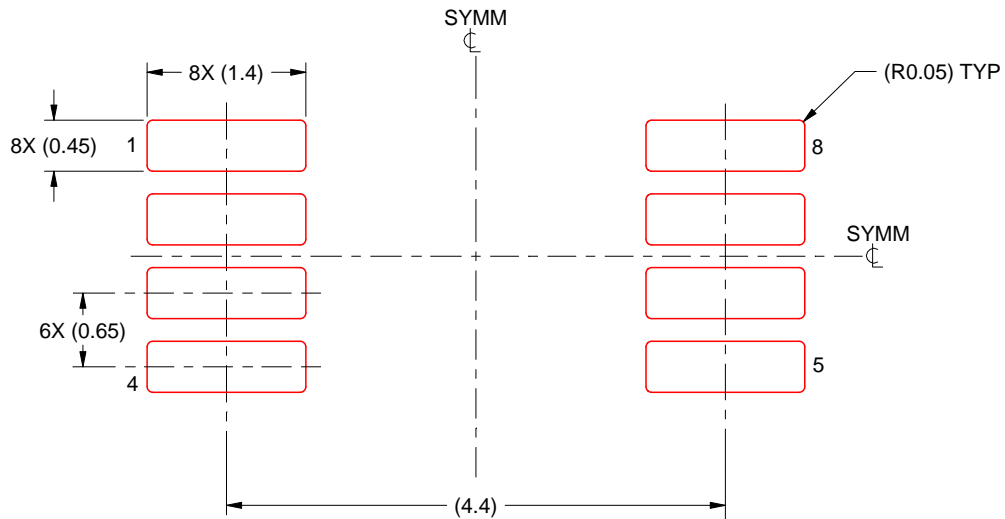
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.
8. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It 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

™ VSSOP - 1.1 mm max height

SMALL OUTLINE PACKAGE



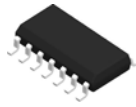
SOLDER PASTE EXAMPLE
SCALE: 15X

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.

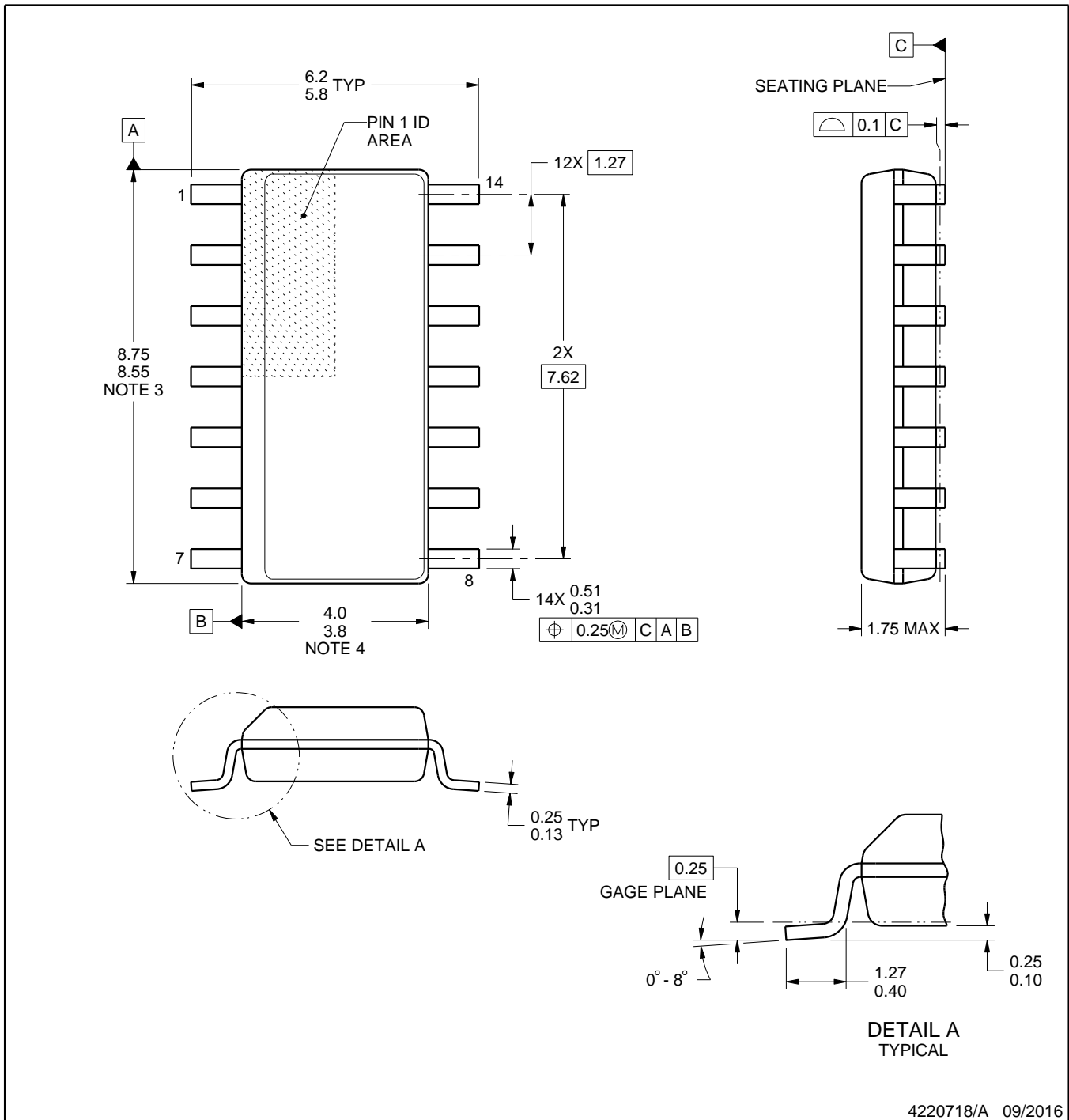
D0014A



PACKAGE OUTLINE

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



4220718/A 09/2016

NOTES:

- All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
- This drawing is subject to change without notice.
- 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.
- This dimension does not include interlead flash. Interlead flash shall not exceed 0.43 mm, per side.
- Reference JEDEC registration MS-012, variation AB.

EXAMPLE BOARD LAYOUT

D0014A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



LAND PATTERN EXAMPLE
SCALE:8X



SOLDER MASK DETAILS

4220718/A 09/2016

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

D0014A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:8X

4220718/A 09/2016

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.

EXAMPLE BOARD LAYOUT

DCK0005A

SOT - 1.1 max height

SMALL OUTLINE TRANSISTOR



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:18X



SOLDER MASK DETAILS

4214834/G 11/2024

NOTES: (continued)

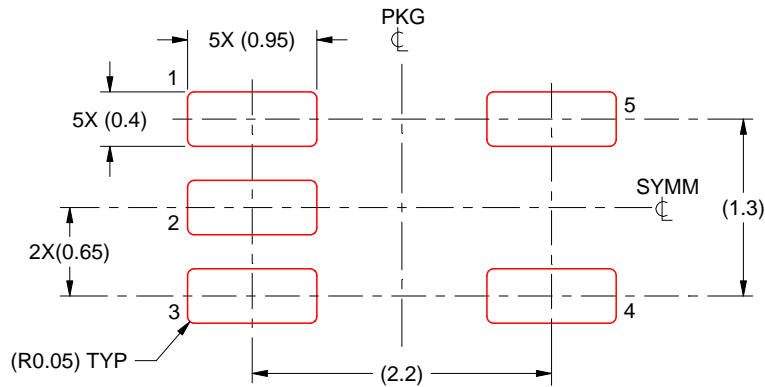
- 7. Publication IPC-7351 may have alternate designs.
- 8. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

DCK0005A

SOT - 1.1 max height

SMALL OUTLINE TRANSISTOR



SOLDER PASTE EXAMPLE
BASED ON 0.125 THICK STENCIL
SCALE: 18X

4214834/G 11/2024

NOTES: (continued)

9. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
10. 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:

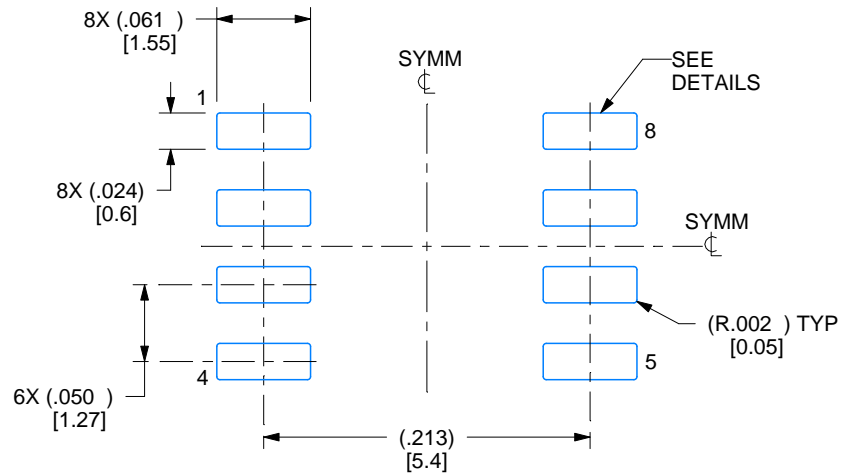
- Linear dimensions are in inches [millimeters]. Dimensions in parenthesis are for reference only. Controlling dimensions are in inches. Dimensioning and tolerancing per ASME Y14.5M.
- This drawing is subject to change without notice.
- This dimension does not include mold flash, protrusions, or gate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

EXAMPLE BOARD LAYOUT

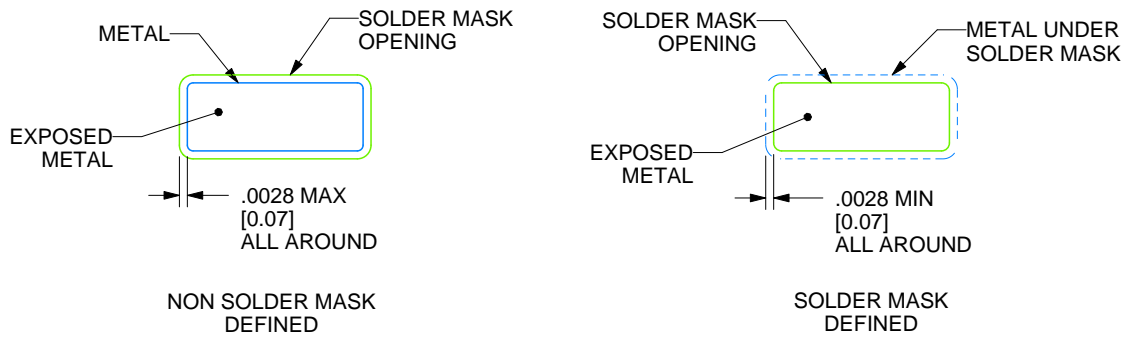
D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:8X



SOLDER MASK DETAILS

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)

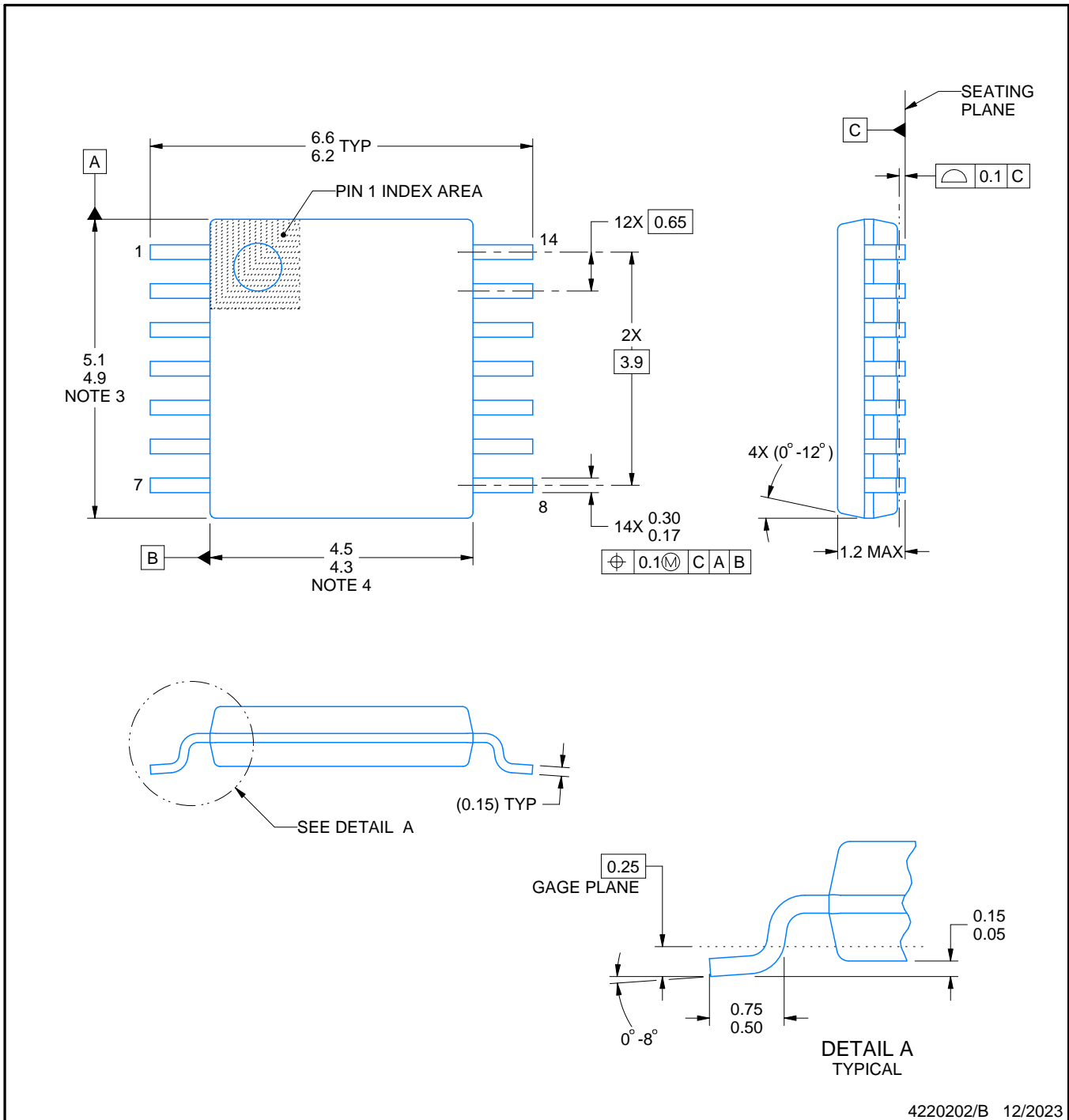
8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

PW0014A



PACKAGE OUTLINE
TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



4220202/B 12/2023

NOTES:

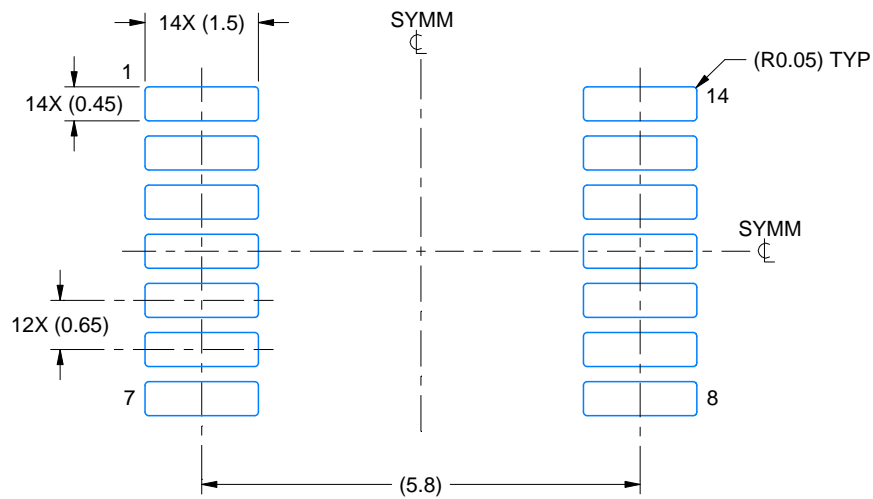
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or 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

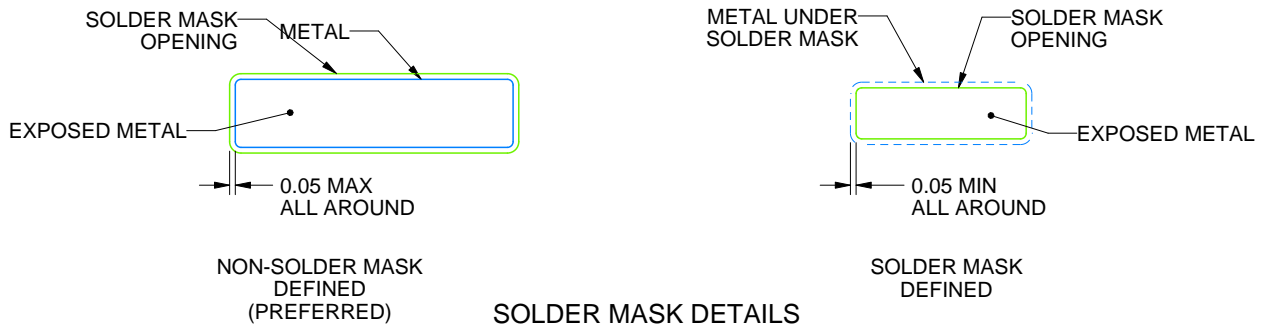
PW0014A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 10X



4220202/B 12/2023

NOTES: (continued)

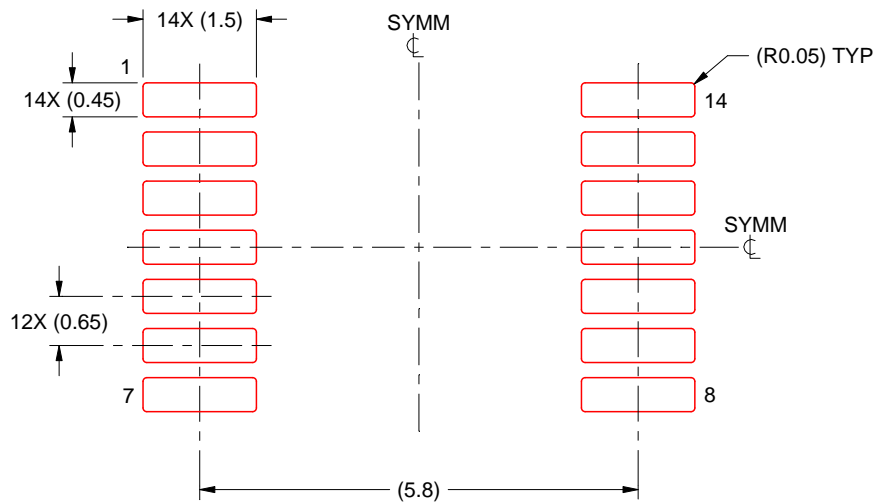
- 6. Publication IPC-7351 may have alternate designs.
- 7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

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.

重要通知和免责声明

TI“按原样”提供技术和可靠性数据（包括数据表）、设计资源（包括参考设计）、应用或其他设计建议、网络工具、安全信息和其他资源，不保证没有瑕疵且不做任何明示或暗示的担保，包括但不限于对适销性、与某特定用途的适用性或不侵犯任何第三方知识产权的暗示担保。

这些资源可供使用 TI 产品进行设计的熟练开发人员使用。您将自行承担以下全部责任：(1) 针对您的应用选择合适的 TI 产品，(2) 设计、验证并测试您的应用，(3) 确保您的应用满足相应标准以及任何其他安全、安保法规或其他要求。

这些资源如有变更，恕不另行通知。TI 授权您仅可将这些资源用于研发本资源所述的 TI 产品的相关应用。严禁以其他方式对这些资源进行复制或展示。您无权使用任何其他 TI 知识产权或任何第三方知识产权。对于因您对这些资源的使用而对 TI 及其代表造成的任何索赔、损害、成本、损失和债务，您将全额赔偿，TI 对此概不负责。

TI 提供的产品受 [TI 销售条款](#)、[TI 通用质量指南](#) 或 [ti.com](#) 上其他适用条款或 TI 产品随附的其他适用条款的约束。TI 提供这些资源并不会扩展或以其他方式更改 TI 针对 TI 产品发布的适用的担保或担保免责声明。除非德州仪器 (TI) 明确将某产品指定为定制产品或客户特定产品，否则其产品均为按确定价格收入目录的标准通用器件。

TI 反对并拒绝您可能提出的任何其他或不同的条款。

版权所有 © 2026，德州仪器 (TI) 公司

最后更新日期：2025 年 10 月