

# OPAx317-Q1ゼロドリフト、低オフセット、レール・ツー・レールI/O オペアンプ

## 1 特長

- 車載アプリケーションに対応
- 下記内容で AEC-Q100 認定済み:
  - デバイス温度グレード1: 動作時周囲温度範囲  $-40^{\circ}\text{C}\sim+125^{\circ}\text{C}$
  - デバイスHBM ESD分類レベル3A
  - デバイスCDM ESD分類レベルC6
- 電源電圧: 1.8V~5.5V
- microPackage:
  - シングル: SOT23-5
  - デュアル: VSSOP-8
  - クワッド: TSSOP-14
- 低いオフセット電圧: 20 $\mu\text{V}$  (標準値)
- CMRR: 108dB (標準値) PSRR
- 静止電流: 35 $\mu\text{A}$  (最大値)
- ゲイン帯域幅: 300kHz
- レール・ツー・レール入出力
- 内部的なEMIおよびRFIフィルタリング

## 2 アプリケーション

- HEV-EVパワートレイン
- 先進運転支援システム(ADAS)
- 自動環境制御
- 低ノイズ、低消費電力の回路
- 航空電子工学、着陸装置
- 医療用計測装置
- 電流感知

## 3 概要

OPA317-Q1シリーズのCMOSオペアンプは、求めやすい価格でありながら高精度の性能を実現します。これらのデバイスは、ゼロドリフト・ファミリのアンプのメンバーで、専用の自動較正技術を使用して、低いオフセット電圧(最大90 $\mu\text{V}$ )、時間と温度に対してゼロに近いドリフト、わずかな35 $\mu\text{A}$  (最大値)の静止電流を同時に実現しています。

OPA317-Q1ファミリは、レール・ツー・レールの入出力に加えて、フラットに近い1/fノイズが特長で、多くのアプリケーションに理想的なアンプであり、システムの設計に簡単に組み込めます。これらのデバイスは、最小1.8V ( $\pm 0.9\text{V}$ )、最大5.5V ( $\pm 2.75\text{V}$ )の低電圧での動作に最適化されています。

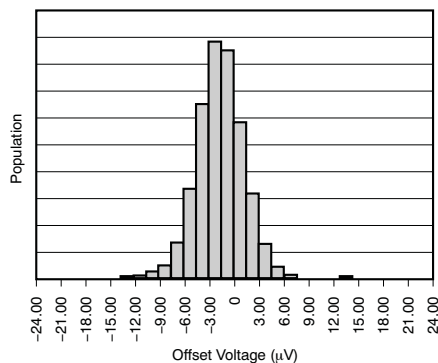
OPA317-Q1 (シングル・バージョン)はSOT23-5パッケージで利用可能です。OPA2317-Q1 (デュアル・バージョン)はVSSOP-8パッケージで利用可能です。OPA4317-Q1はTSSOP-14パッケージで利用可能です。どのバージョンも、 $-40^{\circ}\text{C}\sim+125^{\circ}\text{C}$ での動作が保証されています。

### 製品情報<sup>(1)</sup>

型番	パッケージ	本体サイズ(公称)
OPA317-Q1	SOT-23 (5)	1.60mmx2.90mm
OPA2317-Q1	VSSOP (8)	3.00mmx3.00mm
OPA4317-Q1	TSSOP (14)	4.40mmx5.00mm

(1) 提供されているすべてのパッケージについては、データシートの末尾にある注文情報を参照してください。

オフセット電圧の分布



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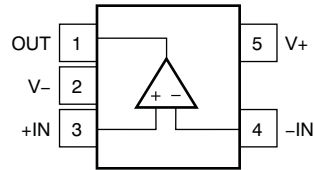
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## 4 改訂履歴

日付	改訂内容	注
2016年7月	*	初版

## 5 Pin Configuration and Functions

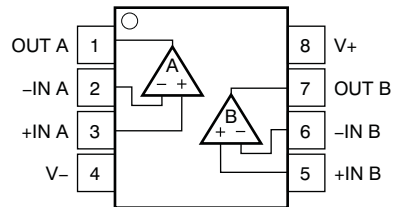
OPA317-Q1: DBV Package  
5-Pin SOT-23  
Top View



Pin Functions: OPA317-Q1

PIN		I/O	DESCRIPTION
NAME	NO. SOT-23		
+IN	3	I	Noninverting input
-IN	4	I	Inverting input
OUT	1	O	Output
V+	5	—	Positive (highest) power supply
V-	2	—	Negative (lowest) power supply

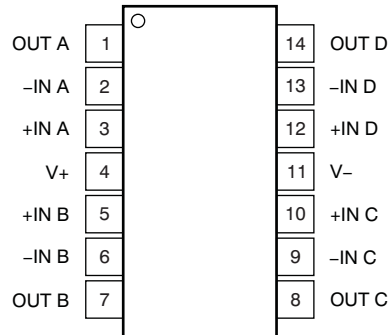
**OPA2317-Q1: DGK Package  
8-Pin VSSOP  
Top View**



**Pin Functions: OPA2317-Q1**

PIN		I/O	DESCRIPTION
NAME	NO. VSSOP		
+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
OUT A	1	O	Output, channel A
OUT B	7	O	Output, channel B
V+	8	—	Positive (highest) power supply
V-	4	—	Negative (lowest) power supply

**OPA4317-Q1: SW Package  
14-Pin TSSOP  
Top View**



**Pin Functions: OPA4317-Q1**

PIN		I/O	DESCRIPTION
NAME	NO. 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.<sup>(1)</sup>

		MIN	MAX	UNIT
$V_S = (V+) - (V-)$	Supply voltage		7	V
	Signal input terminals <sup>(2)</sup>	$(V-) - 0.3$	$(V+) + 0.3$	V
	Signal input terminals <sup>(2)</sup>	-10	10	mA
	Output short circuit <sup>(3)</sup>	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 AEC Q100-002 <sup>(1)</sup>	±4000	
		Charged-device model (CDM), per AEC Q100-011	All pins	±1000
			Corner pins	±1000

- (1) AEC Q100-002 indicates that HBM stressing shall be in accordance with the ANSI/ESDA/JEDEC JS-001 specification.

### 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-Q1

THERMAL METRIC <sup>(1)</sup>		OPA317-Q1	
		DBV (SOT-23)	
		5 PINS	
			UNIT
$R_{\theta JA}$	Junction-to-ambient thermal resistance	220.8	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	97.5	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	61.7	°C/W
$\Psi_{JT}$	Junction-to-top characterization parameter	7.6	°C/W
$\Psi_{JB}$	Junction-to-board characterization parameter	61.1	°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-Q1

THERMAL METRIC <sup>(1)</sup>		OPA2317-Q1	
		DGK (VSSOP)	
		8 PINS	
			UNIT
$R_{\theta JA}$	Junction-to-ambient thermal resistance	180.3	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	48.1	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	100.9	°C/W
$\Psi_{JT}$	Junction-to-top characterization parameter	2.4	°C/W
$\Psi_{JB}$	Junction-to-board characterization parameter	99.3	°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-Q1

THERMAL METRIC <sup>(1)</sup>		OPA4317-Q1	
		PW (TSSOP)	
		14 PINS	
			UNIT
$R_{\theta JA}$	Junction-to-ambient thermal resistance	120.8	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	34.3	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	62.8	°C/W
$\Psi_{JT}$	Junction-to-top characterization parameter	1	°C/W
$\Psi_{JB}$	Junction-to-board characterization parameter	56.5	°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
<b>OFFSET VOLTAGE</b>						
$V_{OS}$	Input offset voltage	$V_S = 5\text{ V}$		20	$\pm 90$	$\mu\text{V}$
		$T_A = -40^\circ\text{C to }+125^\circ\text{C}$ , $V_S = 5\text{ V}$			$\pm 100$	
$dV_{OS}/dT$	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	$\mu\text{V}/\text{V}$
	Long-term stability <sup>(1)</sup>			See <sup>(1)</sup>		
	Channel separation, DC			5		$\mu\text{V}/\text{V}$
<b>INPUT BIAS CURRENT</b>						
$I_B$	Input bias current			$\pm 275$		pA
		OPA4317-Q1		$\pm 155$		
		$T_A = -40^\circ\text{C to }+125^\circ\text{C}$		$\pm 300$		
$I_{OS}$	Input offset current			$\pm 400$		pA
		OPA4317-Q1		$\pm 140$		
<b>NOISE</b>						
$e_n$	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		$\mu\text{V}_{PP}$
		$f = 0.1\text{ Hz to }10\text{ Hz}$		1.1		
$i_n$	Input current noise	$f = 10\text{ Hz}$		100		$\text{fA}/\sqrt{\text{Hz}}$
<b>INPUT VOLTAGE RANGE</b>						
$V_{CM}$	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		
<b>INPUT CAPACITANCE</b>						
	Differential			2		pF
	Common-mode			4		pF
<b>OPEN-LOOP GAIN</b>						
$A_{OL}$	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
<b>FREQUENCY RESPONSE</b>						
GBW	Gain-bandwidth product	$C_L = 100\text{ pF}$		300		kHz
SR	Slew rate	$G = 1$		0.15		$\text{V}/\mu\text{s}$
<b>OUTPUT</b>						
	Voltage output swing from rail	$T_A = -40^\circ\text{C to }+125^\circ\text{C}$		30	100	mV
$I_{SC}$	Short-circuit current			$\pm 5$		mA
$C_L$	Capacitive load drive		See the <a href="#">Typical Characteristics</a> section			
	Open-loop output impedance	$f = 350\text{ kHz}$ , $I_O = 0$		2		k $\Omega$
<b>POWER SUPPLY</b>						
$V_S$	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	$\mu\text{A}$
	Turnon time	$V_S = 5\text{ V}$		100		$\mu\text{s}$

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



### 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.

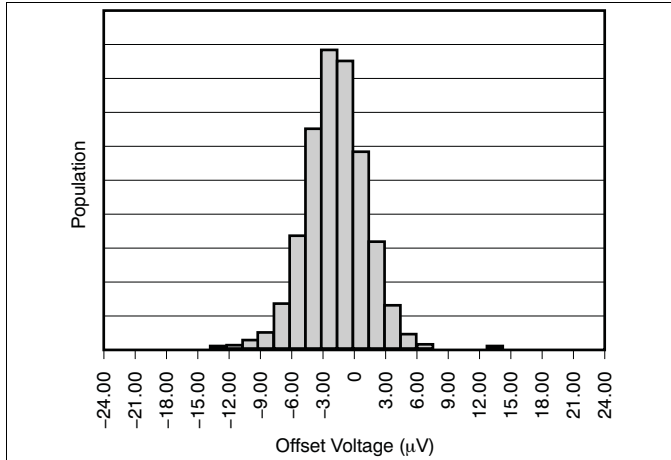


Figure 1. Offset Voltage Production Distribution

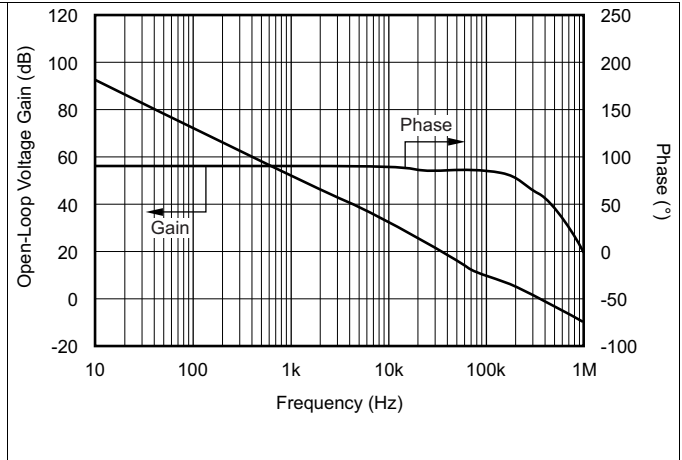


Figure 2. Open-Loop Gain vs Frequency

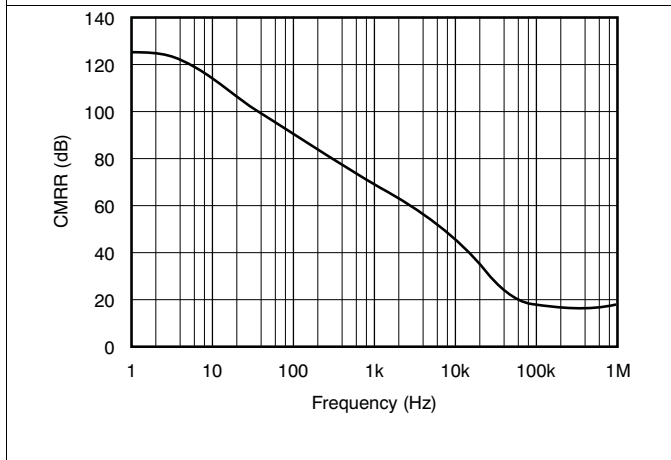


Figure 3. Common-Mode Rejection Ratio vs Frequency

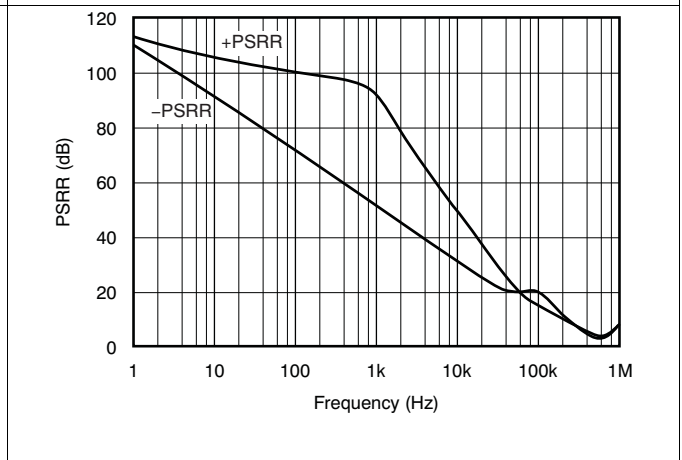


Figure 4. Power-Supply Rejection Ratio vs Frequency

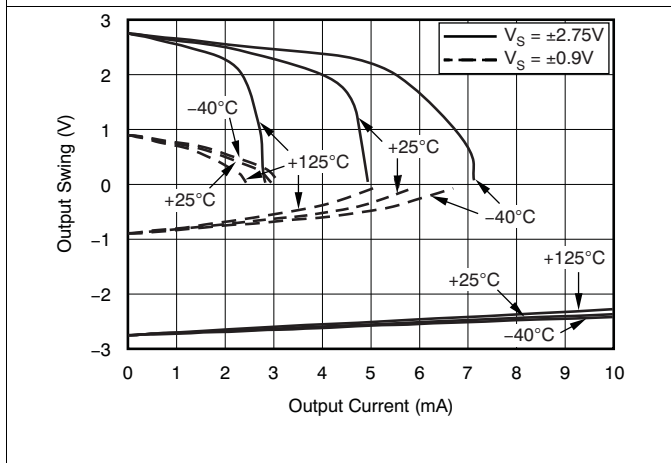


Figure 5. Output Voltage Swing vs Output Current

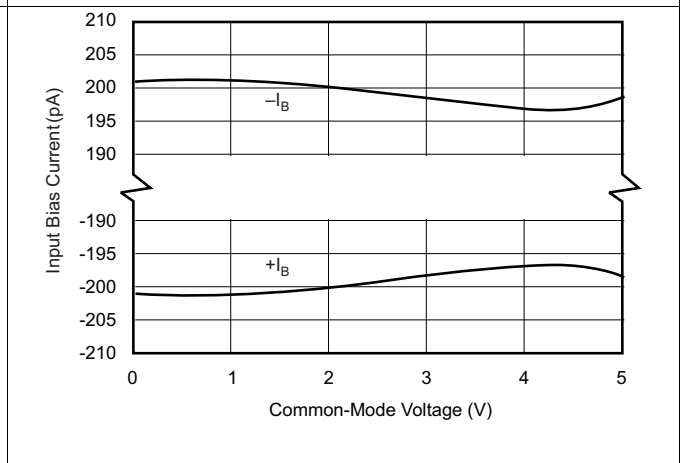


Figure 6. Input Bias Current vs Common-Mode Voltage

### 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.

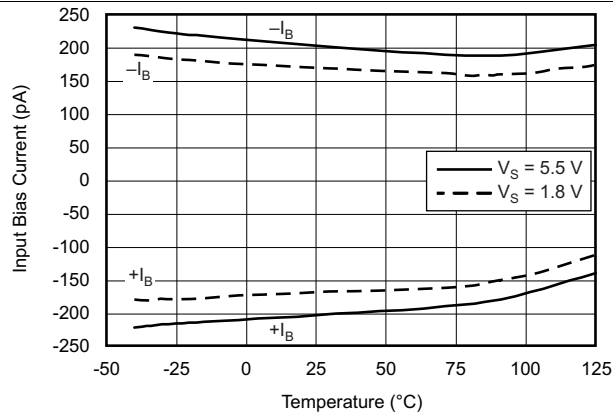


Figure 7. Input Bias Current vs Temperature

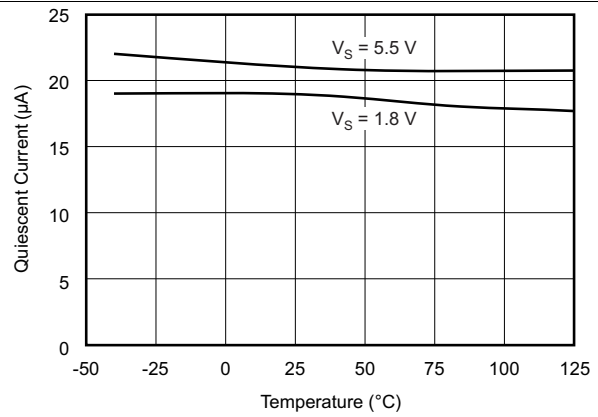


Figure 8. Quiescent Current vs Temperature

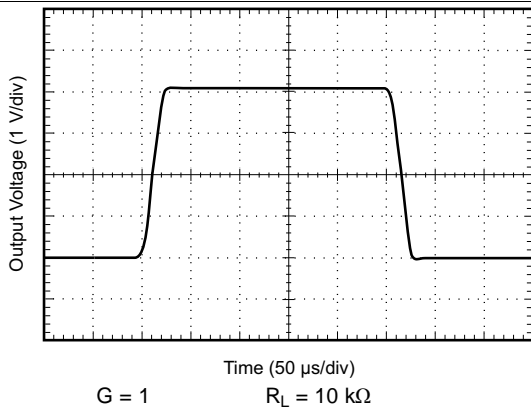


Figure 9. Large-Signal Step Response

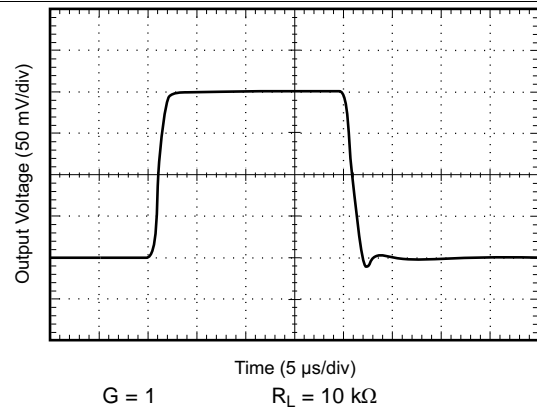


Figure 10. Small-Signal Step Response

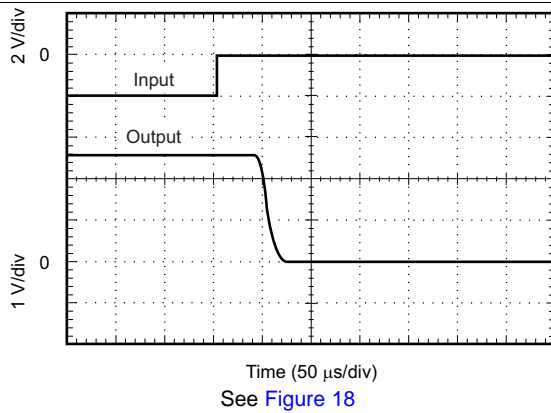


Figure 11. Positive Overvoltage Recovery

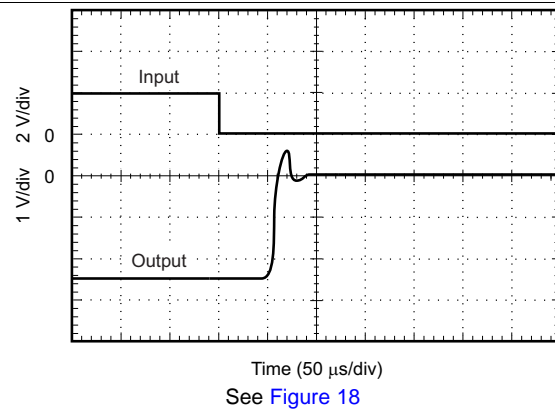


Figure 12. Negative Overvoltage Recovery

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.

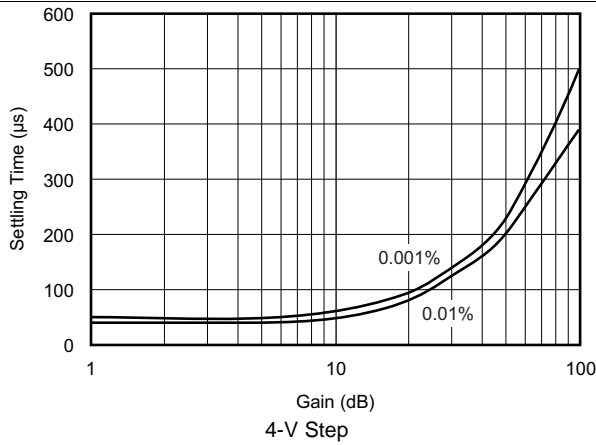


Figure 13. Settling Time vs Closed-Loop Gain

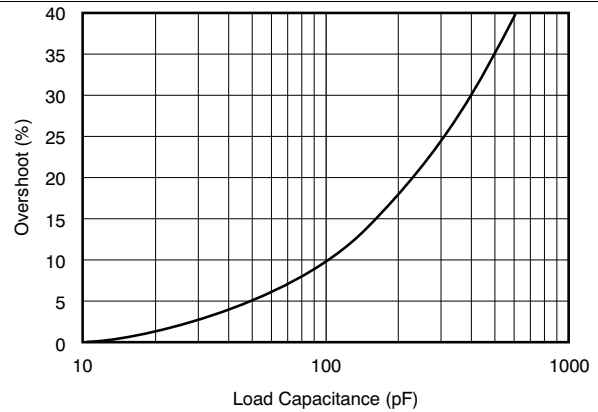


Figure 14. Small-Signal Overshoot vs Load Capacitance

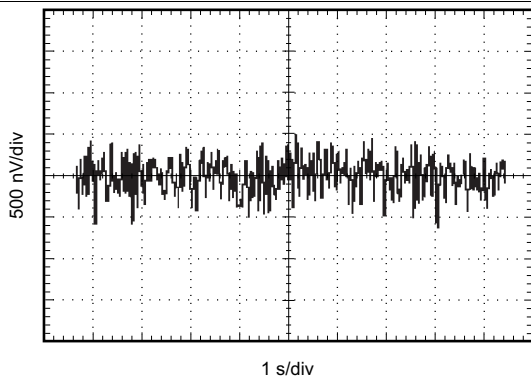


Figure 15. 0.1-Hz to 10-Hz Noise

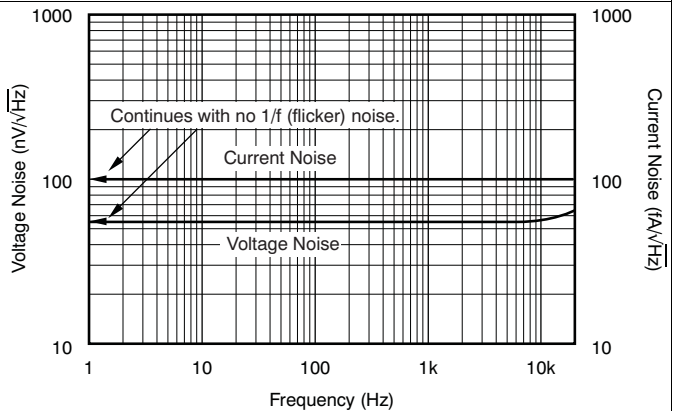
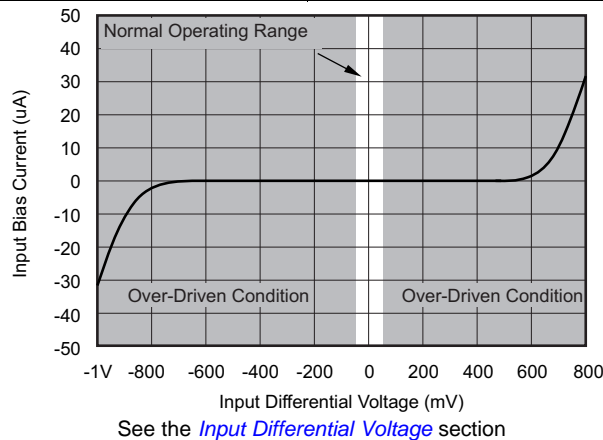


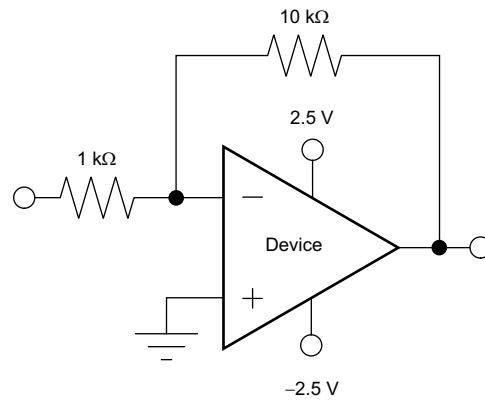
Figure 16. Current and Voltage Noise Spectral Density vs Frequency



See the [Input Differential Voltage](#) section

Figure 17. Input Bias Current vs Input Differential Voltage

## 7 Parameter Measurement Information



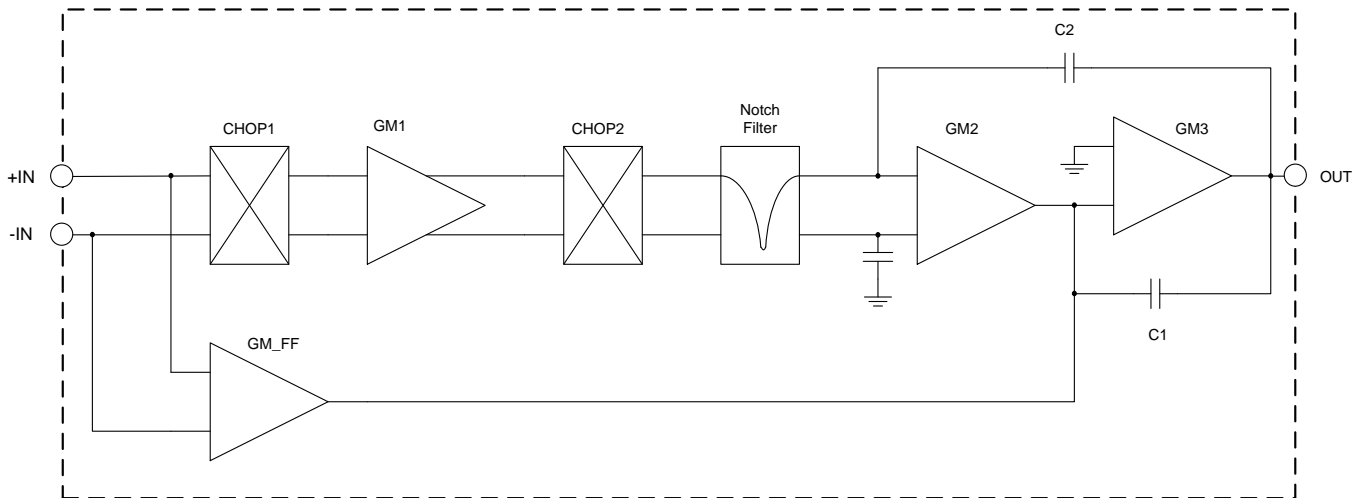
**Figure 18. Overvoltage Recovery Circuit**

## 8 Detailed Description

### 8.1 Overview

The OPA317-Q1 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



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### 8.3 Feature Description

#### 8.3.1 Operating Voltage

The OPA317-Q1 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.

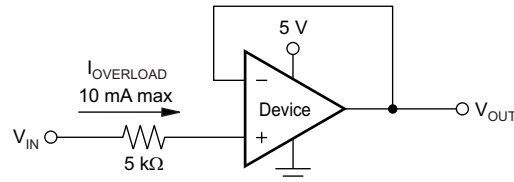
See the [Absolute Maximum Ratings](#) table. Key parameters that vary over the supply voltage or temperature range are shown in the [Typical Characteristics](#) section.

## Feature Description (continued)

### 8.3.2 Input Voltage

The OPA317-Q1, OPA2317-Q1, and OPA4317-Q1 input common-mode voltage range extends 0.1 V beyond the supply rails. The OPA317-Q1 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  $\geq 0.3$  V.

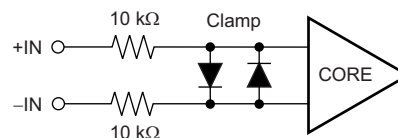
**Figure 19. Input Current Protection**

### 8.3.3 Input Differential Voltage

The typical input bias current of the OPA317-Q1 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-kΩ 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-Q1, OPA2317-Q1, and OPA4317-Q1 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  $\mu$ s using a proprietary technique. Upon power up, the amplifier requires approximately 100  $\mu$ 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-Q1 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-Q1 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

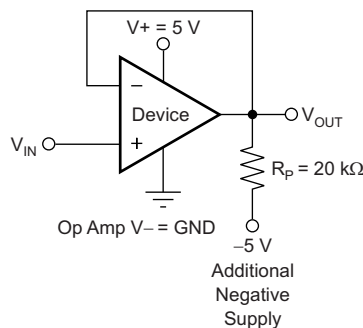
Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation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

### 9.1 Application Information

The OPA317-Q1, OPA2317-Q1, and OPA4317-Q1 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-Q1 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-Q1 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-Q1, OPA2317-Q1, and OPA4317-Q1 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](#).



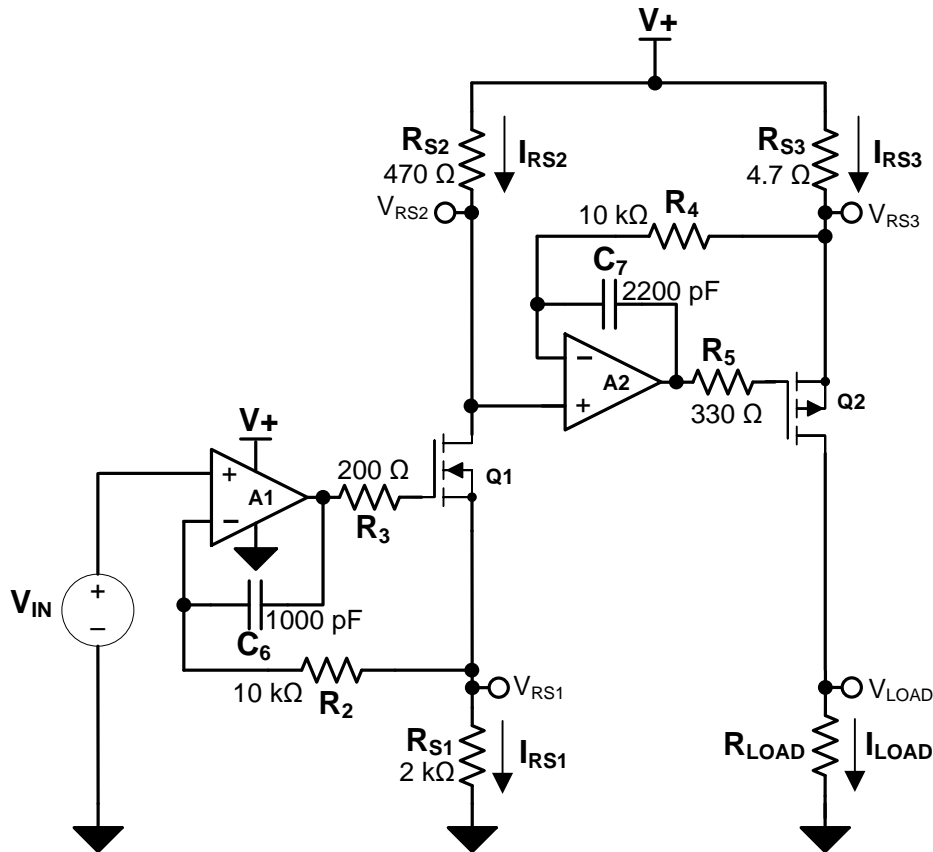
**Figure 21. For  $V_{OUT}$  Range to Ground**

The OPA317-Q1, OPA2317-Q1, and OPA4317-Q1 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-Q1, OPA2317-Q1, and OPA4317-Q1 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.



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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

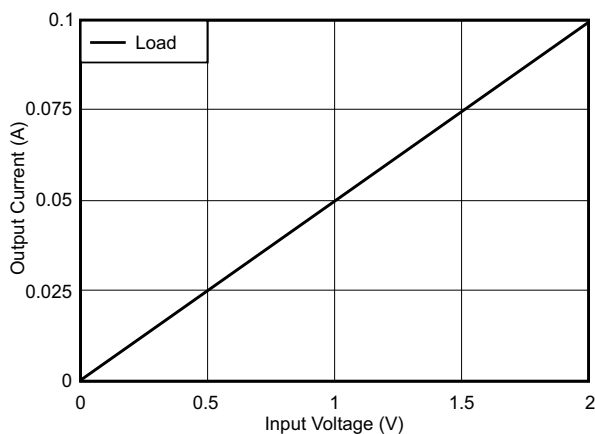
### 9.2.2 Detailed Design Procedure

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- $\mu\text{V}$  offset, 0.05- $\mu\text{V}/^\circ\text{C}$  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.

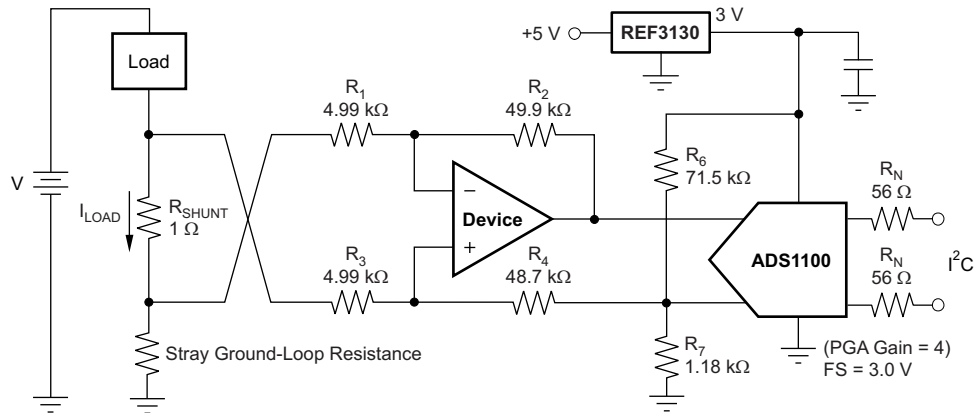
### 9.2.3 Application Curve



**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 I<sup>2</sup>C 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.



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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-Q1 device is specified for operation from 1.8 V to 5.5 V ( $\pm 0.9$  V to  $\pm 2.75$  V); many specifications apply from  $-40^\circ\text{C}$  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- $\mu\text{F}$  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

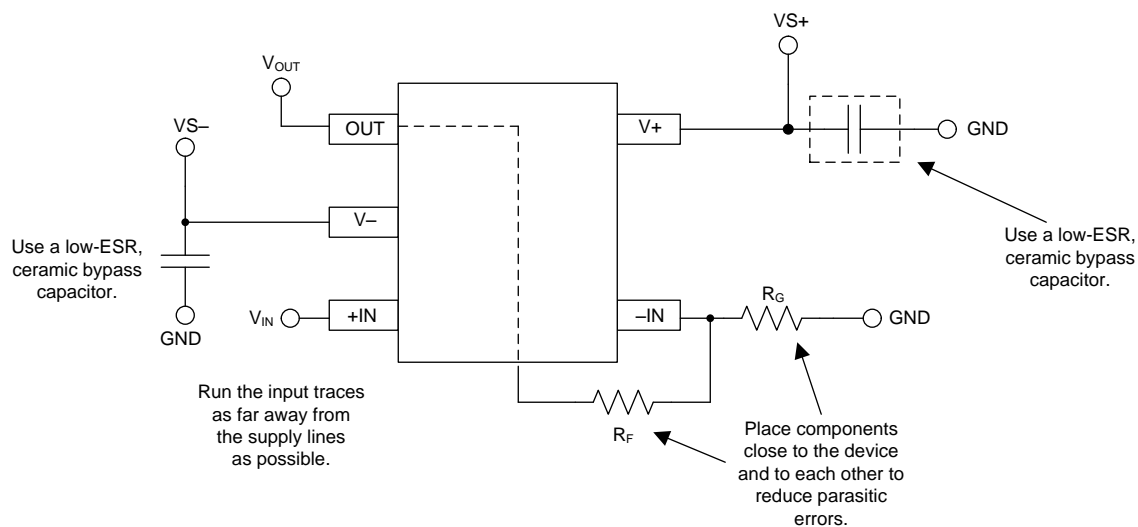
Attention to good layout practice is always recommended. Keep traces short and, when possible, use a printed-circuit board (PCB) ground plane with surface-mount components placed as close to the device pins as possible. Place a 0.1- $\mu\text{F}$  capacitor closely across the supply pins. Apply these 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  $\mu\text{V}/^\circ\text{C}$  or higher, depending on the materials used.

### 11.2 Layout Example



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**Figure 25. OPAx317-Q1 Layout Example**

## 12 デバイスおよびドキュメントのサポート

### 12.1 ドキュメントのサポート

#### 12.1.1 関連資料

関連資料については、以下を参照してください:

- 『セルフ・キャリブレーション、16ビットA/Dコンバータ』、
- 『最大15ppm/°C、100μA、SOT23-3シリーズ 基準電圧』、

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### 12.3 関連リンク

次に、クイック・アクセス・リンクの一覧を示します。カテゴリには、技術資料、サポートおよびコミュニティ・リソース、ツールとソフトウェア、およびサンプル注文またはご購入へのクイック・アクセスが含まれます。

表 1. 関連リンク

製品	プロダクト・フォルダ	サンプルとご購入	技術資料	ツールとソフトウェア	サポートとコミュニティ
OPA317-Q1	<a href="#">ここをクリック</a>	<a href="#">ここをクリック</a>	<a href="#">ここをクリック</a>	<a href="#">ここをクリック</a>	<a href="#">ここをクリック</a>
OPA2317-Q1	<a href="#">ここをクリック</a>	<a href="#">ここをクリック</a>	<a href="#">ここをクリック</a>	<a href="#">ここをクリック</a>	<a href="#">ここをクリック</a>
OPA4317-Q1	<a href="#">ここをクリック</a>	<a href="#">ここをクリック</a>	<a href="#">ここをクリック</a>	<a href="#">ここをクリック</a>	<a href="#">ここをクリック</a>

### 12.4 コミュニティ・リソース

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](http://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.

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### 12.7 Glossary

**SLYZ022** — *TI Glossary*.

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

## 13 メカニカル、パッケージ、および注文情報

以降のページには、メカニカル、パッケージ、および注文に関する情報が記載されています。これらの情報は、指定のデバイスに対して提供されている最新のデータです。このデータは予告なく変更されることがあり、ドキュメントが改訂される場合もあります。本データシートのブラウザ版を使用されている場合は、画面左側の説明をご覧ください。

**PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
OPA2317QDGKRQ1	ACTIVE	VSSOP	DGK	8	2500	RoHS & Green	NIPDAUAG	Level-2-260C-1 YEAR	-40 to 125	2317	<a href="#">Samples</a>
OPA317QDBVRQ1	ACTIVE	SOT-23	DBV	5	3000	RoHS & Green	NIPDAU	Level-3-260C-168 HR	-40 to 125	317Q	<a href="#">Samples</a>

(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) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(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 finish/Ball material - Orderable Devices 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.

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# 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



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

™ 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.

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