TEXAS INSTRUMENTS

REF3012, REF3020, REF3025, REF3030, REF3033, REF3040
SBVS032I – MARCH 2002 – REVISED JULY 2022

REF30xx 50-ppm/°C Max, 50-µA, CMOS Voltage Reference in SOT-23-3

1 Features

- microSize Package: SOT-23-3
- Low Dropout: 1 mV
- High Output Current: 25 mA
- High Accuracy: 0.2%
- Low I_Q: 42 µA (Typical)
- Excellent Specified Drift Performance:
  - 50 ppm/°C (Maximum) From 0°C to 70°C
  - 75 ppm/°C (Maximum) From –40°C to +125°C

2 Applications

- Temperature and Pressure Transmitters
- Portable, Battery-Powered Equipment
- Data Acquisition Systems
- Medical Equipment
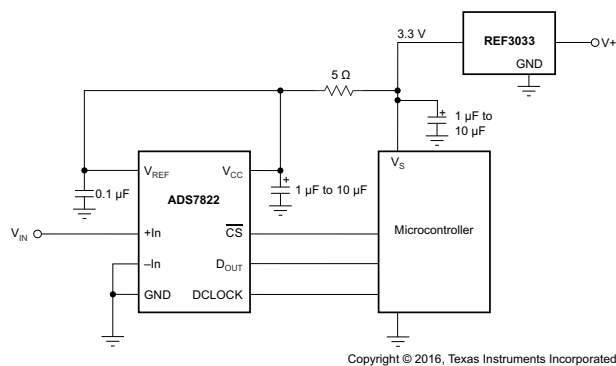- Handheld Test Equipment

3 Description

The REF30xx is a precision, low-power, low-dropout voltage, reference family available in a tiny 3-pin SOT-23 package. The REF30xx offers excellent temperature drift and initial accuracy while operating at a quiescent current of 42 µA (typical).

The low power consumption and the relatively high precision make the REF30xx very attractive for loop-powered industrial applications such as pressure and temperature transmitter applications. The REF30xx is easy to use in intrinsically safe and explosion-proof applications because it does not require a load capacitor to be stable. The REF30xx is specified over the extended industrial temperature range of –40°C to +125°C.
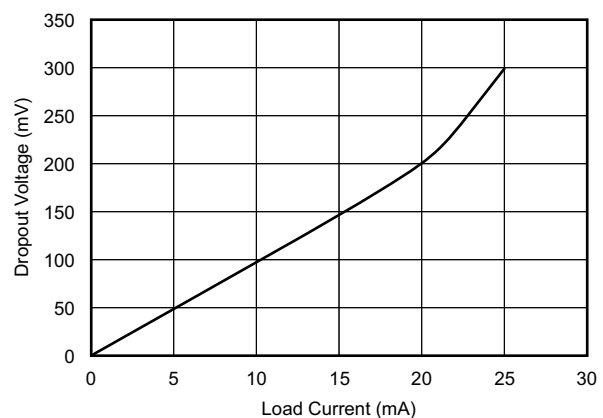
The REF30xx operates with supplies within 1 mV of output voltage under zero-load conditions. Engineers can use the low dropout, small size, and low power consumption of the REF30xx in portable and battery-powered applications.

Device Information

PART NUMBER	PACKAGE	BODY SIZE (NOM)
REF30xx	SOT-23 (3)	2.92 mm × 1.30 mm

Typical Application

Dropout Voltage vs Load Current

Table of Contents

4 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision H (February 2018) to Revision I (July 2022)	**Page**
• Updated the numbering format for tables, figures, and cross-references throughout the document..................1	

Changes from Revision G (November 2015) to Revision H (February 2018)	**Page**
• Changed section header From: REF33xx (REF3312, REF3318, REF3320, REF3325, REF3330, REF3333) To: REF30xx (REF3012, REF3020, REF3025, REF3030, REF30333, REF3040) in the *Section 7.5* 5	
• Added turnon settling time TYP value of 120 µs (deleted by mistake in the previous revision) 5	
• Added NOTE to the *Section 9* section 15	

Changes from Revision F (August 2008) to Revision G (November 2015)	**Page**
• Added *Device Information*, *ESD Ratings*, *Recommended Operating Conditions*, and *Thermal Information* tables...1	
• Added *Detailed Description*, *Applications and Implementation*, *Power-Supply Recommendations*, *Layout*, *Device and Documentation Support*, and *Mechanical, Packaging, and Orderable Information* sections...........1	
• Changed text in *Description* section 1	
• Deleted thermal resistance parameter in Electrical Characteristics; see new Thermal Information table..........5	
• Moved temperature parameters from Electrical Characteristics to Recommended Operating Conditions.........5	

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

Not to scale
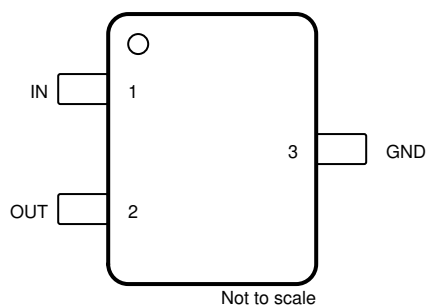
Figure 6-1. DBZ Package 3-Pin SOT-23 Top View

Table 6-1. Pin Functions

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

Product Folder Links: REF3012 REF3020 REF3025 REF3030 REF3033 REF3040

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 *Section 7.6*. 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.

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

7.5 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	

(1) The minimum supply voltage for the REF3012 is 1.8 V.
(2) Box method used to determine over temperature drift.
(3) Typical value of load regulation reflects measurements using a force and sense contacts; see *Section 8.3.6* section.
(4) Thermal hysteresis procedure explained in more detail in *Section 8.3.2* section.

Product Folder Links: *REF3012 REF3020 REF3025 REF3030 REF3033 REF3040*

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

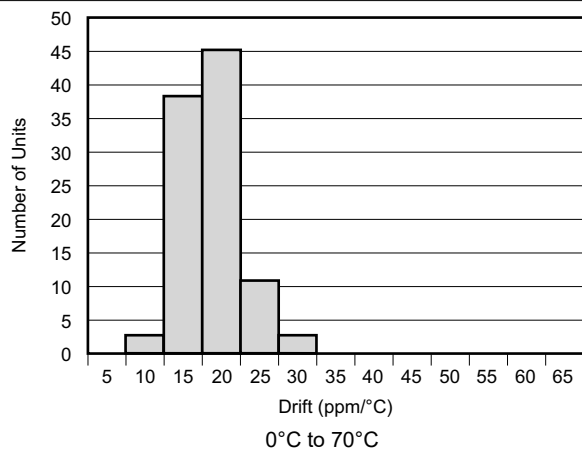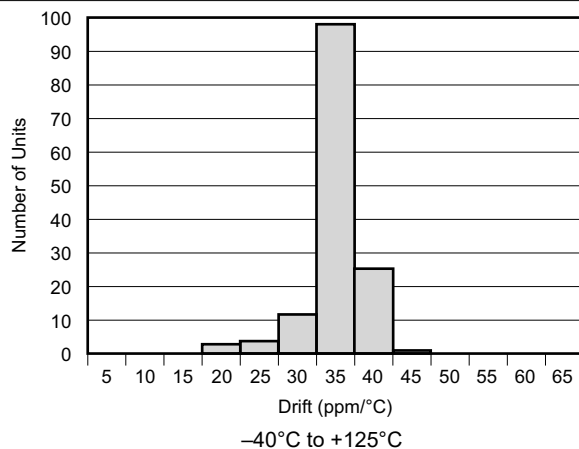**Figure 7-1. Temperature Drift**

−40°C to +125°C

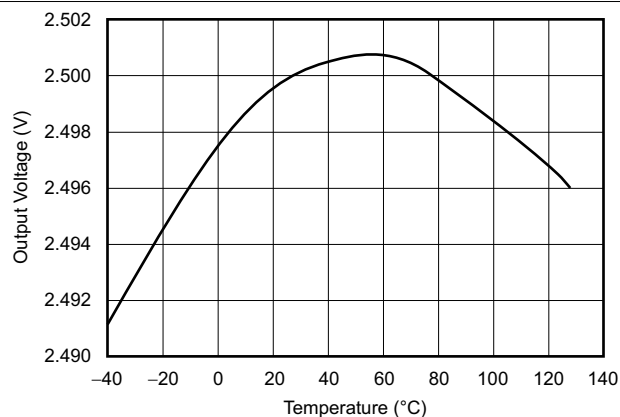**Figure 7-2. Temperature Drift**
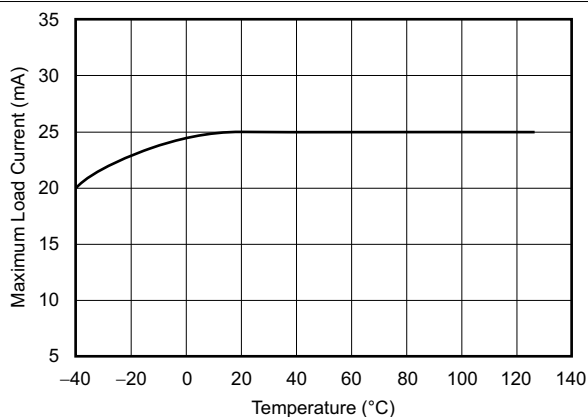

Figure 7-3. Output Voltage vs Temperature
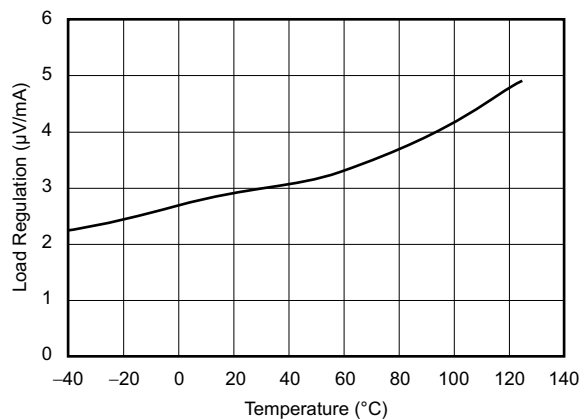

Figure 7-4. Maximum Load Current vs Temperature

Figure 7-5. Load Regulation vs Temperature

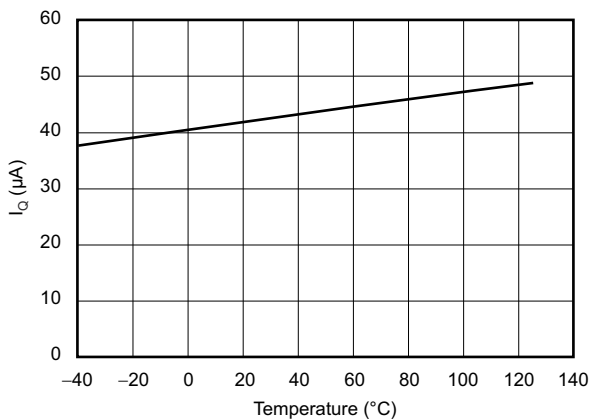
Figure 7-6. Quiescent Current vs Temperature

Product Folder Links: *REF3012 REF3020 REF3025 REF3030 REF3033 REF3040*

7.6 Typical Characteristics (continued)

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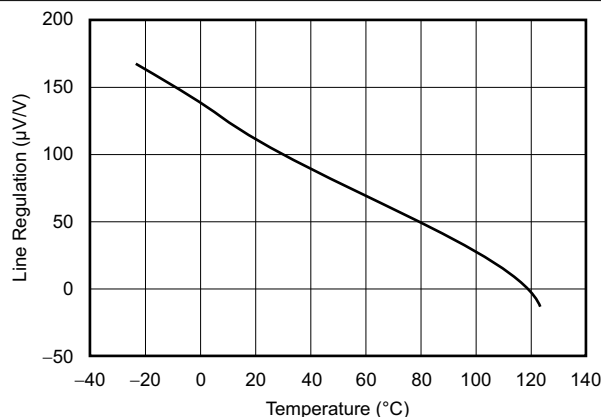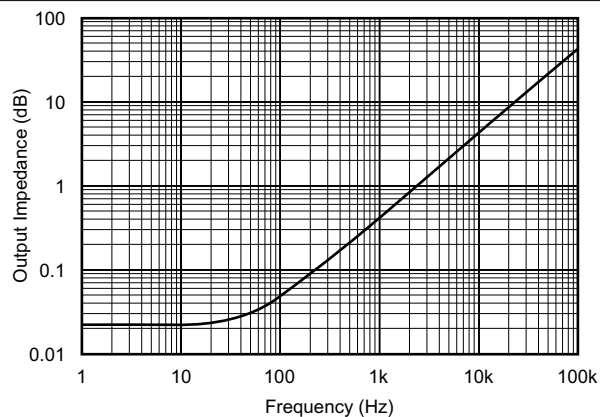

Figure 7-7. Line Regulation vs Temperature
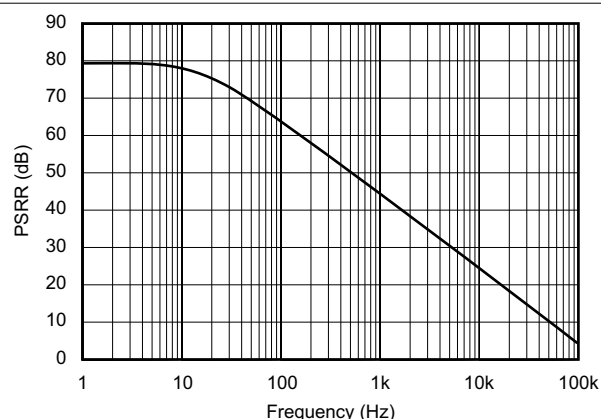

Figure 7-8. Output Impedance vs Frequency
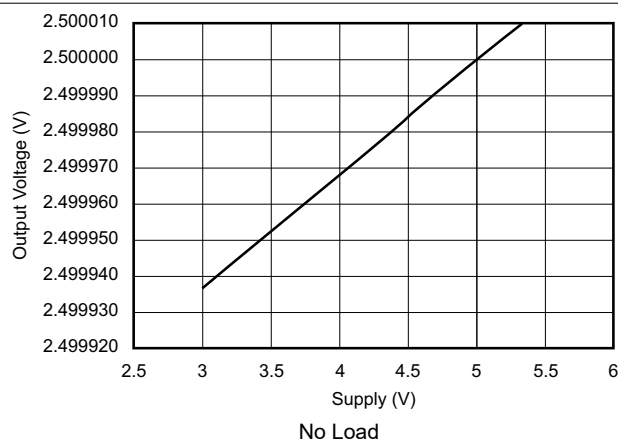

Figure 7-9. Power-Supply Rejection Ratio vs Frequency

No Load

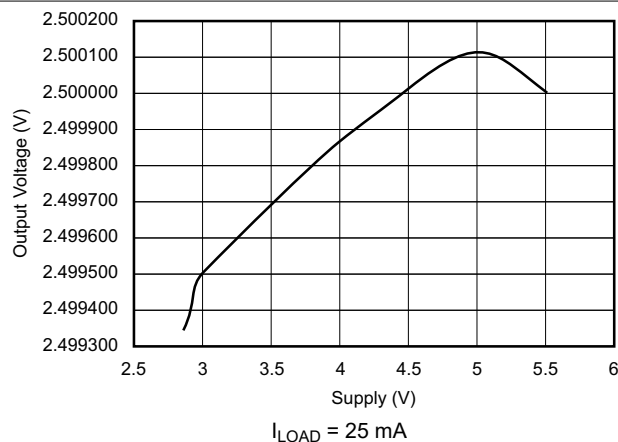**Figure 7-10. Output Voltage vs Supply Voltage**

I_{LOAD} = 25 mA

Figure 7-11. Output Voltage vs Supply Voltage
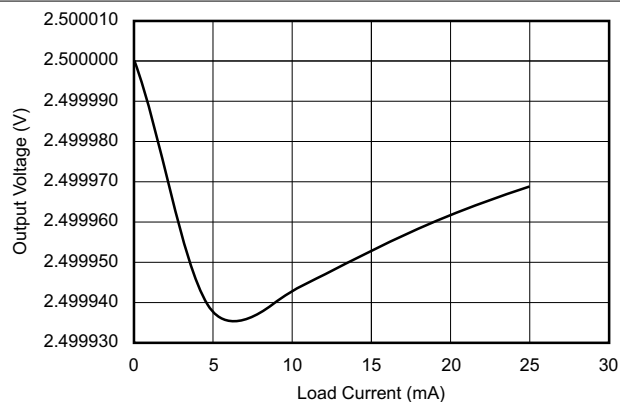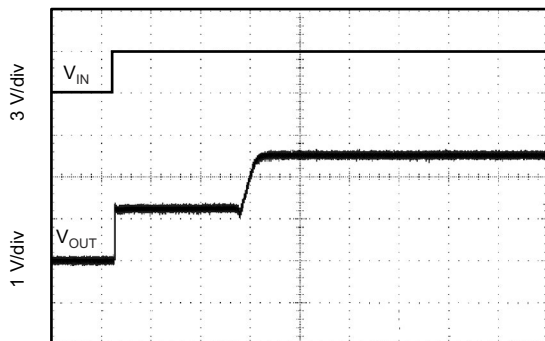

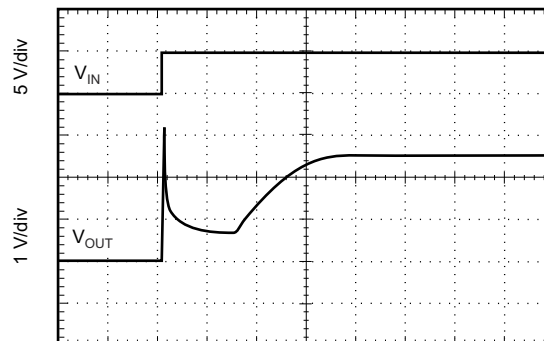**Figure 7-12. Output Voltage vs Load Current**

Product Folder Links: *REF3012 REF3020 REF3025 REF3030 REF3033 REF3040*

7.6 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 7-13. Step Response

C_L = 0, 5-V startup

Figure 7-14. Step Response
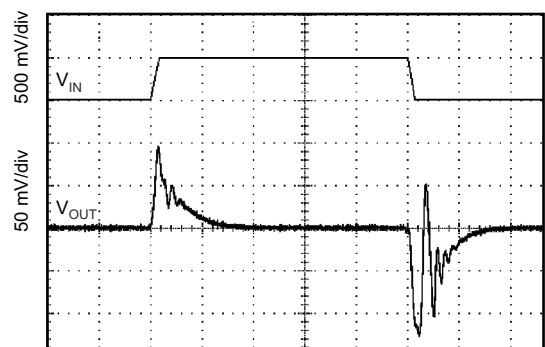
Figure 7-15. Line Transient Response
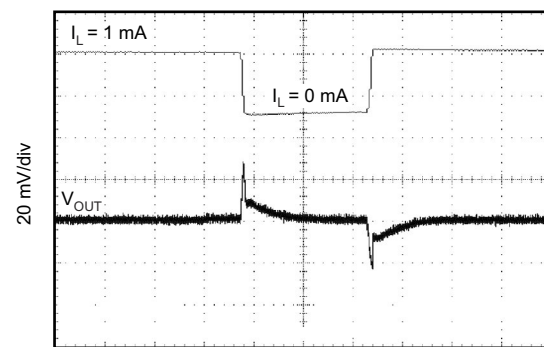
C_L = 0

Figure 7-16. 0-mA to 1-mA Load Transient
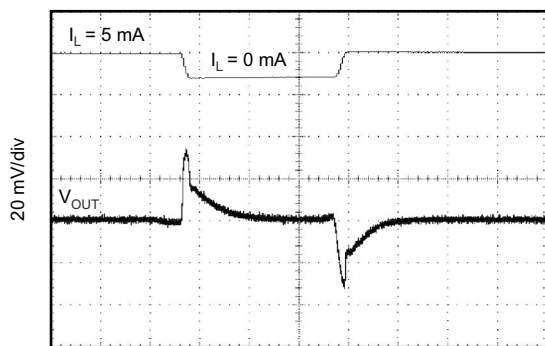
C_L = 0

Figure 7-17. 0-mA to 5-mA Load Transient
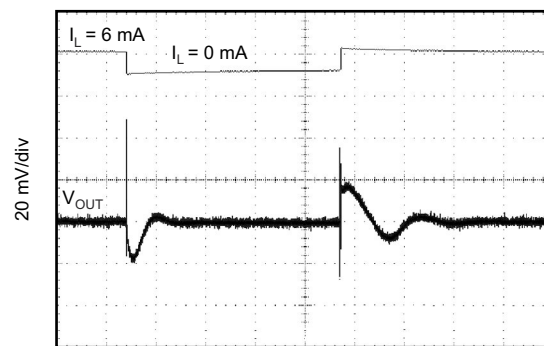
C_L = 1 µF

Figure 7-18. 1-mA to 6-mA Load Transient

Product Folder Links: *REF3012 REF3020 REF3025 REF3030 REF3033 REF3040*

7.6 Typical Characteristics (continued)

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

Figure 7-19. 1-mA to 25-mA Load Transient

Figure 7-20. 0.1-Hz to 10-Hz Noise

Figure 7-21. Long-Term Stability: 0 to 1000 Hours

Figure 7-22. Long-Term Stability: 1000 to 2000 Hours

Figure 7-23. Long-Term Stability: 0 to 2000 Hours

Product Folder Links: *REF3012 REF3020 REF3025 REF3030 REF3033 REF3040*

8 Detailed Description

8.1 Overview

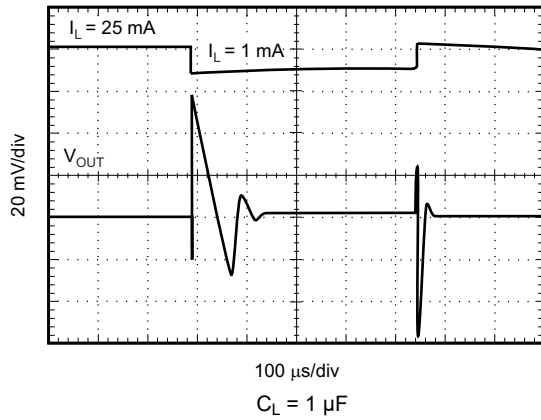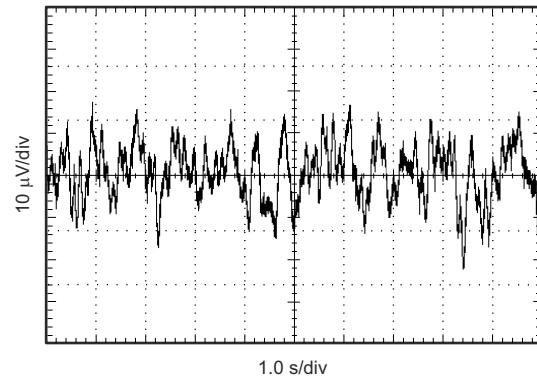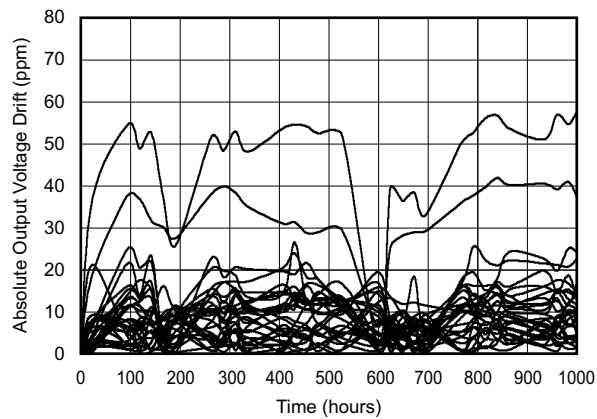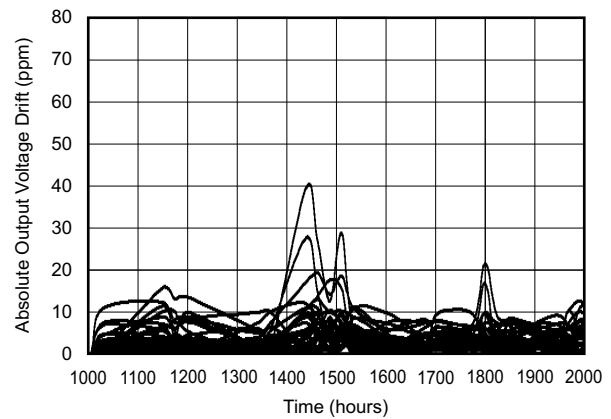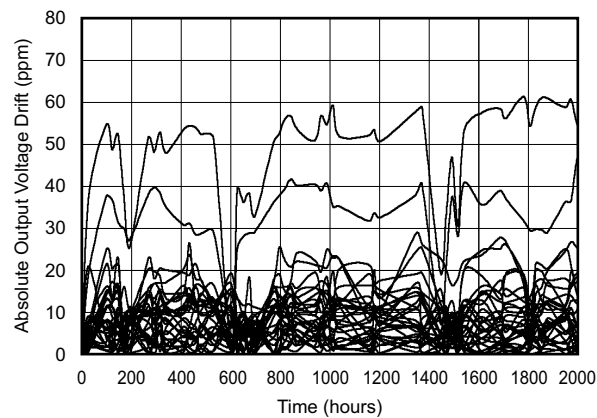The REF30xx is a series, CMOS, precision bandgap voltage reference. Its basic topology is shown in the Section 8.2 section. Transistors Q_1 and Q_2 are biased so that the current density of Q_1 is greater than that of Q_2. The difference of the two base-emitter voltages, $Vbe_1 – Vbe_2$, has a positive 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 7-3, 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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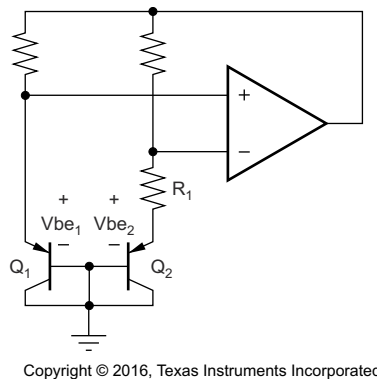
8.3 Feature Description

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 8-1.

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.
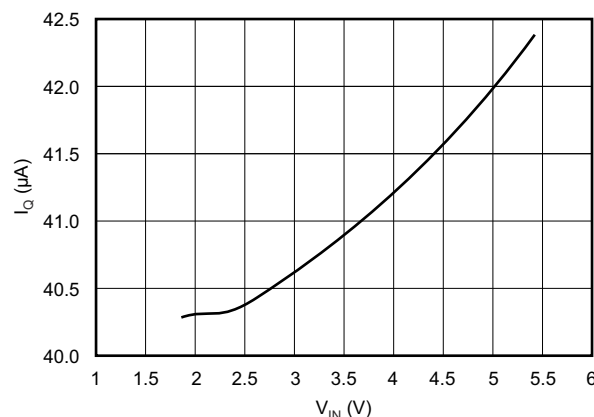

Figure 8-1. Supply Current vs Supply Voltage

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:

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

(1)

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.

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 7-20 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.

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 8-2. 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.
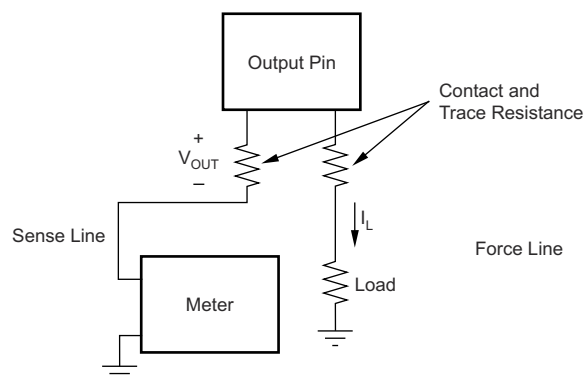
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Figure 8-2. Accurate Load Regulation of REF30xx

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 8-3 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.
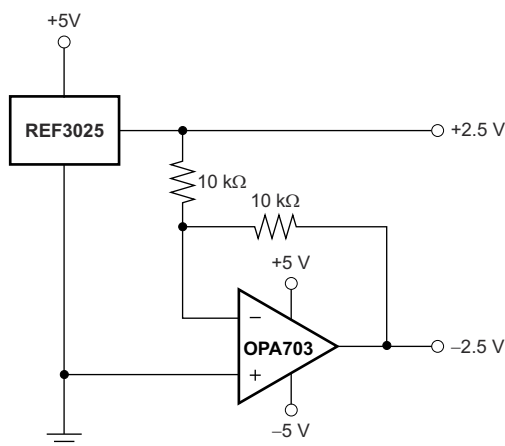
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Figure 8-3. REF3025 Combined With OPA703 to Create Positive and Negative Reference Voltages.

Product Folder Links: *REF3012 REF3020 REF3025 REF3030 REF3033 REF3040*

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 8-4 and Figure 8-5 show two basic data acquisition systems.

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Figure 8-4. Basic Data Acquisition System 1

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Figure 8-5. Basic Data Acquisition System 2
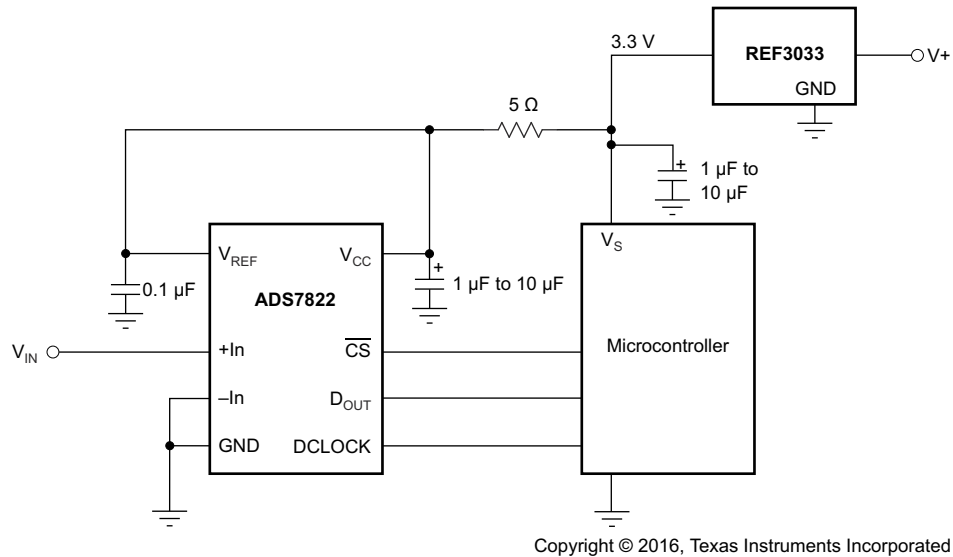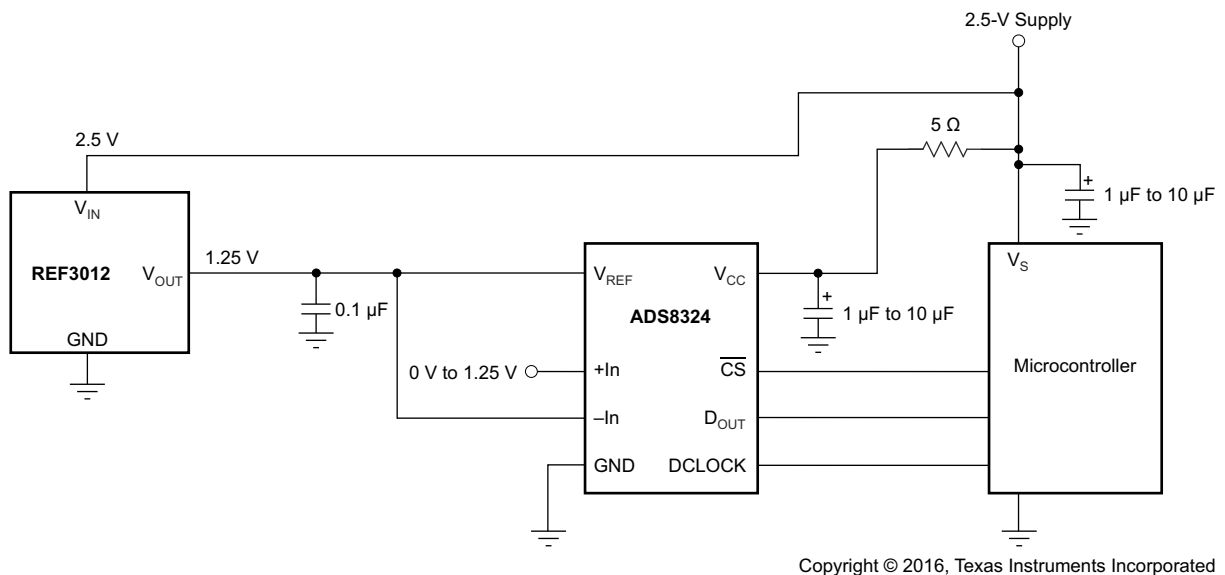
9 Application and Implementation

> **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, as well as validating and testing 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 9-1 shows the typical connections required for operation of the REF30xx. A supply bypass capacitor of 0.47 µF is always recommended.
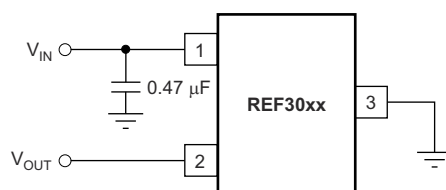
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Figure 9-1. Typical Connections for Operating REF30xx

9.2 Typical Application

Figure 9-2 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.
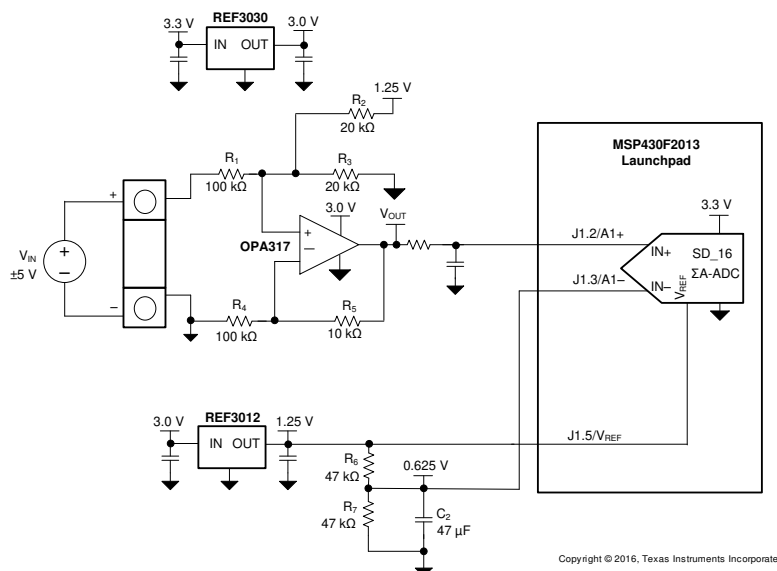
Copyright © 2016, Texas Instruments Incorporated

Figure 9-2. Low-Power Reference and Bipolar Voltage Conditioning Circuit for Low-Power ADCs

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 9-2 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.
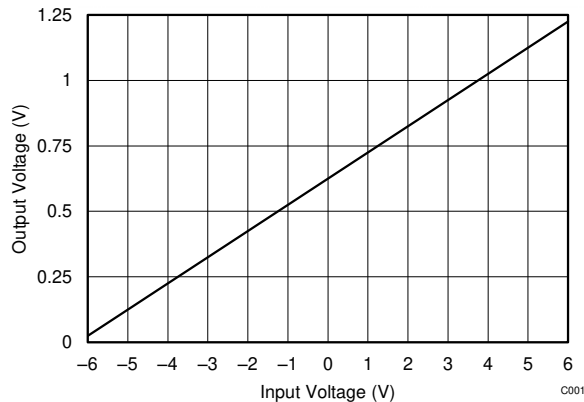
9.2.3 Application Curves
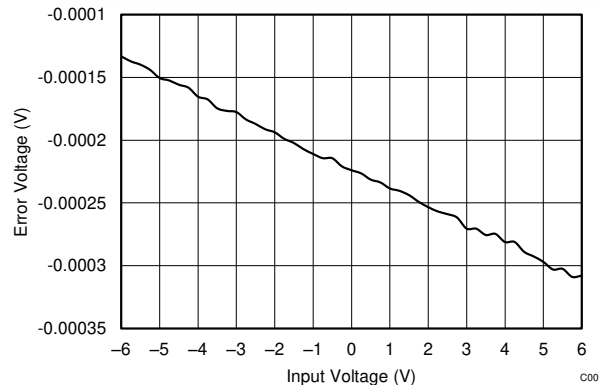

Figure 9-3. OPA317 Output Voltage vs Input Voltage

Figure 9-4. OPA317 Output Voltage Error vs Input Voltage
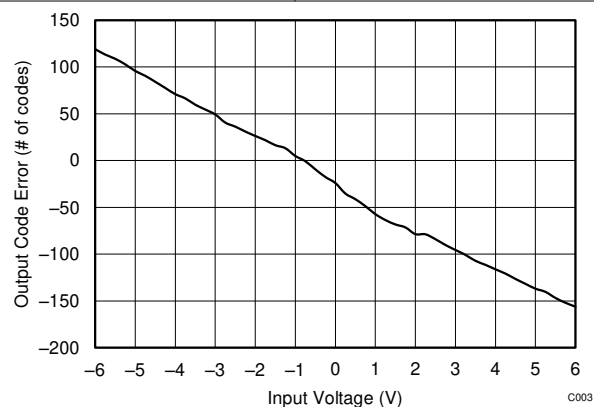
Figure 9-5. Output Code Error vs Input Voltage

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, *Figure 3-1*. Use a supply bypass capacitor greater than 0.47 µF.

11 Layout

11.1 Layout Guidelines

Figure 11-1 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 11-1. Layout Example

Product Folder Links: *REF3012 REF3020 REF3025 REF3030 REF3033 REF3040*

12 Device and Documentation Support

12.1 Documentation Support

12.1.1 Related Documentation

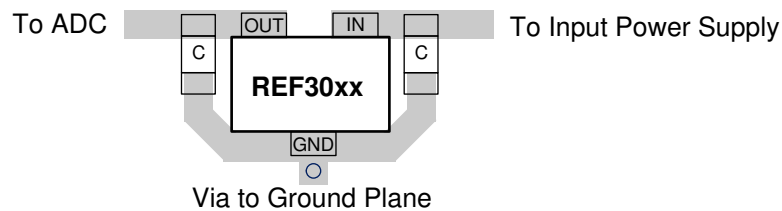*CMOS, Rail-to-Rail, I/O Operational Amplifiers* (SBOS180)

REF29xx 100 ppm/°C, 50 µA in 3-Pin SOT-23 CMOS Voltage Reference (SBVS033)

12.2 Related Links

Table 12-1 lists quick access links. Categories include technical documents, support and community resources, tools and software, and quick access to sample or buy.

Table 12-1. Related Links

PARTS	PRODUCT FOLDER	SAMPLE & BUY	TECHNICAL DOCUMENTS	TOOLS & SOFTWARE	SUPPORT & COMMUNITY
REF3012	Click here	Click here	Click here	Click here	Click here
REF3020	Click here	Click here	Click here	Click here	Click here
REF3025	Click here	Click here	Click here	Click here	Click here
REF3030	Click here	Click here	Click here	Click here	Click here
REF3033	Click here	Click here	Click here	Click here	Click here
REF3040	Click here	Click here	Click here	Click here	Click here

12.3 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. Click on *Subscribe to updates* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

12.4 Support Resources

TI E2E™ support forums are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

Linked content is 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.

12.5 Trademarks

TI E2E™ is a trademark of Texas Instruments.
All trademarks are the property of their respective owners.

12.6 Electrostatic Discharge Caution

This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

12.7 Glossary

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

13 Mechanical, Packaging, and Orderable Information

The following pages include mechanical packaging and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

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
REF3012AIDBZT	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
REF3020AIDBZT	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
REF3025AIDBZT	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
REF3030AIDBZT	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
REF3033AIDBZT	ACTIVE	SOT-23	DBZ	3	250	RoHS & Green	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	R30D	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

(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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OTHER QUALIFIED VERSIONS OF REF3033 :

- Automotive : REF3033-Q1

NOTE: Qualified Version Definitions:

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

![Texas Instruments logo]

PACKAGE MATERIALS INFORMATION

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

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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.
4. Support pin may differ or may not be present.
5. Body dimensions do not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.25mm per side

3X (1.3)

1

3X (0.6)

PKG

SYMM

3

2X (0.95)

2

(R0.05) TYP

(2.1)
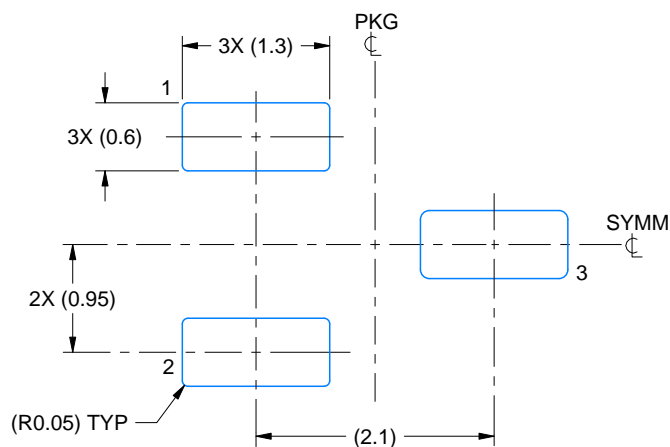
LAND PATTERN EXAMPLE
SCALE:15X

SOLDER MASK
OPENING

METAL

0.07 MAX
ALL AROUND

NON SOLDER MASK
DEFINED
(PREFERRED)

METAL UNDER
SOLDER MASK

SOLDER MASK
OPENING

0.07 MIN
ALL AROUND

SOLDER MASK
DEFINED
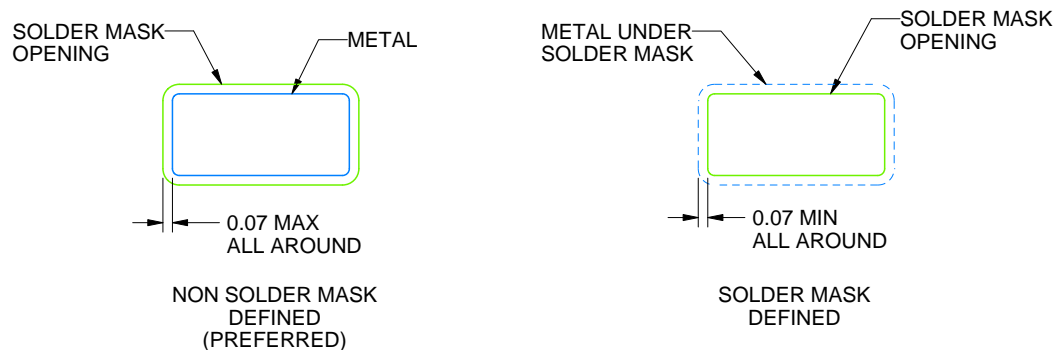
SOLDER MASK DETAILS

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NOTES: (continued)

5. Publication IPC-7351 may have alternate designs.
6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.
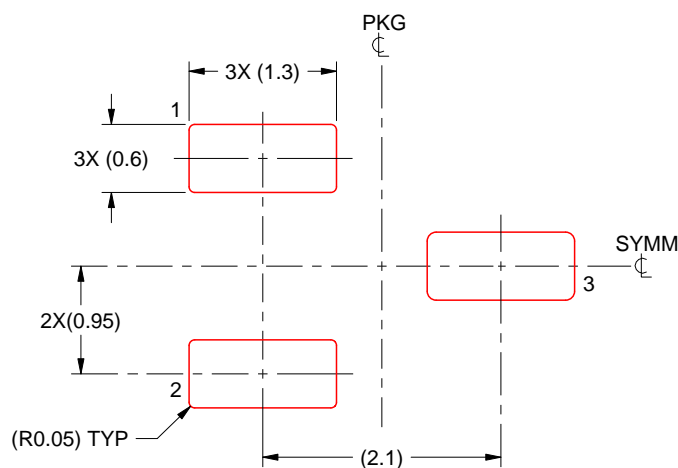
SOLDER PASTE EXAMPLE
BASED ON 0.125 THICK STENCIL
SCALE:15X

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NOTES: (continued)

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

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