TEXAS INSTRUMENTS

REF3012, REF3020, REF3025, REF3030, REF3033, REF3040
ZHCSHP0H – MARCH 2002 – REVISED FEBRUARY 2018

采用 SOT-23-3 封装的 REF30xx 50ppm/°C（最大值）、50µA、CMOS 电压基准

1 特性

- 微型封装：SOT-23-3
- 低压降：1mV
- 高输出电流：25mA
- 高精度：0.2%
- 低 I_Q：42µA（典型值）
- 出色的额定温漂性能：
  - 0°C 至 70°C 范围内为 50ppm/°C（最大值）
  - –40°C 至 +125°C 范围内为 75ppm/°C（最大值）

2 应用

- 温度和压力发送器
- 便携式、电池供电类设备
- 数据采集系统
- 医疗设备
- 手持测试设备

3 说明

REF30xx 是采用微型 3 引脚 SOT-23 封装的精密、低功耗、低压降电压基准产品系列。REF30xx 提供出色的温漂和初始精度，具有 42µA（典型值）的静态电流。

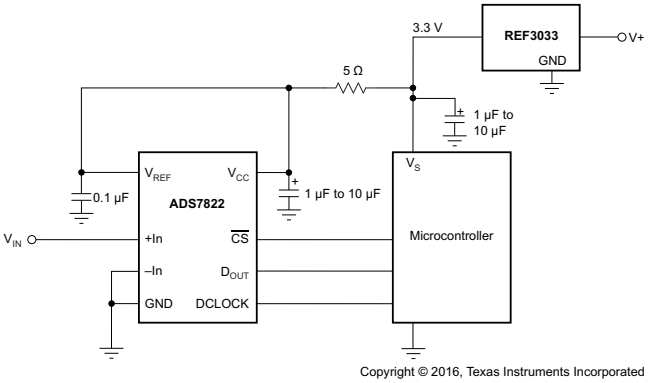
低功耗和相对较高的精度使得 REF30xx 非常适合环路供电式工业 应用 ，如压力和温度变送器 应用中，低功耗是一个关键问题。REF30xx 非常便于用在本安和防爆 应用 中，因为它无需负载电容器即可实现稳定。REF30xx 的额定工业温度范围为 –40°C 至 +125°C。

在零负载条件下，REF30xx 由 1mV 输出电压范围的电源供电。工程师们可在便携式和电池供电类应用中充分发挥 REF30xx 系列器件的低压降、小尺寸和低功耗特性 应用中，的需求。

器件信息

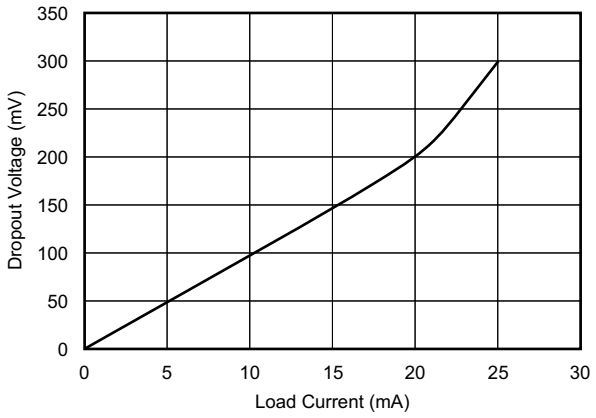
器件型号	封装	封装尺寸（标称值）
REF30xx	SOT-23 (3)	2.92mm × 1.30mm

典型应用



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压降电压与负载电流间的关系



An IMPORTANT NOTICE at the end of this data sheet addresses availability, warranty, changes, use in safety-critical applications, intellectual property matters and other important disclaimers. PRODUCTION DATA.

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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 G (November 2015) to Revision H **Page**

- Changed section header From: REF33xx (REF3312, REF3318, REF3320, REF3325, REF3330, REF3333) To: REF30xx (REF3012, REF3020, REF3025, REF3030, REF30333, REF3040) in the *Electrical Characteristics* ... 6
- Added turnon settling time TYP value of 120 µs (deleted by mistake in the previous revision) ... 6
- Added NOTE to the *Application and Implementation* section ... 15

Changes from Revision F (August 2008) to Revision G **Page**

- 添加*器件信息*、*ESD 额定值*、*建议运行条件* 和*热性能信息* 表。 ... 1
- 添加*详细 说明*、*应用 和实施*、*电源建议*、*布局*、*器件和文档支持* 以及*机械*、*封装和可订购信息* 部分 ... 1
- 已更改 *说明*部分 ... 1
- Deleted thermal resistance parameter in Electrical Characteristics; see new Thermal Information table ... 6
- Moved temperature parameters from Electrical Characteristics to Recommended Operating Conditions ... 6

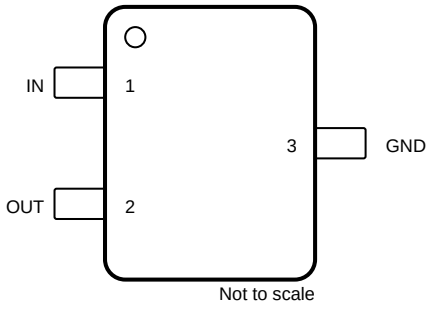
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5 Device Comparison Table

PART NUMBER	VOLTAGE (V)
REF3012	1.25
REF3020	2.048
REF3025	2.5
REF3030	3.0
REF3033	3.3
REF3040	4.096

6 Pin Configuration and Functions

DBZ Package
3-Pin SOT-23
Top View



Pin Functions

PIN		I/O	DESCRIPTION
NO.	NAME		
1	IN	Input	Input supply voltage
2	OUT	Output	Reference output voltage
3	GND	—	Ground

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7 Specifications

7.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)(1)

	MIN	MAX	UNIT
Supply voltage, V+ to V–		7.0	V
Output short-circuit current(2)		Continuous	
Operating temperature	–40	125	°C
Junction temperature		150	°C
Storage temperature, T_{stg}	–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) Short circuit to ground.

7.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001(1)	±4000	V
		Charged-device model (CDM), per JEDEC specification JESD22-C101(2)	±1500	

(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.

7.3 Recommended Operating Conditions

at T_A = 25°C, V_{IN} = 5 V, and I_{LOAD} = 0 mA (unless otherwise noted)

		MIN	NOM	MAX	UNIT
V_{IN}	Input voltage	V_{REF} + 0.05(1)		5.5	V
I_{LOAD}	Load current			25	mA
T_A	Operating temperature	–40		125	°C

(1) For I_L > 0, see *Typical Characteristics*. Minimum supply voltage for REF3012 is 1.8 V .

7.4 Thermal Information

THERMAL METRIC(1)		REF30xx DBZ (SOT-23) 3 PINS	UNIT
$R_{\theta JA}$	Junction-to-ambient thermal resistance	297.3	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	128.5	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	91.7	°C/W
ψ_{JT}	Junction-to-top characterization parameter	12.8	°C/W
ψ_{JB}	Junction-to-board characterization parameter	90.3	°C/W
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	N/A	°C/W

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

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7.5 Electrical Characteristics

at T_A = 25°C, V_{IN} = 5 V, and I_{LOAD} = 0 mA (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
REF3012 (1.25 V)(1)						
V_{OUT}	Output voltage		1.2475	1.25	1.2525	V
	Initial accuracy				0.2%	
	Output voltage noise	f = 0.1 Hz to 10 Hz		14		μV_{PP}
		f = 10 Hz to 10 kHz		42		µVrms
	Line regulation	1.8 V ≤ V_{IN} ≤ 5.5 V		60	190	µV/V
REF3020 (2.048 V)						
V_{OUT}	Output voltage		2.044	2.048	2.052	V
	Initial accuracy				0.2%	
	Output voltage noise	f = 0.1 Hz to 10 Hz		23		μV_{PP}
		f = 10 Hz to 10 kHz		65		µVrms
	Line regulation	V_{REF} + 50 mV ≤ V_{IN} ≤ 5.5 V		110	290	µV/V
REF3025 (2.5 V)						
V_{OUT}	Output voltage		2.495	2.50	2.505	V
	Initial accuracy				0.2%	
	Output voltage noise	f = 0.1 Hz to 10 Hz		28		μV_{PP}
		f = 10 Hz to 10 kHz		80		µVrms
	Line regulation	V_{REF} + 50 mV ≤ V_{IN} ≤ 5.5 V		120	325	µV/V
REF3030 (3.0 V)						
V_{OUT}	Output voltage		2.994	3.0	3.006	V
	Initial accuracy				0.2%	
	Output voltage noise	f = 0.1 Hz to 10 Hz		33		μV_{PP}
		f = 10 Hz to 10 kHz		94		µVrms
	Line regulation	V_{REF} + 50 mV ≤ V_{IN} ≤ 5.5 V		120	375	µV/V
REF3033 (3.3 V)						
V_{OUT}	Output voltage		3.294	3.30	3.306	V
	Initial accuracy				0.2%	
	Output voltage noise	f = 0.1 Hz to 10 Hz		36		μV_{PP}
		f = 10 Hz to 10 kHz		105		µVrms
	Line regulation	V_{REF} + 50 mV ≤ V_{IN} ≤ 5.5 V		130	400	µV/V
REF3040 (4.096 V)						
V_{OUT}	Output voltage		4.088	4.096	4.104	V
	Initial accuracy				0.2%	
	Output voltage noise	f = 0.1 Hz to 10 Hz		45		μV_{PP}
		f = 10 Hz to 10 kHz		128		µVrms
	Line regulation	V_{REF} + 50 mV ≤ V_{IN} ≤ 5.5 V		160	410	µV/V

(1) The minimum supply voltage for the REF3012 is 1.8 V.

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Electrical Characteristics (continued)

at T_A = 25°C, V_{IN} = 5 V, and I_{LOAD} = 0 mA (unless otherwise noted)

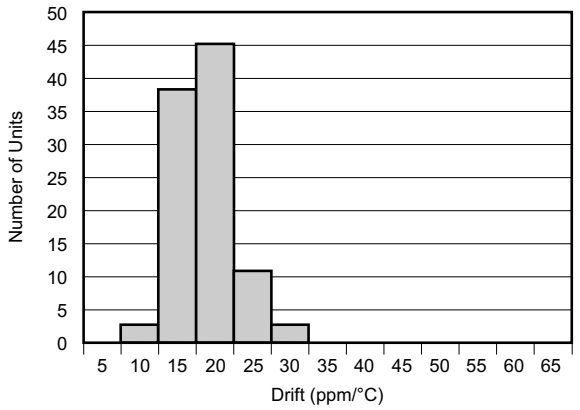
PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
REF30xx (REF3012, REF3020, REF3025, REF3030, REF30333, REF3040)						
dV_{OUT}/dT	Output voltage temperature drift(2)	0°C ≤ T_A ≤ 70°C		20	50	ppm/°C
		–30°C ≤ T_A ≤ +85°C		28	60	
		–40°C ≤ T_A ≤ +85°C		30	65	
		–40°C ≤ T_A ≤ +125°C		35	75	
	Long-term stability	0000h to 1000h		24		ppm
		1000h to 2000h		15		
$\Delta V_{O(\Delta IL)}$	Load regulation(3)	0 mA < I_{LOAD} < 25 mA, V_{IN} = V_{REF} + 500 mV(1)		3	100	µV/mA
dT	Thermal hysteresis(4)			25	100	ppm
$V_{IN} – V_{OUT}$	Dropout voltage			1	50	mV
I_{SC}	Short-circuit current			45		mA
	Turnon settling time	To 0.1% with C_L = 1 µF		120		µs
POWER SUPPLY						
I_Q	Quiescent current			42	50	µA
		–40°C ≤ T_A ≤ +125°C			59	

(2) Box method used to determine over temperature drift.
(3) Typical value of load regulation reflects measurements using a force and sense contacts; see *Load Regulation* section.
(4) Thermal hysteresis procedure explained in more detail in *Thermal Hysteresis* section.

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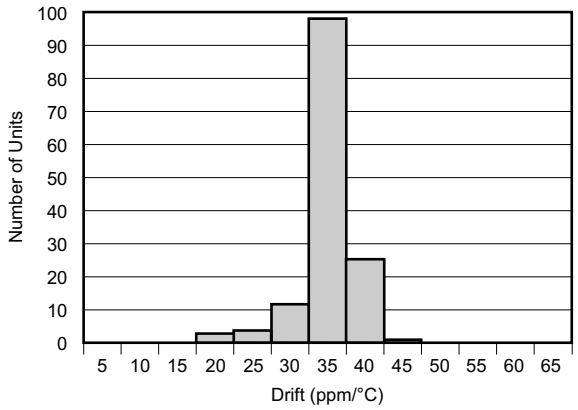
7.6 Typical Characteristics

at T_A = 25°C, V_{IN} = 5 V, and REF3025 used for typical characteristics (unless otherwise noted)



0°C to 70°C

Figure 1. Temperature Drift



–40°C to +125°C

Figure 2. Temperature Drift

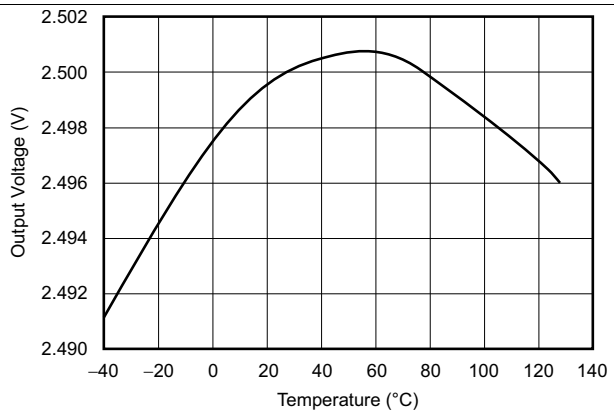


Figure 3. Output Voltage vs Temperature

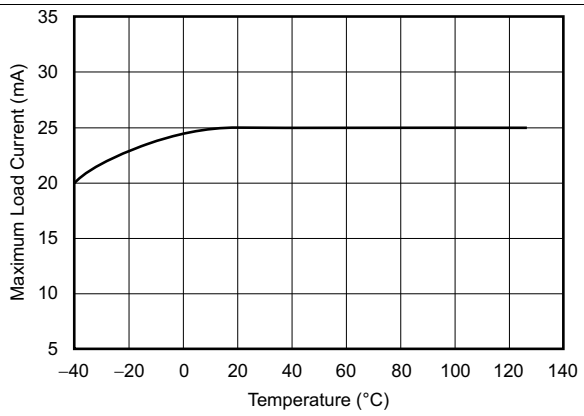


Figure 4. Maximum Load Current vs Temperature

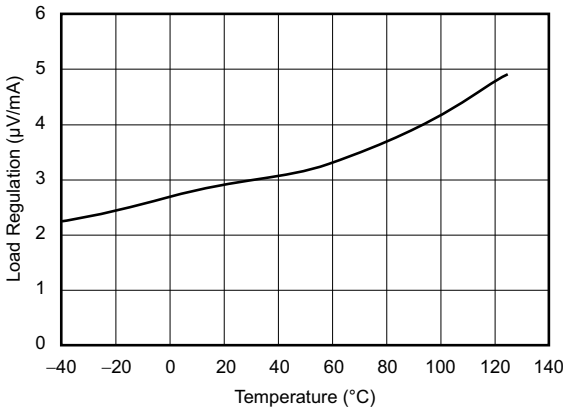


Figure 5. Load Regulation vs Temperature

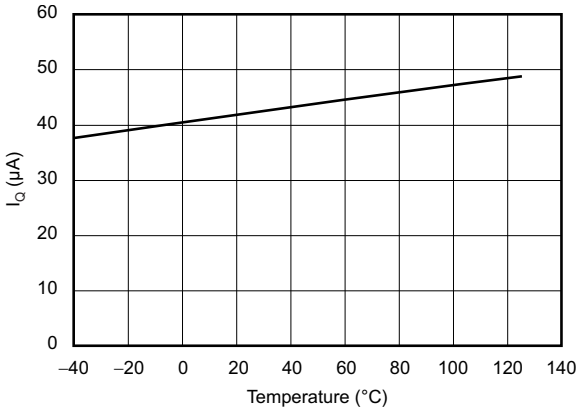


Figure 6. Quiescent Current vs Temperature

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Typical Characteristics (continued)

at T_A = 25°C, V_{IN} = 5 V, and REF3025 used for typical characteristics (unless otherwise noted)

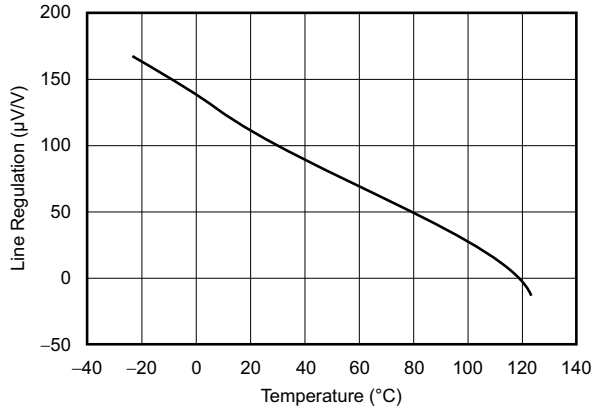


Figure 7. Line Regulation vs Temperature

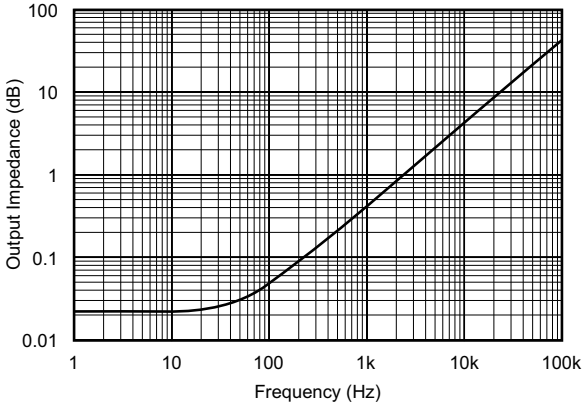


Figure 8. Output Impedance vs Frequency

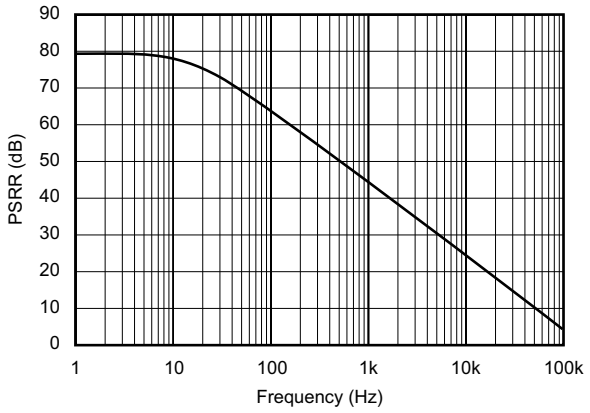
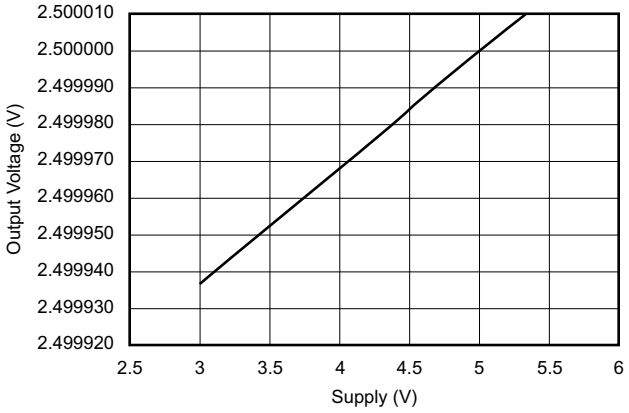
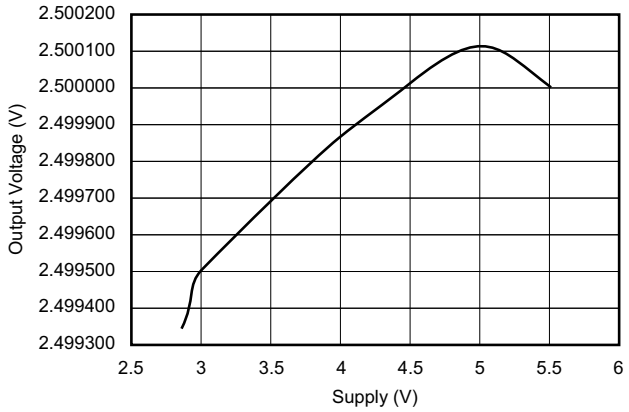


Figure 9. Power-Supply Rejection Ratio vs Frequency



No Load

Figure 10. Output Voltage vs Supply Voltage



I_{LOAD} = 25 mA

Figure 11. Output Voltage vs Supply Voltage

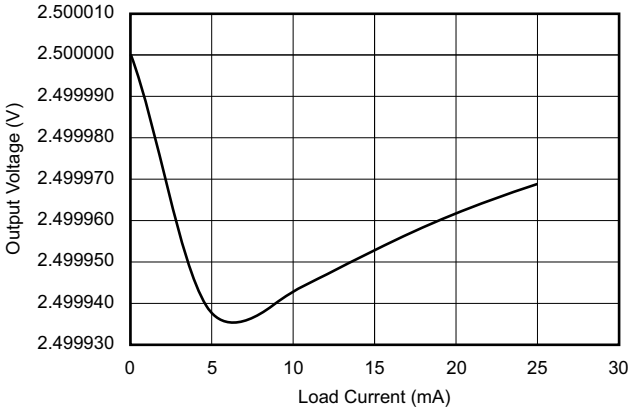
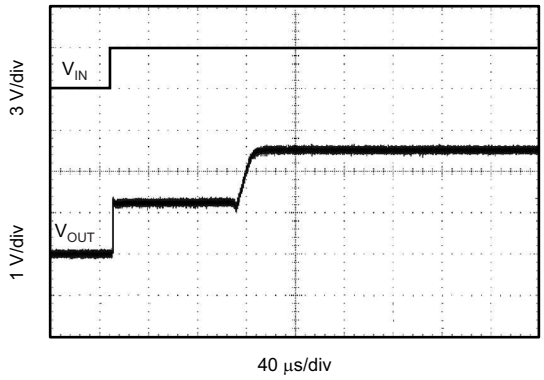


Figure 12. Output Voltage vs Load Current

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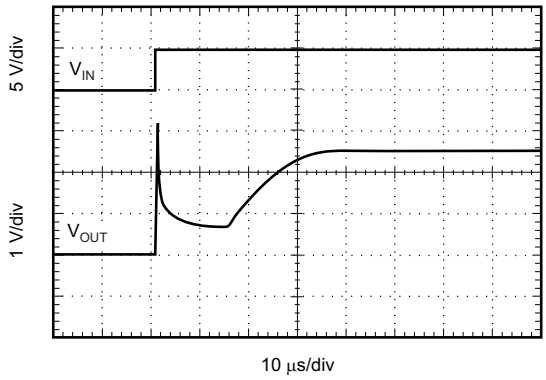
Typical Characteristics (continued)

at T_A = 25°C, V_{IN} = 5 V, and REF3025 used for typical characteristics (unless otherwise noted)



C_L = 0, 3-V startup

Figure 13. Step Response



C_L = 0, 5-V startup

Figure 14. Step Response

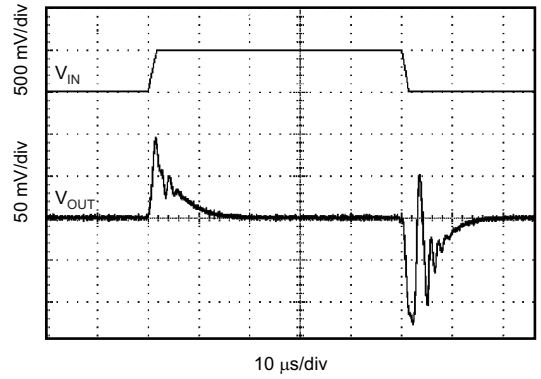
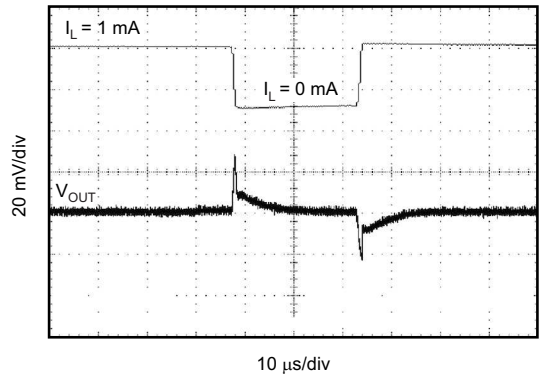
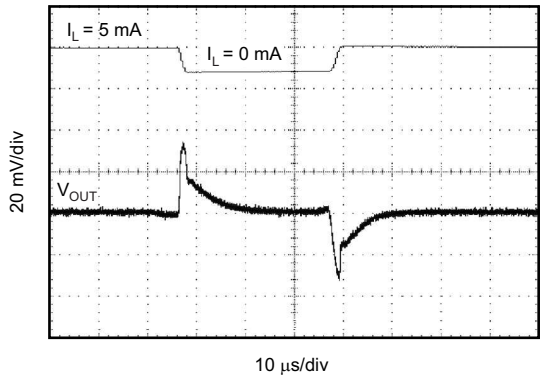


Figure 15. Line Transient Response



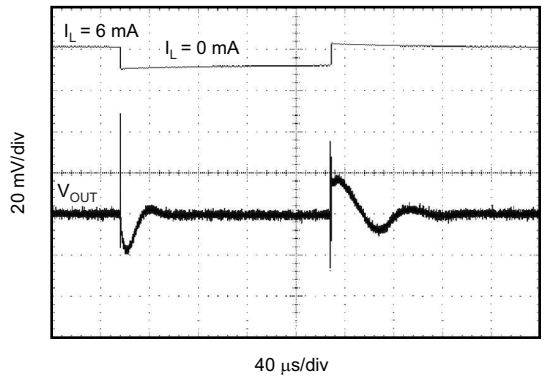
C_L = 0

Figure 16. 0-mA to 1-mA Load Transient



C_L = 0

Figure 17. 0-mA to 5-mA Load Transient



C_L = 1 µF

Figure 18. 1-mA to 6-mA Load Transient

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Typical Characteristics (continued)

at T_A = 25°C, V_{IN} = 5 V, and REF3025 used for typical characteristics (unless otherwise noted)

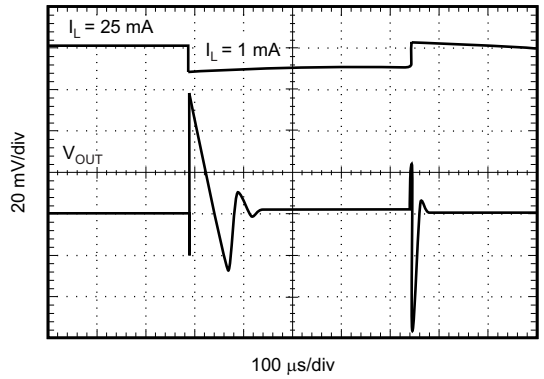


Figure 19. 1-mA to 25-mA Load Transient

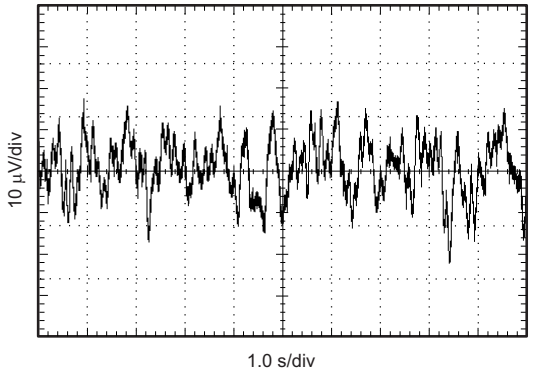


Figure 20. 0.1-Hz to 10-Hz Noise

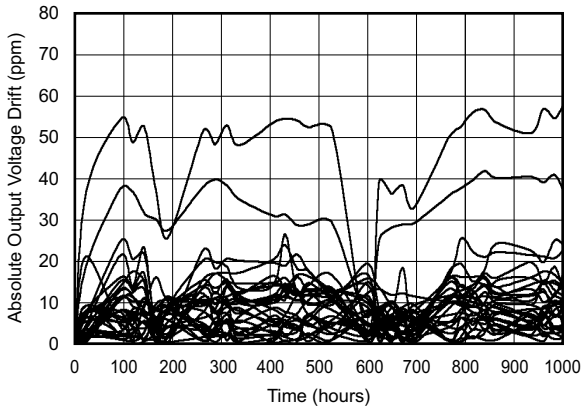


Figure 21. Long-Term Stability: 0 to 1000 Hours

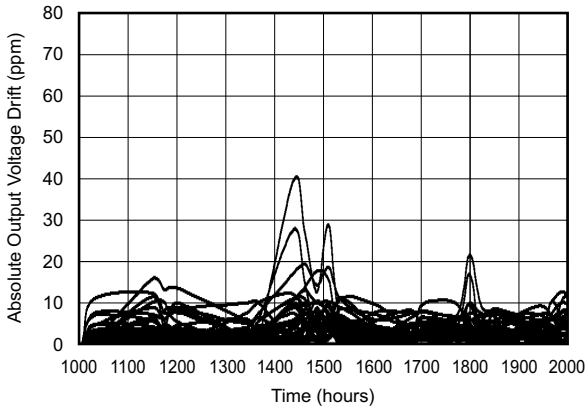


Figure 22. Long-Term Stability: 1000 to 2000 Hours

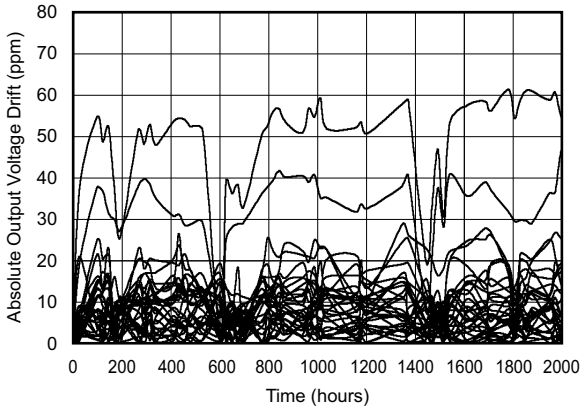


Figure 23. Long-Term Stability: 0 to 2000 Hours

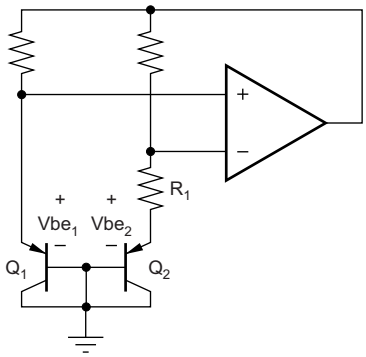
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8 Detailed Description

8.1 Overview

The REF30xx is a series, CMOS, precision bandgap voltage reference. Its basic topology is shown in the *Functional Block Diagram* section. Transistors Q_1 and Q_2 are biased so that the current density of Q_1 is greater than that of Q_2. The difference of the two base-emitter voltages, $Vbe_1 - Vbe_2$, has a positive temperature coefficient and is forced across resistor R_1. This voltage is gained up and added to the base-emitter voltage of Q_2, which has a negative coefficient. The resulting output voltage is virtually independent of temperature. The curvature of the bandgap voltage, as shown in Figure 3, is due to the slightly nonlinear temperature coefficient of the base-emitter voltage of Q_2.

8.2 Functional Block Diagram



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8.3 Feature Description

8.3.1 Supply Voltage

The REF30xx family of references features an extremely low dropout voltage. With the exception of the REF3012, which has a minimum supply requirement of 1.8 V, the REF30xx can be operated with a supply of only 1 mV above the output voltage in an unloaded condition. For loaded conditions, a typical dropout voltage versus load is shown on the front page.

The REF30xx features a low quiescent current that is extremely stable over changes in both temperature and supply. The typical room temperature quiescent current is 42 μA, and the maximum quiescent current over temperature is just 59 μA. Additionally, the quiescent current typically changes less than 2.5 μA over the entire supply range, as shown in Figure 24.

Supply voltages below the specified levels can cause the REF30xx to momentarily draw currents greater than the typical quiescent current. Use a power supply with a fast rising edge and low output impedance to easily prevent this issue.

Feature Description (continued)

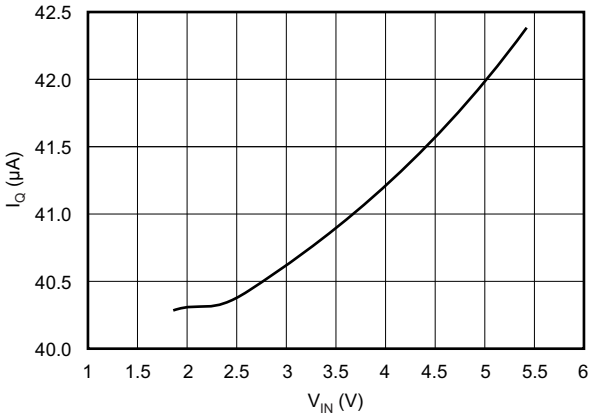


Figure 24. Supply Current vs Supply Voltage

8.3.2 Thermal Hysteresis

Thermal hysteresis for the REF30xx is defined as the change in output voltage after operating the device at 25°C, cycling the device through the specified temperature range, and returning to 25°C, and can be expressed as shown in Equation 1:

$$V_{HYST} = \left(\frac{\text{abs}\left|V_{PRE} - V_{POST}\right|}{V_{NOM}} \right) \bullet 10^6 \text{ (ppm)}$$

where

- V_{HYST} = Calculated hysteresis
- V_{PRE} = Output voltage measured at 25°C pretemperature cycling
- V_{POST} = Output voltage measured when device has been operated at 25°C, cycled through specified range of –40°C to +125°C, and returned to operation at 25°C. (1)

8.3.3 Temperature Drift

The REF30xx exhibits minimal drift error, defined as the change in output voltage over varying temperature. Using the *box* method of drift measurement, the REF30xx features a typical drift coefficient of 20 ppm from 0°C to 70°C, the primary temperature range of use for many applications. For industrial temperature ranges of –40°C to +125°C, the REF30xx family drift increases to a typical value of 50 ppm.

8.3.4 Noise Performance

The REF30xx generates noise less than 50 μV_{PP} between frequencies of 0.1 Hz to 10 Hz, and can be seen in Figure 20 The noise voltage of the REF30xx increases with output voltage and operating temperature. Additional filtering may be used to improve output noise levels; however, ensure the output impedance does not degrade AC performance.

8.3.5 Long-Term Stability

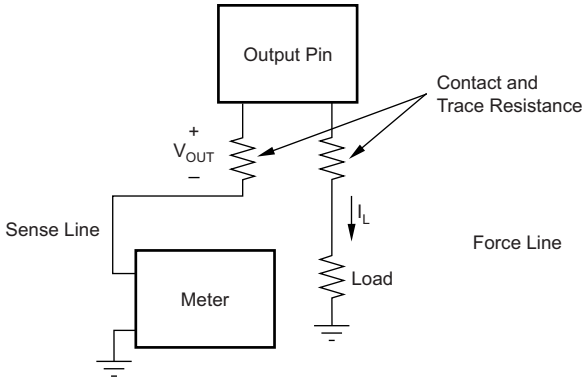
Long-term stability refers to the change of the output voltage of a reference over a period of months or years. This effect lessens as time progresses as is apparent by the long-term stability curves. The typical drift value for the REF30xx is 24 ppm from 0 hours to 1000 hours, and 15 ppm from 1000 hours to 2000 hours. This parameter is characterized by measuring 30 units at regular intervals for a period of 2000 hours.

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Feature Description (continued)

8.3.6 Load Regulation

Load regulation is defined as the change in output voltage as a result of changes in load current. Load regulation for the REF30xx is measured using force and sense contacts as shown in Figure 25. The force and sense lines tied to the contact area of the output pin reduce the impact of contact and trace resistance, resulting in accurate measurement of the load regulation contributed solely by the REF30xx. For applications requiring improved load regulation, use force and sense lines.



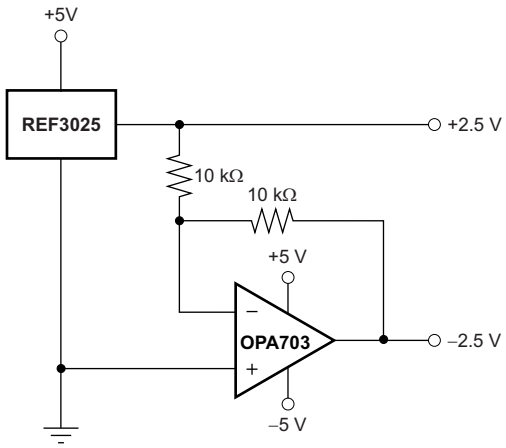
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Figure 25. Accurate Load Regulation of REF30xx

8.4 Device Functional Modes

8.4.1 Negative Reference Voltage

For applications requiring a negative and positive reference voltage, the OPA703 and REF30xx can be used to provide a dual-supply reference from a ±5-V supply. Figure 26 shows the REF3025 used to provide a ±2.5-V supply reference voltage. The low offset voltage and low drift of the OPA703 complement the low drift performance of the REF30xx to provide an accurate solution for split-supply applications.



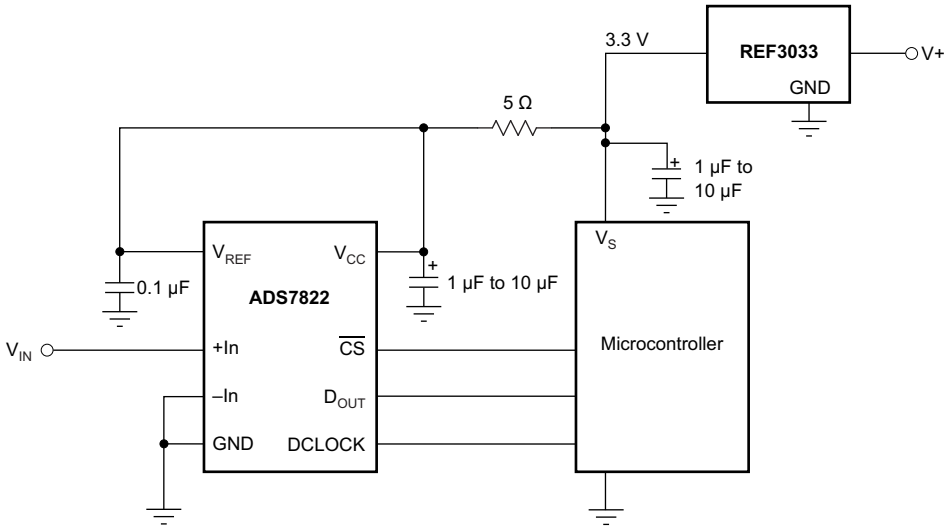
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Figure 26. REF3025 Combined With OPA703 to Create Positive and Negative Reference Voltages.

Device Functional Modes (continued)

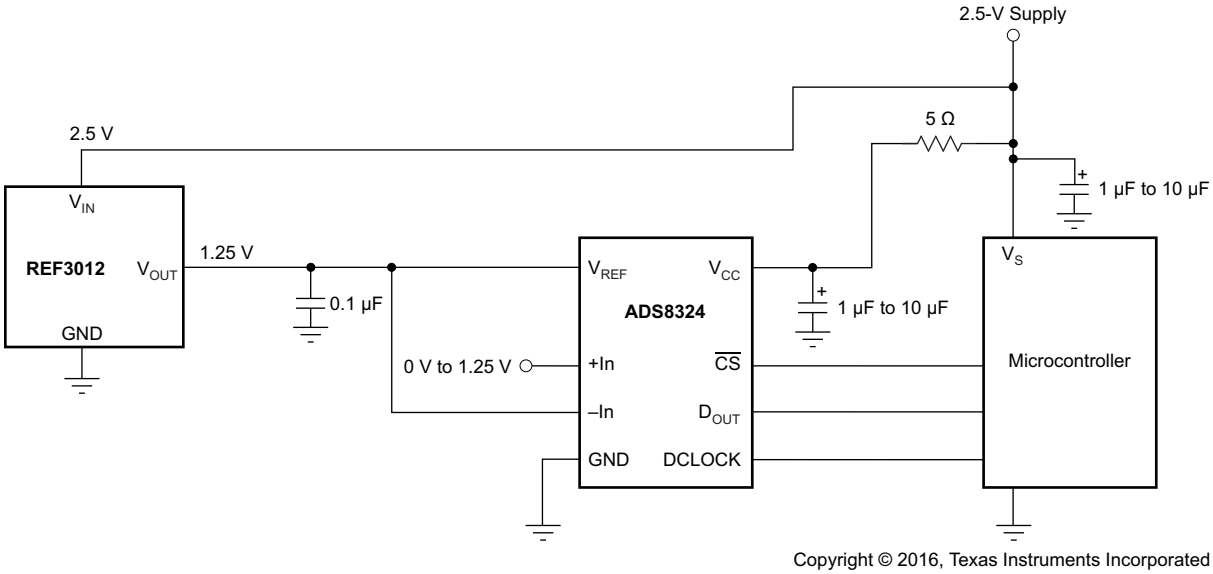
8.4.2 Data Acquisition

Often data acquisition systems require stable voltage references to maintain necessary accuracy. The REF30xx family features stability and a wide range of voltages suitable for most microcontrollers and data converters. Figure 27 and Figure 28 show two basic data acquisition systems.



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Figure 27. Basic Data Acquisition System 1



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Figure 28. Basic Data Acquisition System 2

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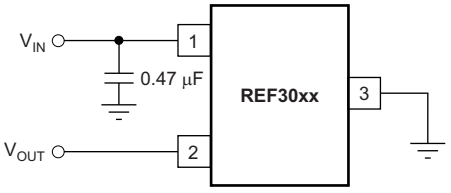
9 Application and Implementation

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

For normal operation, the REF30xx does not require a capacitor on the output. If a capacitive load is connected, take special care when using low equivalent series resistance (ESR) capacitors and high capacitance. This precaution is especially true for low-output voltage devices; therefore, for the REF3012 use a low-ESR capacitance of 10 μF or less. Figure 29 shows the typical connections required for operation of the REF30xx. A supply bypass capacitor of 0.47 μF is always recommended.

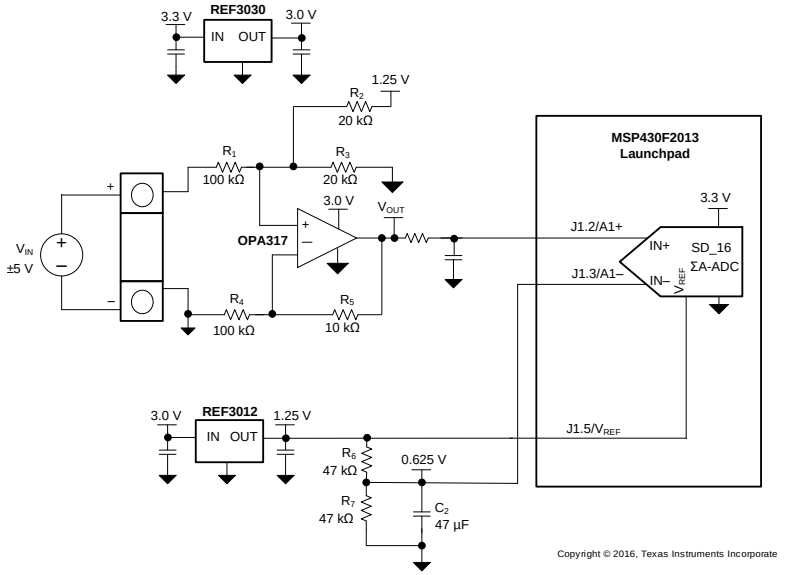


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Figure 29. Typical Connections for Operating REF30xx

9.2 Typical Application

Figure 30 shows a low-power reference and conditioning circuit. This circuit attenuates and level-shifts a bipolar input voltage within the proper input range of a single-supply low power 16-Bit ΔΣ ADC, such as the one inside the MSP430 or other similar single-supply ADCs. Precision reference circuits are used to level-shift the input signal, provide the ADC reference voltage and to create a well-regulated supply voltage for the low-power analog circuitry. A low-power, zero-drift, op-amp circuit is used to attenuate and level-shift the input signal.



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Figure 30. Low-Power Reference and Bipolar Voltage Conditioning Circuit for Low-Power ADCs

Typical Application (continued)

9.2.1 Design Requirements

- Supply Voltage: 3.3 V
- Maximum Input Voltage: ±6 V
- Specified Input Voltage: ±5 V
- ADC Reference Voltage: 1.25 V

The goal for this design is to accurately condition a ±5-V bipolar input voltage into a voltage suitable for conversion by a low-voltage ADC with a 1.25-V reference voltage, V_{REF}, and an input voltage range of V_{REF} / 2. The circuit should function with reduced performance over a wider input range of at least ±6 V to allow for easier protection of overvoltage conditions.

9.2.2 Detailed Design Procedure

Figure 30 depicts a simplified schematic for this design showing the MSP430 ADC inputs and full input conditioning circuitry. The ADC is configured for a bipolar measurement where final conversion result is the differential voltage between the voltage at the positive and negative ADC inputs. The bipolar, GND-referenced input signal must be level-shifted and attenuated by the op amp so that the output is biased to VREF / 2 and has a differential voltage that is within the ±VREF / 2 input range of the ADC.

9.2.3 Application Curves

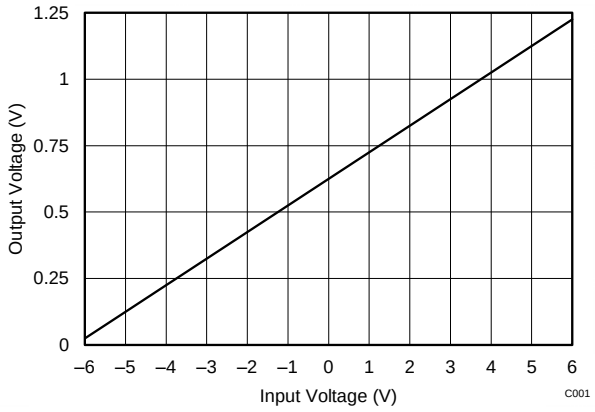


Figure 31. OPA317 Output Voltage vs Input Voltage

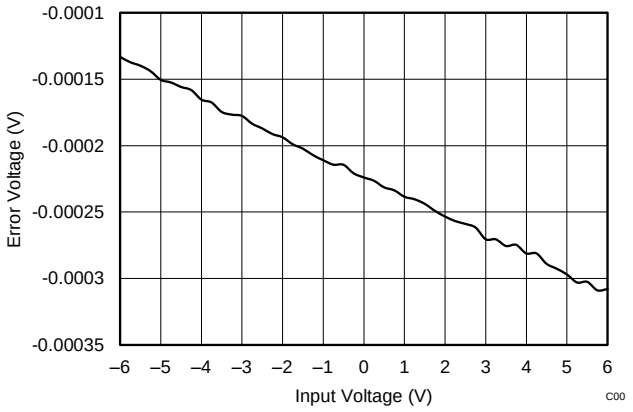


Figure 32. OPA317 Output Voltage Error vs Input Voltage

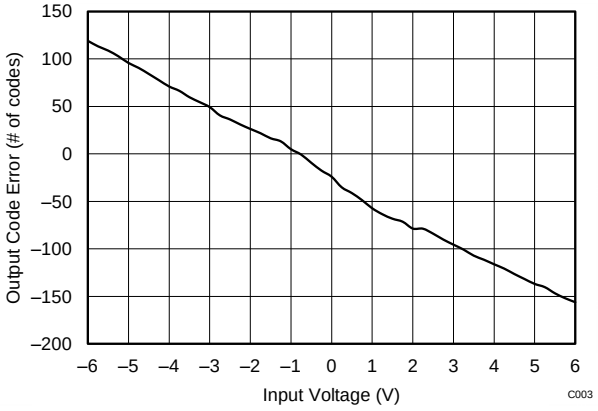


Figure 33. Output Code Error vs Input Voltage

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10 Power Supply Recommendations

The REF30xx family of references feature an extremely low-dropout voltage. These references can be operated with a supply of only 50 mV above the output voltage. For loaded reference conditions, a typical dropout voltage versus load is shown in the front page plot, *压降电压与负载电流间的关系*. Use a supply bypass capacitor greater than 0.47 µF.

11 Layout

11.1 Layout Guidelines

Figure 34 illustrates an example of a printed-circuit board (PCB) layout using the REF30xx. Some key considerations are:

- Connect low-ESR, 0.1-µF ceramic bypass capacitors at V_{IN} of the REF30xx
- Decouple other active devices in the system per the device specifications
- Use a solid ground plane to help distribute heat and reduces electromagnetic interference (EMI) noise pickup
- Place the external components as close to the device as possible. This configuration prevents parasitic errors (such as the Seebeck effect) from occurring
- Minimize trace length between the reference and bias connections to the INA and ADC to reduce noise pickup
- Do not run sensitive analog traces in parallel with digital traces. Avoid crossing digital and analog traces if possible, and only make perpendicular crossings when absolutely necessary

11.2 Layout Example

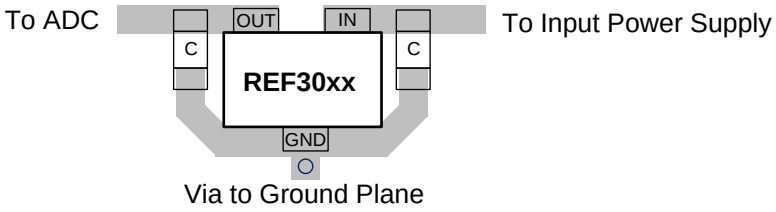


Figure 34. Layout Example

12 器件和文档支持

12.1 文档支持

12.1.1 相关文档

《CMOS、轨至轨、I/O 运算放大器》(SBOS180)

采用 3 引脚 SOT-23 封装的 REF29xx 100ppm/°C、50μA、CMOS 电压基准》(SBVS033)

12.2 相关链接

表 1 列出了快速访问链接。类别包括技术文档、支持和社区资源、工具和软件以及申请样片或购买产品的快速访问链接。

表 **1.** 相关链接

器件	产品文件夹	样片与购买	技术文档	工具和软件	支持和社区
REF3012	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
REF3020	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
REF3025	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
REF3030	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
REF3033	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
REF3040	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

12.3 接收文档更新通知

要接收文档更新通知，请导航至 TI.com 上的器件产品文件夹。请单击右上角的*提醒我* 进行注册，即可每周接收产品信息更改摘要。有关更改的详细信息，请查看任何已修订文档中包含的修订历史记录。

12.4 社区资源

下列链接提供到 TI 社区资源的连接。链接的内容由各个分销商“按照原样”提供。这些内容并不构成 TI 技术规范，并且不一定反映 TI 的观点；请参阅 TI 的 《使用条款》。

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设计支持 ***TI 参考设计支持*** 可帮助您快速查找有帮助的 E2E 论坛、设计支持工具以及技术支持的联系信息。

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12.6 静电放电警告

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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

以下页面包含机械、封装和可订购信息。这些信息是指定器件的最新可用数据。数据如有变更，恕不另行通知和修订此文档。如欲获取此数据表的浏览器版本，请参阅左侧的导航。

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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
REF3012AIDBZR	ACTIVE	SOT-23	DBZ	3	3000	RoHS & Green	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	R30A	Samples
REF3012AIDBZRG4	ACTIVE	SOT-23	DBZ	3	3000	RoHS & Green	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	R30A	Samples
REF3012AIDBZT	ACTIVE	SOT-23	DBZ	3	250	RoHS & Green	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	R30A	Samples
REF3012AIDBZTG4	ACTIVE	SOT-23	DBZ	3	250	RoHS & Green	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	R30A	Samples
REF3020AIDBZR	ACTIVE	SOT-23	DBZ	3	3000	RoHS & Green	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	R30B	Samples
REF3020AIDBZRG4	ACTIVE	SOT-23	DBZ	3	3000	RoHS & Green	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	R30B	Samples
REF3020AIDBZT	ACTIVE	SOT-23	DBZ	3	250	RoHS & Green	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	R30B	Samples
REF3020AIDBZTG4	ACTIVE	SOT-23	DBZ	3	250	RoHS & Green	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	R30B	Samples
REF3025AIDBZR	ACTIVE	SOT-23	DBZ	3	3000	RoHS & Green	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	R30C	Samples
REF3025AIDBZRG4	ACTIVE	SOT-23	DBZ	3	3000	RoHS & Green	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	R30C	Samples
REF3025AIDBZT	ACTIVE	SOT-23	DBZ	3	250	RoHS & Green	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	R30C	Samples
REF3025AIDBZTG4	ACTIVE	SOT-23	DBZ	3	250	RoHS & Green	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	R30C	Samples
REF3030AIDBZR	ACTIVE	SOT-23	DBZ	3	3000	RoHS & Green	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	R30F	Samples
REF3030AIDBZRG4	ACTIVE	SOT-23	DBZ	3	3000	RoHS & Green	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	R30F	Samples
REF3030AIDBZT	ACTIVE	SOT-23	DBZ	3	250	RoHS & Green	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	R30F	Samples
REF3030AIDBZTG4	ACTIVE	SOT-23	DBZ	3	250	RoHS & Green	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	R30F	Samples
REF3033AIDBZR	ACTIVE	SOT-23	DBZ	3	3000	RoHS & Green	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	R30D	Samples
REF3033AIDBZRG4	ACTIVE	SOT-23	DBZ	3	3000	RoHS & Green	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	R30D	Samples
REF3033AIDBZT	ACTIVE	SOT-23	DBZ	3	250	RoHS & Green	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	R30D	Samples
REF3033AIDBZTG4	ACTIVE	SOT-23	DBZ	3	250	RoHS & Green	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	R30D	Samples

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
REF3040AIDBZR	ACTIVE	SOT-23	DBZ	3	3000	RoHS & Green	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	R30E	Samples
REF3040AIDBZT	ACTIVE	SOT-23	DBZ	3	250	RoHS & Green	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	R30E	Samples
REF3040AIDBZTG4	ACTIVE	SOT-23	DBZ	3	250	RoHS & Green	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	R30E	Samples

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) **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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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 REF3033 :

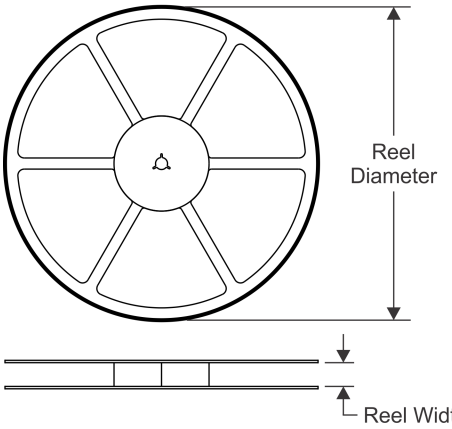
- Automotive : REF3033-Q1

NOTE: Qualified Version Definitions:

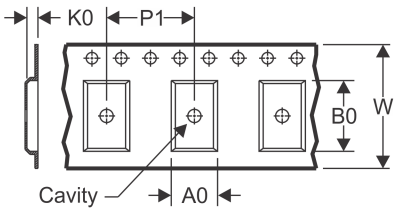
- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects

TAPE AND REEL INFORMATION

REEL DIMENSIONS

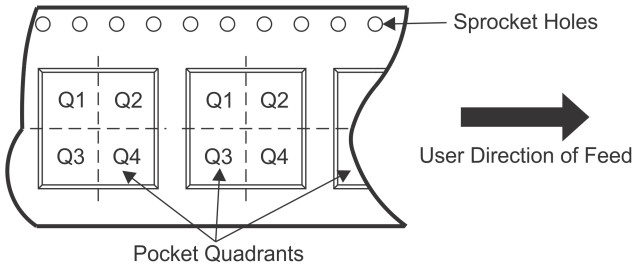


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

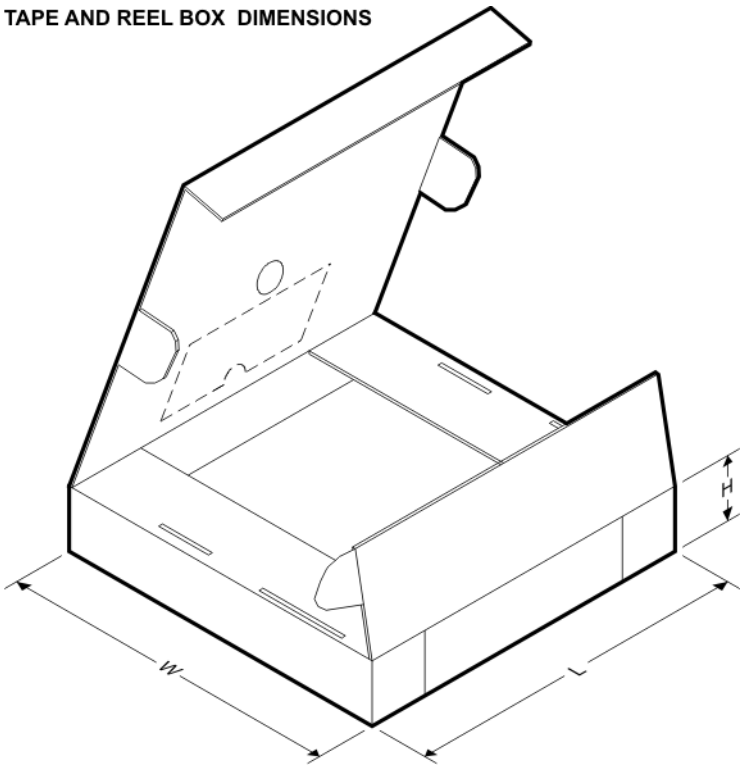
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
REF3012AIDBZR	SOT-23	DBZ	3	3000	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
REF3012AIDBZT	SOT-23	DBZ	3	250	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
REF3020AIDBZR	SOT-23	DBZ	3	3000	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
REF3020AIDBZT	SOT-23	DBZ	3	250	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
REF3025AIDBZR	SOT-23	DBZ	3	3000	180.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
REF3025AIDBZT	SOT-23	DBZ	3	250	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
REF3030AIDBZR	SOT-23	DBZ	3	3000	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
REF3030AIDBZT	SOT-23	DBZ	3	250	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
REF3033AIDBZR	SOT-23	DBZ	3	3000	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
REF3033AIDBZT	SOT-23	DBZ	3	250	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
REF3040AIDBZR	SOT-23	DBZ	3	3000	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3
REF3040AIDBZT	SOT-23	DBZ	3	250	179.0	8.4	3.15	2.95	1.22	4.0	8.0	Q3

TAPE AND REEL BOX DIMENSIONS



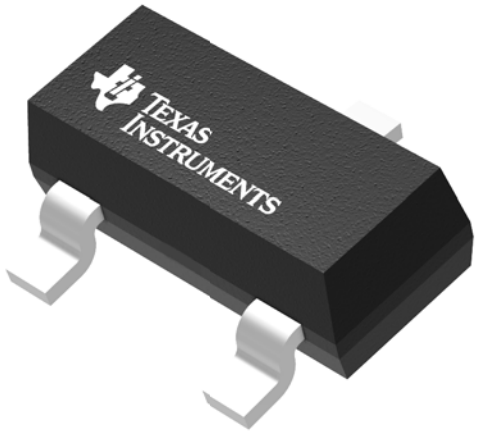
*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
REF3012AIDBZR	SOT-23	DBZ	3	3000	200.0	183.0	25.0
REF3012AIDBZT	SOT-23	DBZ	3	250	200.0	183.0	25.0
REF3020AIDBZR	SOT-23	DBZ	3	3000	200.0	183.0	25.0
REF3020AIDBZT	SOT-23	DBZ	3	250	200.0	183.0	25.0
REF3025AIDBZR	SOT-23	DBZ	3	3000	200.0	183.0	25.0
REF3025AIDBZT	SOT-23	DBZ	3	250	200.0	183.0	25.0
REF3030AIDBZR	SOT-23	DBZ	3	3000	200.0	183.0	25.0
REF3030AIDBZT	SOT-23	DBZ	3	250	200.0	183.0	25.0
REF3033AIDBZR	SOT-23	DBZ	3	3000	200.0	183.0	25.0
REF3033AIDBZT	SOT-23	DBZ	3	250	200.0	183.0	25.0
REF3040AIDBZR	SOT-23	DBZ	3	3000	200.0	183.0	25.0
REF3040AIDBZT	SOT-23	DBZ	3	250	200.0	183.0	25.0

GENERIC PACKAGE VIEW

DBZ 3 SOT-23 - 1.12 mm max height

SMALL OUTLINE TRANSISTOR



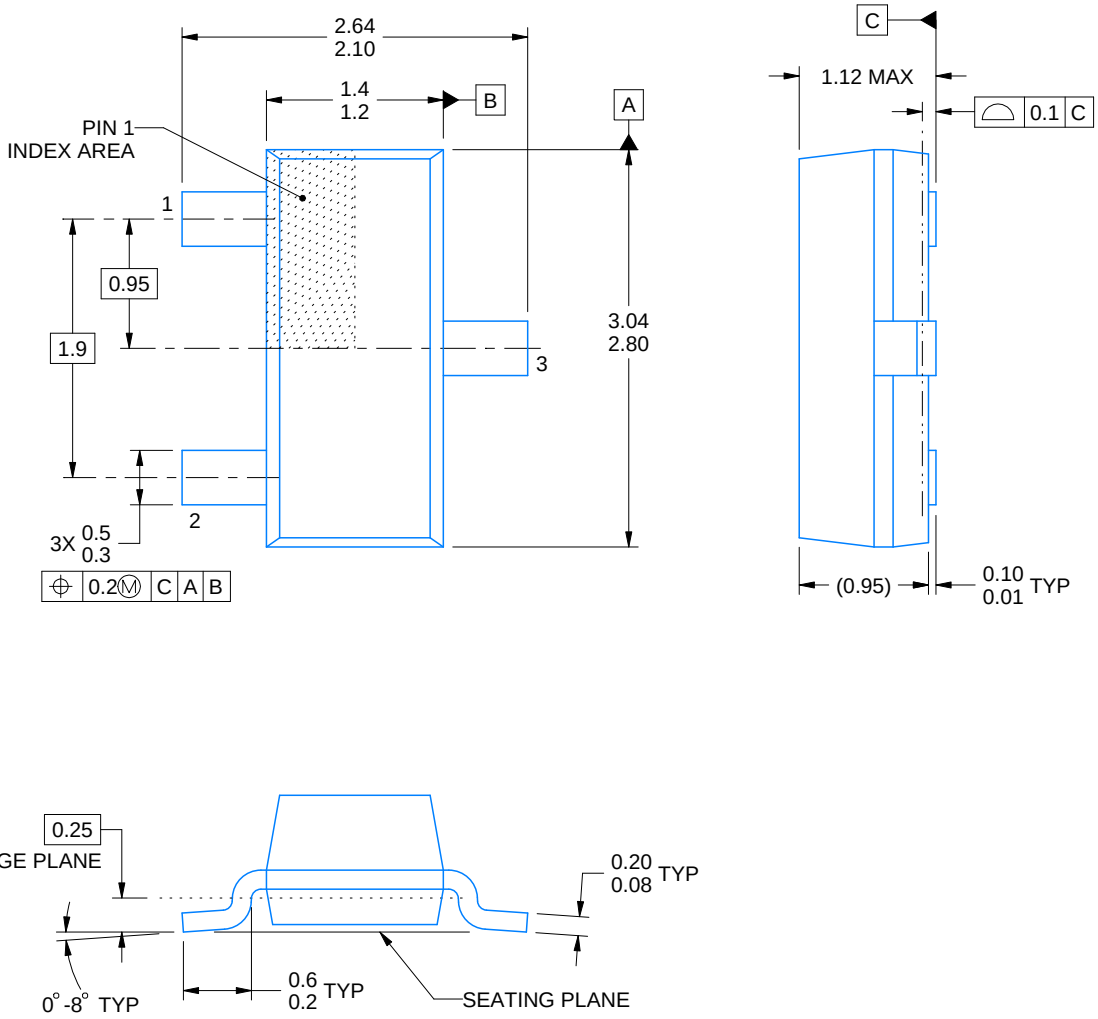
Images above are just a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.

PACKAGE OUTLINE

DBZ0003A

SOT-23 - 1.12 mm max height

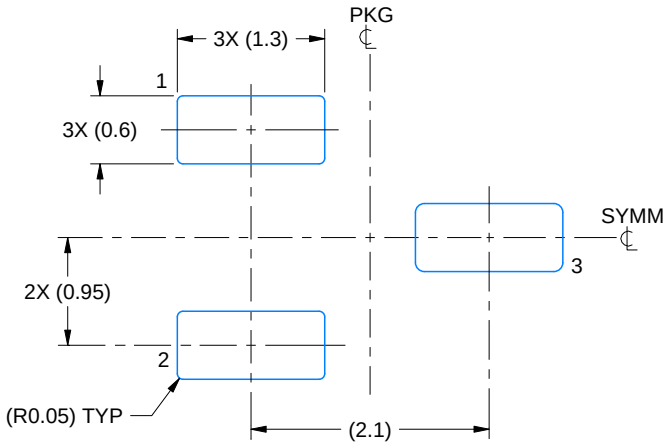
SMALL OUTLINE TRANSISTOR



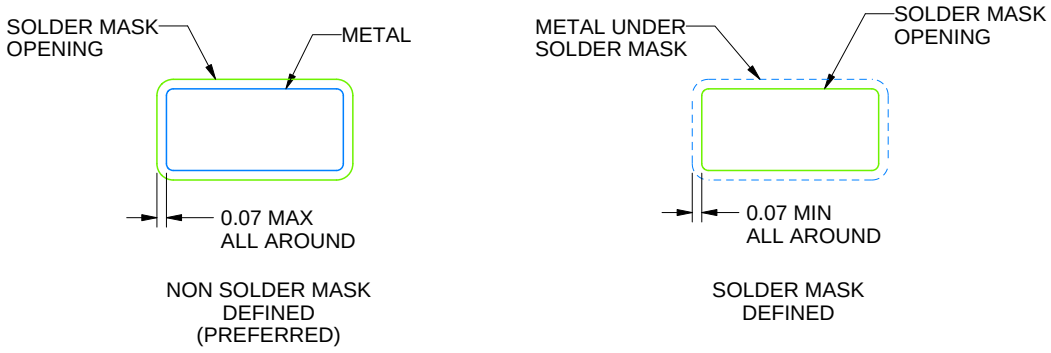
4214838/C 04/2017

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. Reference JEDEC registration TO-236, except minimum foot length.



LAND PATTERN EXAMPLE
SCALE:15X

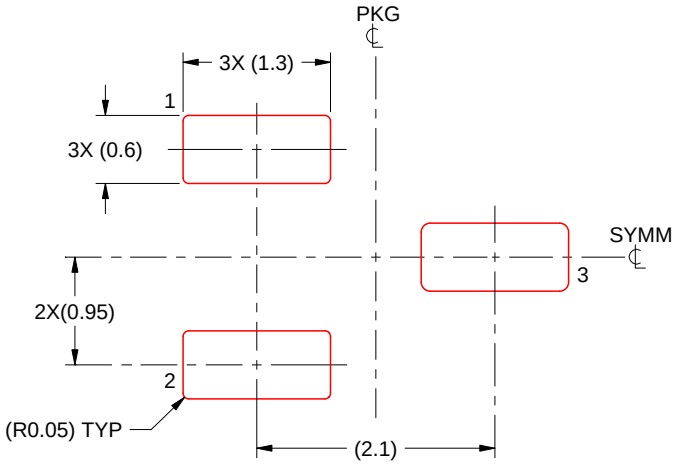


SOLDER MASK DETAILS

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NOTES: (continued)

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



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

4214838/C 04/2017

NOTES: (continued)

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

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