

50ppm/°C Max, 50μA in SOT23-3 CMOS VOLTAGE REFERENCE

FEATURES

- **MicroSIZE PACKAGE:** SOT23-3
- **LOW DROPOUT:** 1mV
- **HIGH OUTPUT CURRENT:** 25mA
- **HIGH ACCURACY:** 0.2%
- **LOW I_Q:** 50μA max
- **EXCELLENT SPECIFIED DRIFT PERFORMANCE:**
 - 50ppm/°C (max) from 0°C to +70°C
 - 75ppm/°C (max) from -40°C to +125°C

APPLICATIONS

- PORTABLE, BATTERY-POWERED EQUIPMENT
- DATA ACQUISITION SYSTEMS
- MEDICAL EQUIPMENT
- HAND-HELD TEST EQUIPMENT

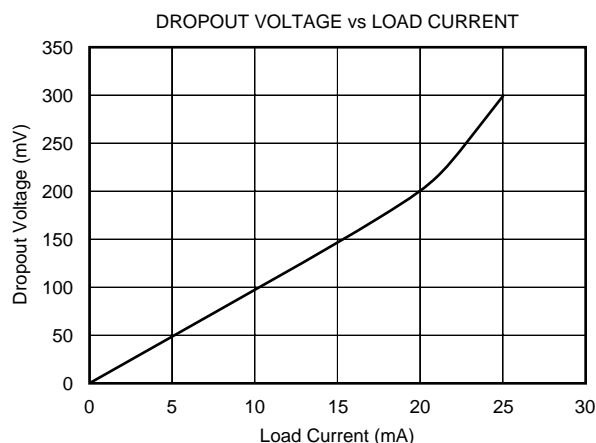
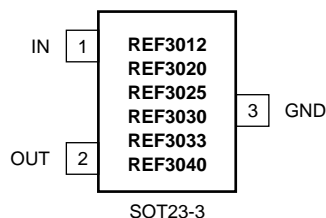
DESCRIPTION

The REF30xx is a precision, low power, low voltage dropout voltage reference family available in a tiny SOT23-3.

The REF30xx small size and low power consumption (50μA max) make it ideal for portable and battery-powered applications. The REF30xx does not require a load capacitor.

Unloaded, the REF30xx can be operated with supplies within 1mV of output voltage. All models are specified for the wide temperature range, -40°C to +125°C.

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



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

All trademarks are the property of their respective owners.

ABSOLUTE MAXIMUM RATINGS⁽¹⁾

Supply Voltage, V+ to V-.....	7.0V
Output Short-Circuit ⁽²⁾	Continuous
Operating Temperature	-40°C to +125°C
Storage Temperature	-65°C to +150°C
Junction Temperature.....	+150°C
Lead Temperature (soldering, 10s).....	+300°C

NOTES: (1) Stresses above these ratings may cause permanent damage. Exposure to absolute maximum conditions for extended periods may degrade device reliability. These are stress ratings only, and functional operation of the device at these, or any other conditions beyond those specified, is not implied. (2) Short circuit to ground.



ELECTROSTATIC DISCHARGE SENSITIVITY

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.

PACKAGE/ORDERING INFORMATION⁽¹⁾

PRODUCT	PACKAGE-LEAD	PACKAGE DESIGNATOR	SPECIFIED TEMPERATURE RANGE	PACKAGE MARKING	ORDERING NUMBER	TRANSPORT MEDIA, QUANTITY
REF3012	SOT23-3	DBZ	-40°C to +125°C	R30A	REF3012AIDBZT	Tape and Reel, 250
"	"	"	"	"	REF3012AIDBZR	Tape and Reel, 3000
REF3020	SOT23-3	DBZ	-40°C to +125°C	R30B	REF3020AIDBZT	Tape and Reel, 250
"	"	"	"	"	REF3020AIDBZR	Tape and Reel, 3000
REF3025	SOT23-3	DBZ	-40°C to +125°C	R30C	REF3025AIDBZT	Tape and Reel, 250
"	"	"	"	"	REF3025AIDBZR	Tape and Reel, 3000
REF3030	SOT23-3	DBZ	-40°C to +125°C	R30F	REF3030AIDBZRT	Tape and Reel, 250
"	"	"	"	"	REF3030AIDBZR	Tape and Reel, 3000
REF3033	SOT23-3	DBZ	-40°C to +125°C	R30D	REF3033AIDBZT	Tape and Reel, 250
"	"	"	"	"	REF3033AIDBZR	Tape and Reel, 3000
REF3040	SOT23-3	DBZ	-40°C to +125°C	R30E	REF3040AIDBZT	Tape and Reel, 250
"	"	"	"	"	REF3040AIDBZR	Tape and Reel, 3000

NOTE: (1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI website at www.ti.com.

ELECTRICAL CHARACTERISTICS

Boldface limits apply over the specified temperature range, $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$.

At $T_A = +25^\circ\text{C}$, $I_{LOAD} = 0\text{mA}$, $V_{IN} = 5\text{V}$, unless otherwise noted.

PARAMETER	CONDITIONS	REF30xx			UNITS
		MIN	TYP	MAX	
REF3012⁽¹⁾ - 1.25V					
OUTPUT VOLTAGE Initial Accuracy	V_{OUT}	1.2475	1.25	1.2525 0.2	V %
NOISE Output Voltage Noise Voltage Noise	$f = 0.1\text{Hz to }10\text{Hz}$ $f = 10\text{Hz to }10\text{kHz}$		14 42		$\mu\text{Vp-p}$ μVrms
LINE REGULATION	$1.8\text{V} \leq V_{IN} \leq 5.5\text{V}$		60	190	$\mu\text{V/V}$
REF3020 - 2.048					
OUTPUT VOLTAGE Initial Accuracy	V_{OUT}	2.044	2.048	2.052 0.2	V %
NOISE Output Voltage Noise Voltage Noise	$f = 0.1\text{Hz to }10\text{Hz}$ $f = 10\text{Hz to }10\text{kHz}$		23 65		$\mu\text{Vp-p}$ μVrms
LINE REGULATION	$V_{REF} + 50\text{mV} \leq V_{IN} \leq 5.5\text{V}$		110	290	$\mu\text{V/V}$
REF3025 - 2.5V					
OUTPUT VOLTAGE Initial Accuracy	V_{OUT}	2.495	2.50	2.505 0.2	V %
NOISE Output Voltage Noise Voltage Noise	$f = 0.1\text{Hz to }10\text{Hz}$ $f = 10\text{Hz to }10\text{kHz}$		28 80		$\mu\text{Vp-p}$ μVrms
LINE REGULATION	$V_{REF} + 50\text{mV} \leq V_{IN} \leq 5.5\text{V}$		120	325	$\mu\text{V/V}$

ELECTRICAL CHARACTERISTICS**Boldface limits apply over the specified temperature range, $T_A = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$.**At $T_A = +25^{\circ}\text{C}$, $I_{\text{LOAD}} = 0\text{mA}$, $V_{\text{IN}} = 5\text{V}$, unless otherwise noted.

PARAMETER	CONDITIONS	REF30xx			UNITS
		MIN	TYP	MAX	
REF3030 – 3.0V					
OUTPUT VOLTAGE Initial Accuracy	V_{OUT}	2.994	3.0	3.006 0.2	V %
NOISE Output Voltage Noise Voltage Noise	$f = 0.1\text{Hz to }10\text{Hz}$ $f = 10\text{Hz to }10\text{kHz}$		33 94		$\mu\text{Vp-p}$ μVrms
LINE REGULATION	$V_{\text{REF}} + 50\text{mV} \leq V_{\text{IN}} \leq 5.5\text{V}$		120	375	$\mu\text{V/V}$
REF3033 – 3.3V					
OUTPUT VOLTAGE Initial Accuracy	V_{OUT}	3.294	3.30	3.306 0.2	V %
NOISE Output Voltage Noise Voltage Noise	$f = 0.1\text{Hz to }10\text{Hz}$ $f = 10\text{Hz to }10\text{kHz}$		36 105		$\mu\text{Vp-p}$ μVrms
LINE REGULATION	$V_{\text{REF}} + 50\text{mV} \leq V_{\text{IN}} \leq 5.5\text{V}$		130	400	$\mu\text{V/V}$
REF3040 – 4.096V					
OUTPUT VOLTAGE Initial Accuracy	V_{OUT}	4.088	4.096	4.104 0.2	V %
NOISE Output Voltage Noise Voltage Noise	$f = 0.1\text{Hz to }10\text{Hz}$ $f = 10\text{Hz to }10\text{kHz}$		45 128		$\mu\text{Vp-p}$ μVrms
LINE REGULATION	$V_{\text{REF}} + 50\text{mV} \leq V_{\text{IN}} \leq 5.5\text{V}$		160	410	$\mu\text{V/V}$
REF3012, REF3020, REF3025, REF3030, REF3033, REF3040					
OUTPUT VOLTAGE TEMP DRIFT⁽²⁾	dV_{OUT}/dT	$0^{\circ}\text{C} \leq T_A \leq +70^{\circ}\text{C}$ $-30^{\circ}\text{C} \leq T_A \leq +85^{\circ}\text{C}$ $-40^{\circ}\text{C} \leq T_A \leq +85^{\circ}\text{C}$ $-40^{\circ}\text{C} \leq T_A \leq +125^{\circ}\text{C}$	20 28 30 35	50 60 65 75	ppm/ $^{\circ}\text{C}$ ppm/ $^{\circ}\text{C}$ ppm/ $^{\circ}\text{C}$ ppm/ $^{\circ}\text{C}$
LONG-TERM STABILITY		0-1000h 1000-2000h	24 15		ppm ppm
LOAD REGULATION⁽³⁾	$dV_{\text{OUT}}/dI_{\text{LOAD}}$	$0\text{mA} < I_{\text{LOAD}} < 25\text{mA}$, $V_{\text{IN}} = V_{\text{REF}} + 500\text{mV}^{(1)}$	3	100	$\mu\text{V}/\text{mA}$
THERMAL HYSTERESIS⁽⁴⁾	dT		25	100	ppm
DROPOUT VOLTAGE	$V_{\text{IN}} - V_{\text{OUT}}$		1	50	mV
SHORT-CIRCUIT CURRENT	I_{SC}		45		mA
TURN ON SETTLING TIME		to 0.1% at $V_{\text{IN}} = 5\text{V}$ with $C_L = 0$	120		μs
POWER SUPPLY Voltage	V_S	$I_L = 0$	$V_{\text{REF}} + 0.001^{(5)}$	5.5	V
Over Temperature Quiescent Current	I_Q	$-40^{\circ}\text{C} \leq T_A \leq +125^{\circ}\text{C}$	$V_{\text{REF}} + 0.05$	5.5 50	V μA
Over Temperature		$-40^{\circ}\text{C} \leq T_A \leq +125^{\circ}\text{C}$		59	μA
TEMPERATURE RANGE Specified Range Operating Range Storage Range Thermal Resistance SOT23-3 Surface-Mount	θ_{JC} θ_{JA}		-40 -40 -65	+125 +125 +150	$^{\circ}\text{C}$ $^{\circ}\text{C}$ $^{\circ}\text{C}$ $^{\circ}\text{C}/\text{W}$ $^{\circ}\text{C}/\text{W}$

NOTES: (1) Minimum supply voltage for REF3012 is 1.8V.

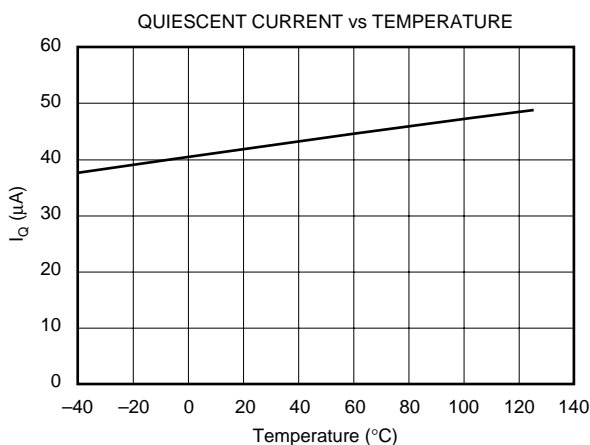
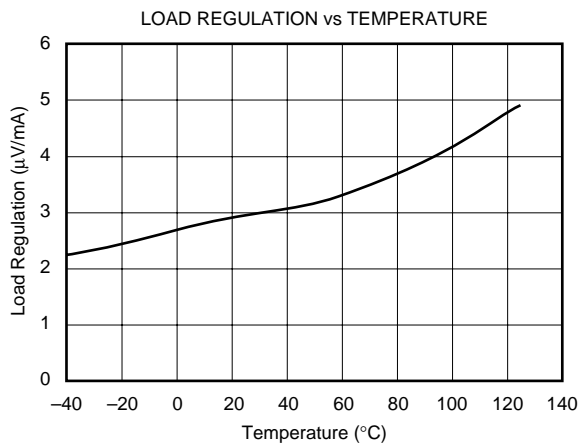
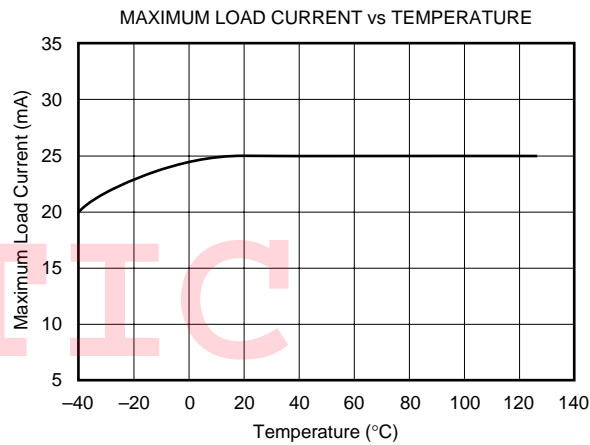
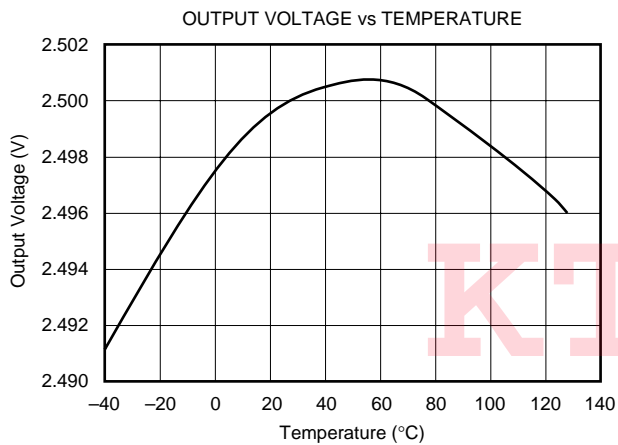
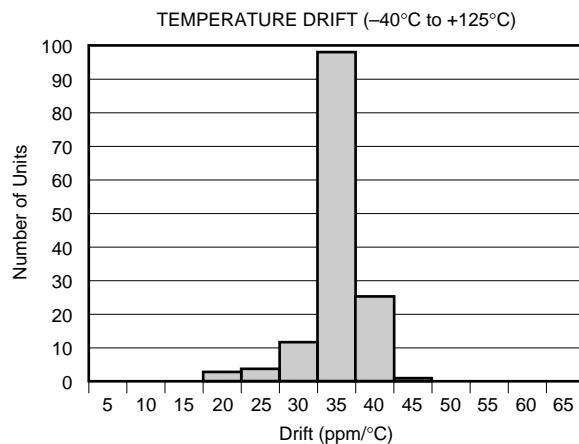
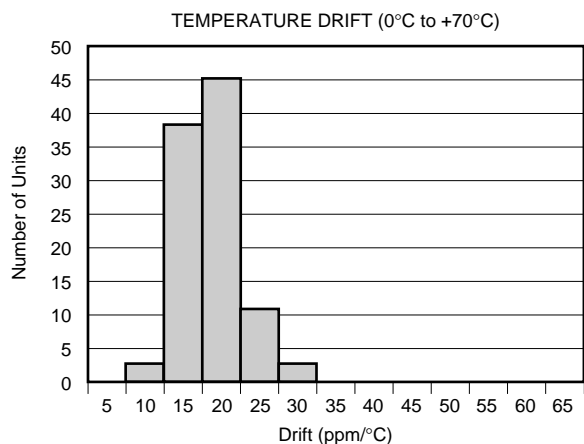
(2) Box Method used to determine over temperature drift.

(3) Typical value of load regulation reflects measurements using a force and sense contacts, see text *Load Regulation*.

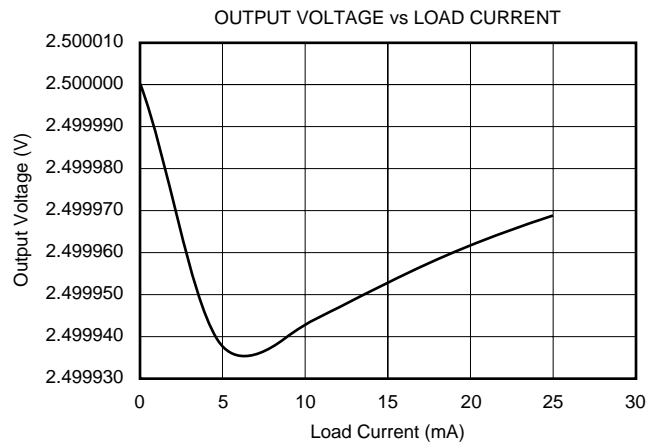
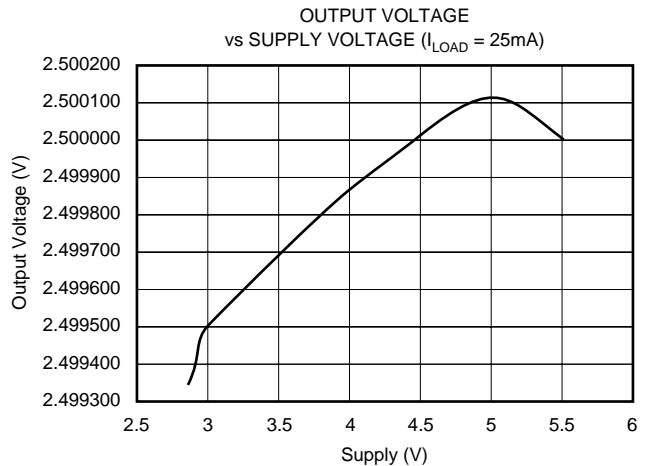
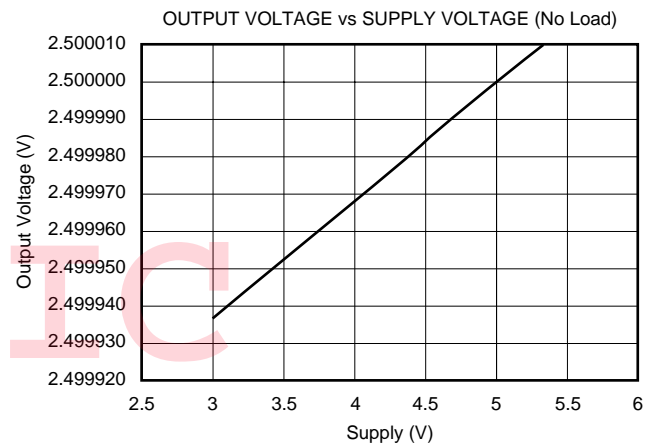
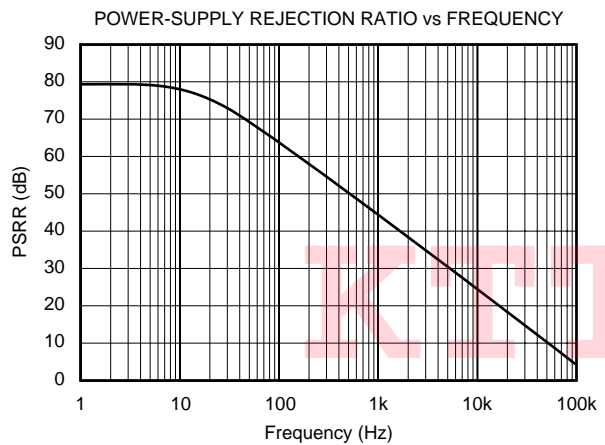
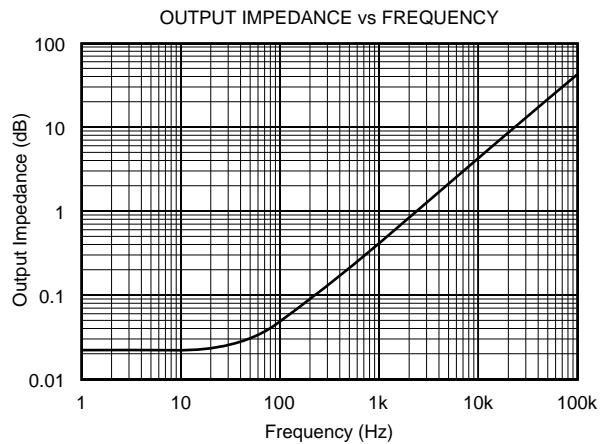
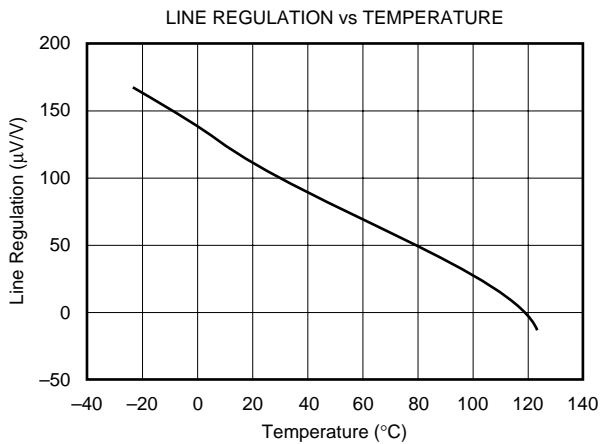
(4) Thermal hysteresis procedure is explained in more detail in Applications Information section of data sheet.

(5) For $I_L > 0$, see Typical Characteristic curves.

At $T_A = +25^\circ\text{C}$, $V_{IN} = +5\text{V}$ power supply, REF3025 is used for typical characteristics, unless otherwise noted.

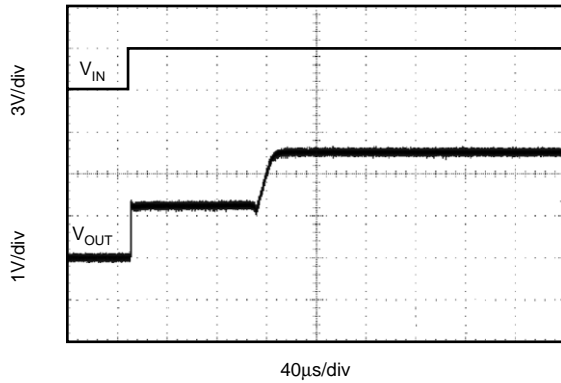


At $T_A = +25^\circ\text{C}$, $V_{IN} = +5\text{V}$ power supply, REF3025 is used for typical characteristics, unless otherwise noted.

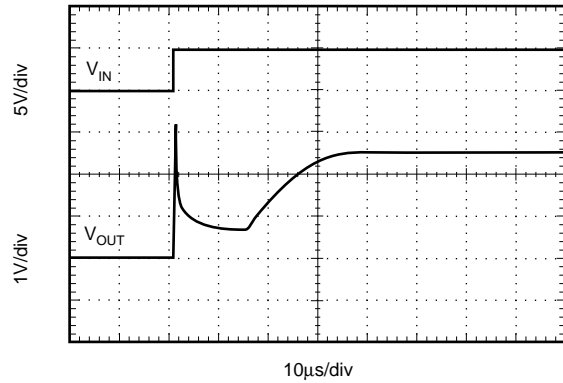


At $T_A = +25^\circ\text{C}$, $V_{IN} = +5\text{V}$ power supply, REF3025 is used for typical characteristics, unless otherwise noted.

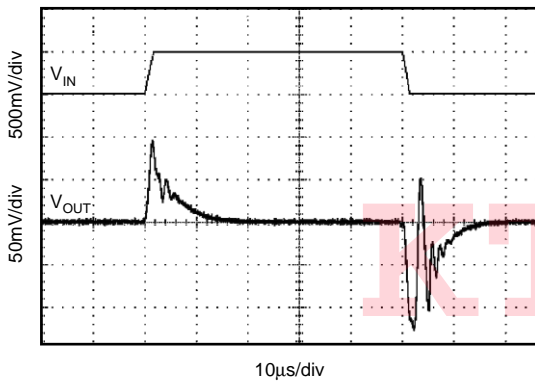
STEP RESPONSE, $C_L = 0$, 3V STARTUP



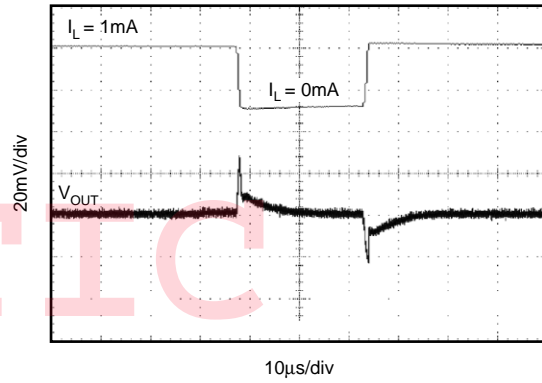
STEP RESPONSE, $C_L = 0$, 5V STARTUP



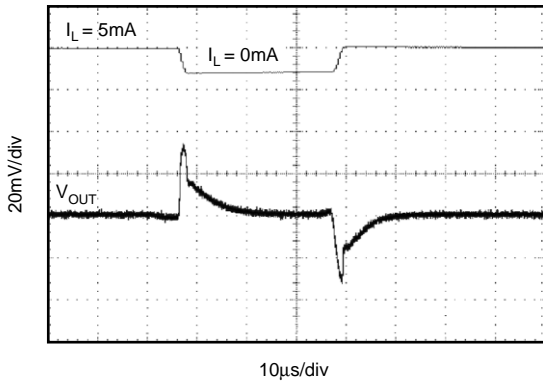
LINE TRANSIENT RESPONSE



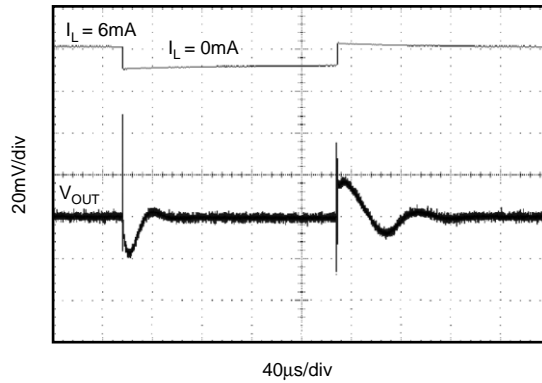
0-1mA LOAD TRANSIENT ($C_L = 0$)



0-5mA LOAD TRANSIENT ($C_L = 0$)

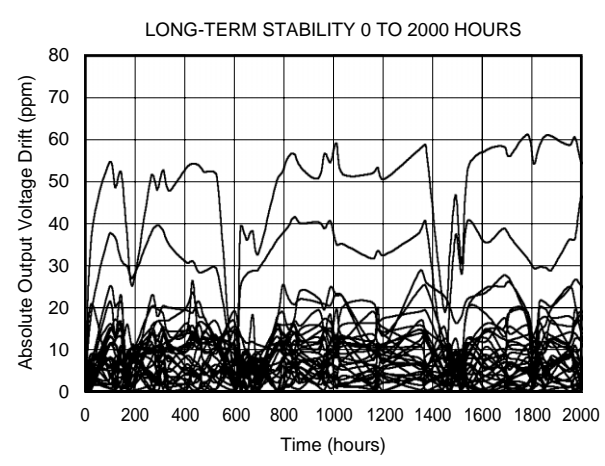
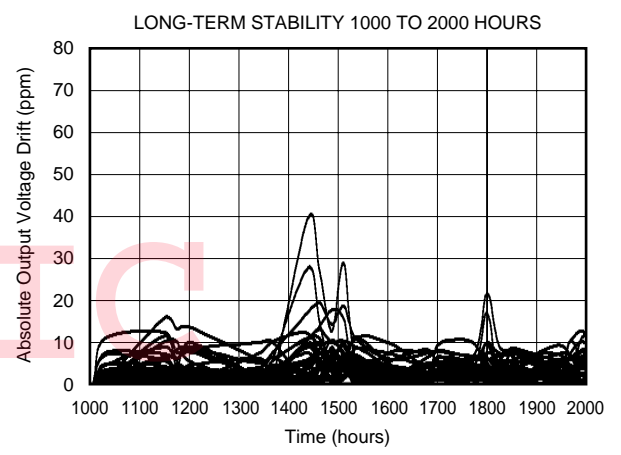
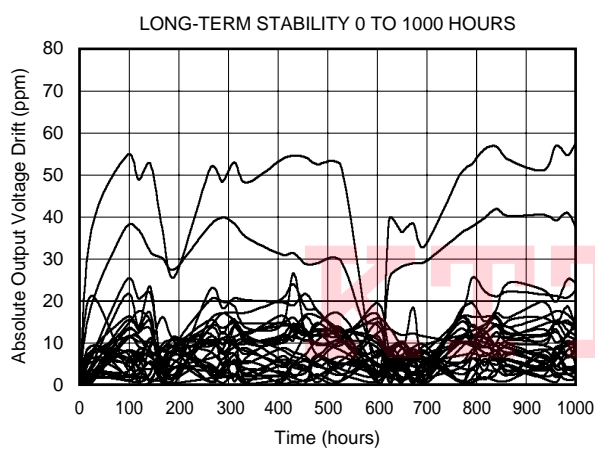
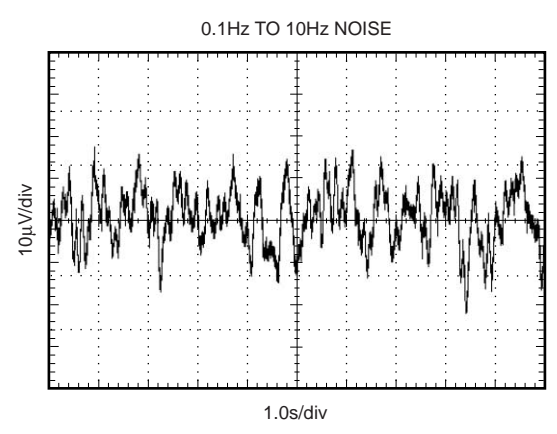
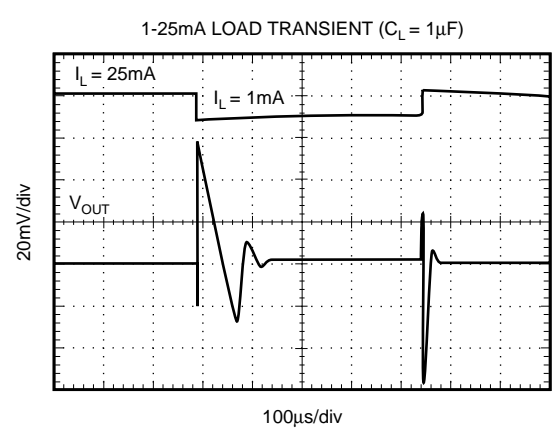


1-6mA LOAD TRANSIENT ($C_L = 1\mu\text{F}$)



TYPICAL CHARACTERISTICS (Cont.)

At $T_A = +25^\circ\text{C}$, $V_{IN} = +5\text{V}$ power supply, REF3025 is used for typical characteristics, unless otherwise noted.



THEORY OF OPERATION

The REF30xx is a series, CMOS, precision bandgap voltage reference. Its basic topology is shown in Figure 1. The transistors Q_1 and Q_2 are biased such that the current density of Q_1 is greater than that of Q_2 . The difference of the two base-emitter voltages, $V_{be1} - V_{be2}$, 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 seen in the typical curve, "Output Voltage vs Temperature," is due to the slightly nonlinear temperature coefficient of the base-emitter voltage of Q_2 .

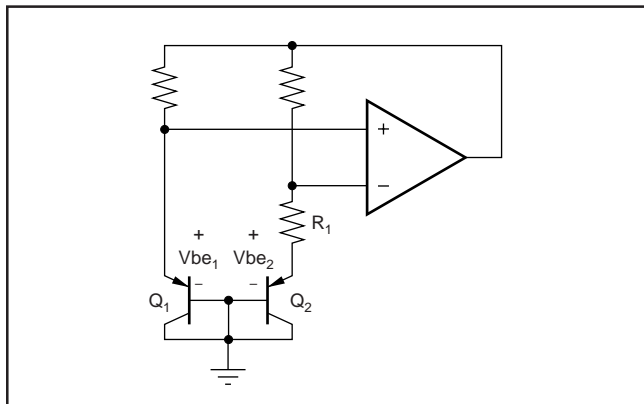


FIGURE 1. Simplified Schematic of Bandgap Reference.

The REF30xx features a low quiescent current, which is extremely stable over changes in both temperature and supply. The typical room temperature quiescent current is $42\mu A$, and the maximum quiescent current over temperature is just $59\mu A$. Additionally, the quiescent current typically changes less than $2.5\mu A$ over the entire supply range, as shown in Figure 3.

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

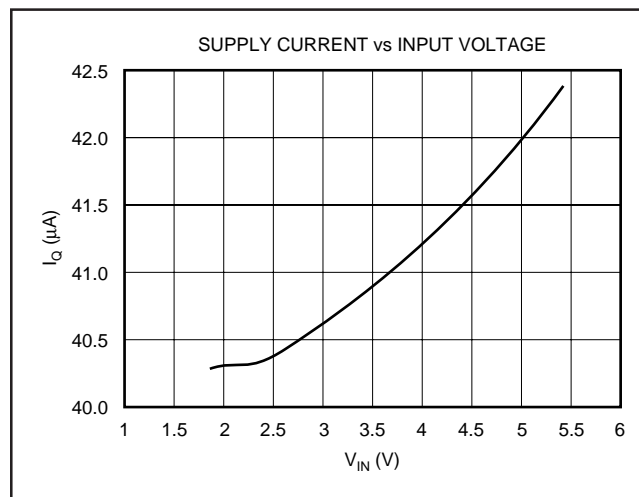


FIGURE 3. Supply Current vs Supply Voltage.

APPLICATION INFORMATION

For normal operation, the REF30xx does not require a capacitor on the output. If a capacitive load is connected, special care must be taken with the combination of low equivalent series resistance (ESR) capacitors and high capacitance. This caution is especially true for low-output voltage devices; therefore, the REF3012 should only have a low-ESR capacitance of $10\mu F$ or less. Figure 2 shows the typical connections required for operation of the REF30xx. A supply bypass capacitor of $0.47\mu F$ is always recommended.

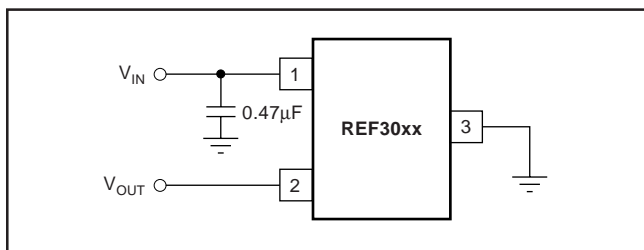


FIGURE 2. Typical Connections for Operating REF30xx.

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 1.8V, the REF30xx can be operated with a supply of only 1mV above the output voltage in an unloaded condition. For loaded conditions, a typical dropout voltage versus load is shown on the cover page.

THERMAL HYSTERESIS

Thermal hysteresis for the REF30xx is defined as the change in output voltage after operating the device at $25^{\circ}C$, cycling the device through the specified temperature range, and returning to $25^{\circ}C$, and can be expressed as:

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

Where: V_{HYST} = Calculated hysteresis

V_{PRE} = Output voltage measured at $25^{\circ}C$ pre-temperature cycling

V_{POST} = Output voltage measured when device has been operated at $25^{\circ}C$, cycled through specified range $-40^{\circ}C$ to $+125^{\circ}C$ and returned to operation at $25^{\circ}C$.

TEMPERATURE DRIFT

The REF30xx is designed to exhibit 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 20ppm from $0^{\circ}C$ to $70^{\circ}C$ —the primary temperature range of use for many applications. For industrial temperature ranges of $-40^{\circ}C$ to $125^{\circ}C$, the REF30xx family drift increases to a typical value of 50ppm.

NOISE PERFORMANCE

The REF30xx generates noise less than $50\mu\text{Vp-p}$ between frequencies of 0.1Hz to 10Hz, and can be seen in the Typical Characteristic Curve “0.1 to 10Hz Voltage Noise.” The noise voltage of the REF30xx increases with output voltage and operating temperature. Additional filtering may be used to improve output noise levels, although care should be taken to ensure the output impedance does not degrade AC performance.

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 24ppm from 0-1000 hours, and 15ppm from 1000-2000 hours. This parameter is characterized by measuring 30 units at regular intervals for a period of 2000 hours.

LOAD REGULATION

Load regulation is defined as the change in output voltage due to changes in load current. Load regulation for the REF30xx is measured using force and sense contacts as pictured in Figure 4. 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, force and sense lines should be used.

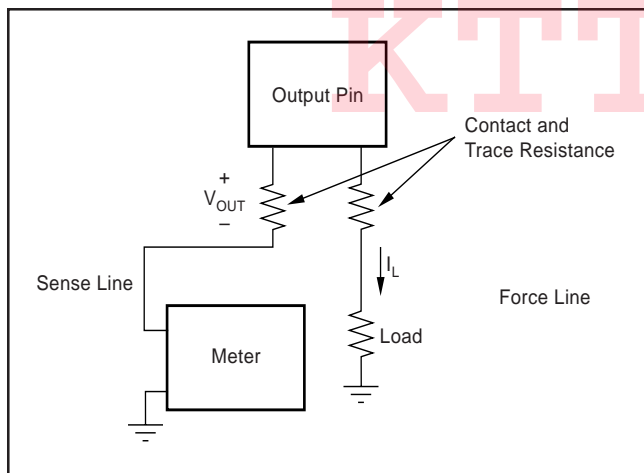


FIGURE 4. Accurate Load Regulation of REF30xx.

APPLICATION CIRCUITS

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 $\pm 5\text{V}$ supply. Figure 5 shows the REF3025 used to provide a $\pm 2.5\text{V}$ 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.

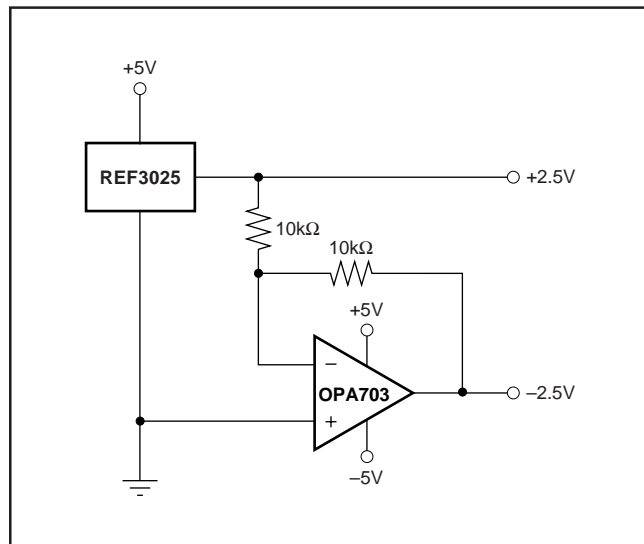


FIGURE 5. REF3025 Combined with OPA703 to Create Positive and Negative Reference Voltages.

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 micro-controllers and data converters. Figure 6 and Figure 7 show two basic data acquisition systems.

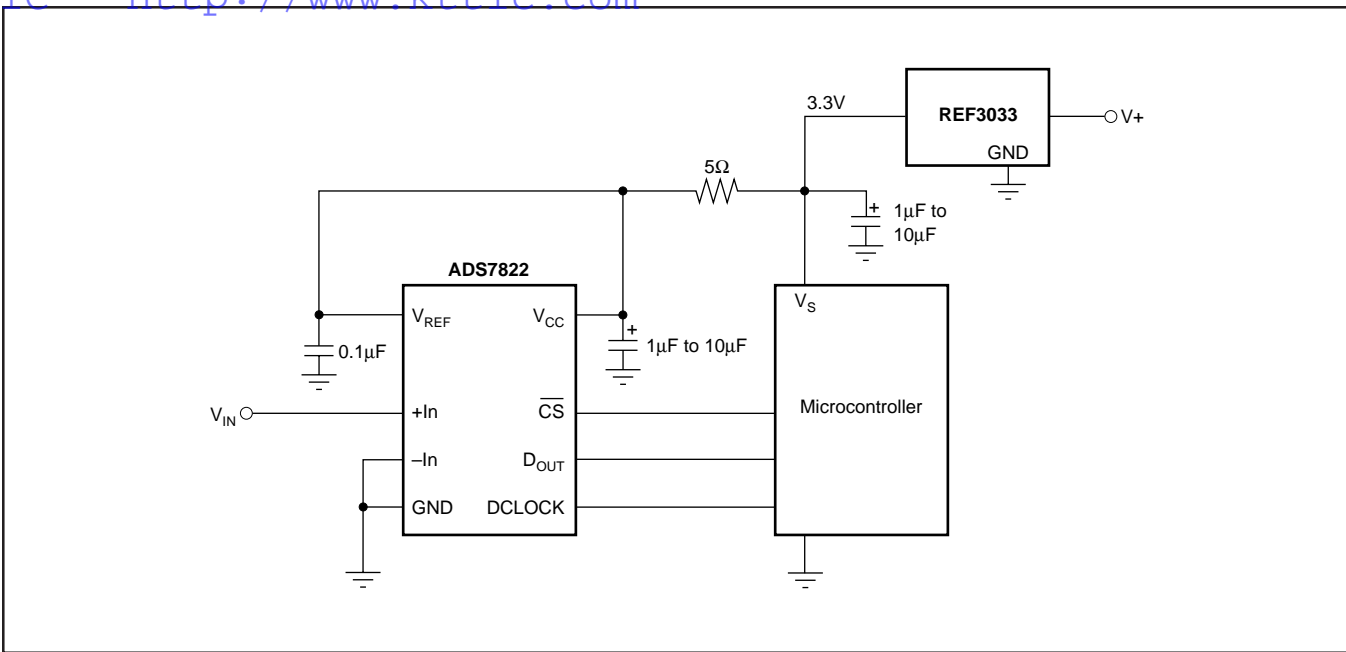


FIGURE 6. Basic Data Acquisition System 1.

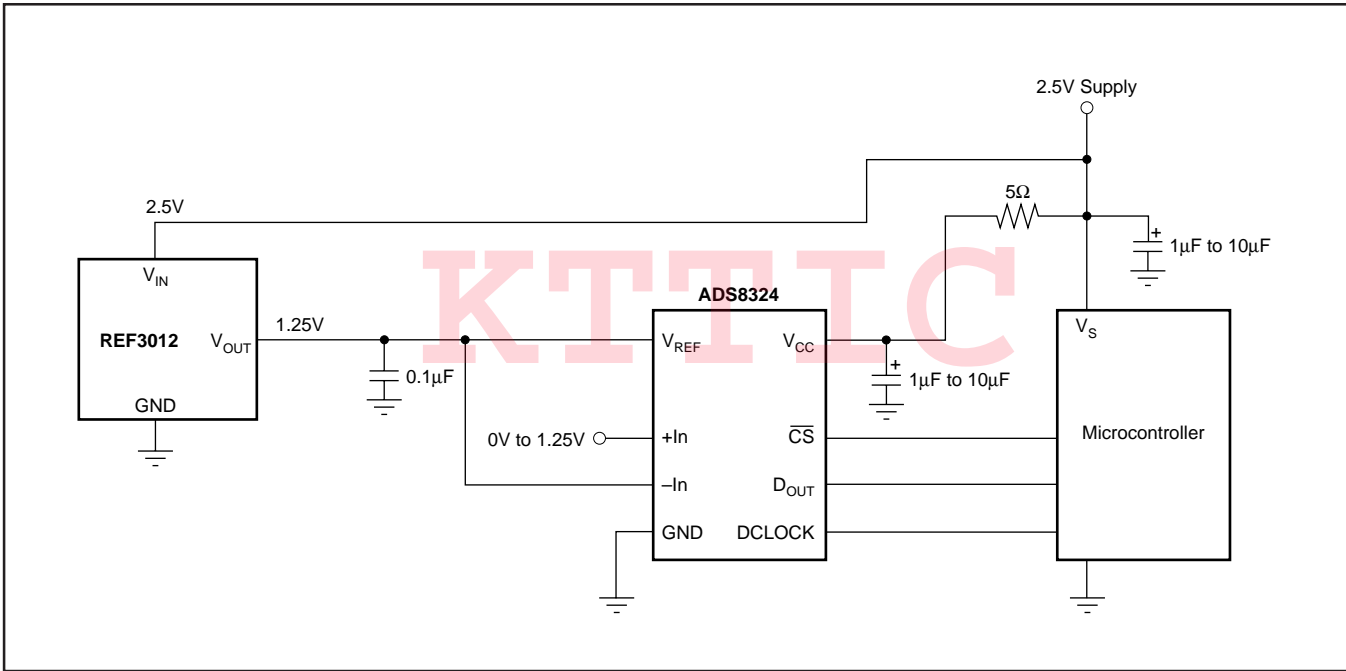


FIGURE 7. Basic Data Acquisition System 2.

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
REF3012AIDBZR	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
REF3012AIDBZRG4	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
REF3012AIDBZT	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
REF3012AIDBZTG4	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
REF3020AIDBZR	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
REF3020AIDBZRG4	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
REF3020AIDBZT	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
REF3020AIDBZTG4	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
REF3025AIDBZR	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
REF3025AIDBZRG4	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
REF3025AIDBZT	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
REF3025AIDBZTG4	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
REF3030AIDBZR	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
REF3030AIDBZRG4	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
REF3030AIDBZT	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
REF3030AIDBZTG4	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
REF3033AIDBZR	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
REF3033AIDBZRG4	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
REF3033AIDBZT	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
REF3033AIDBZTG4	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
REF3040AIDBZR	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
REF3040AIDBZRG4	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
REF3040AIDBZT	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
REF3040AIDBZTG4	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

⁽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⁾ Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

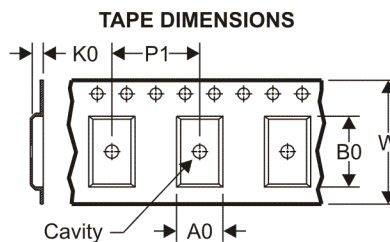
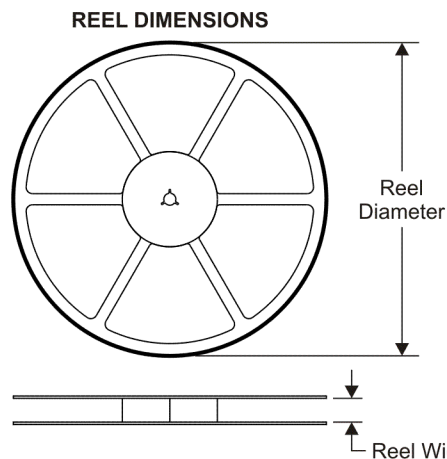
⁽³⁾ MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

Important Information and Disclaimer:The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

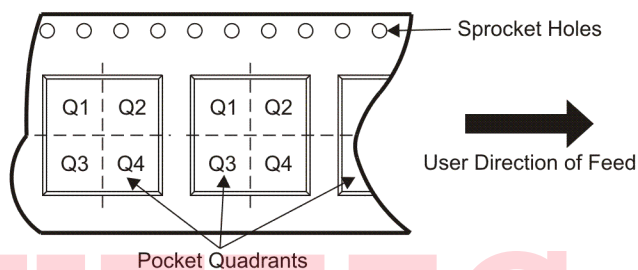
KTTIC

TAPE AND REEL INFORMATION



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

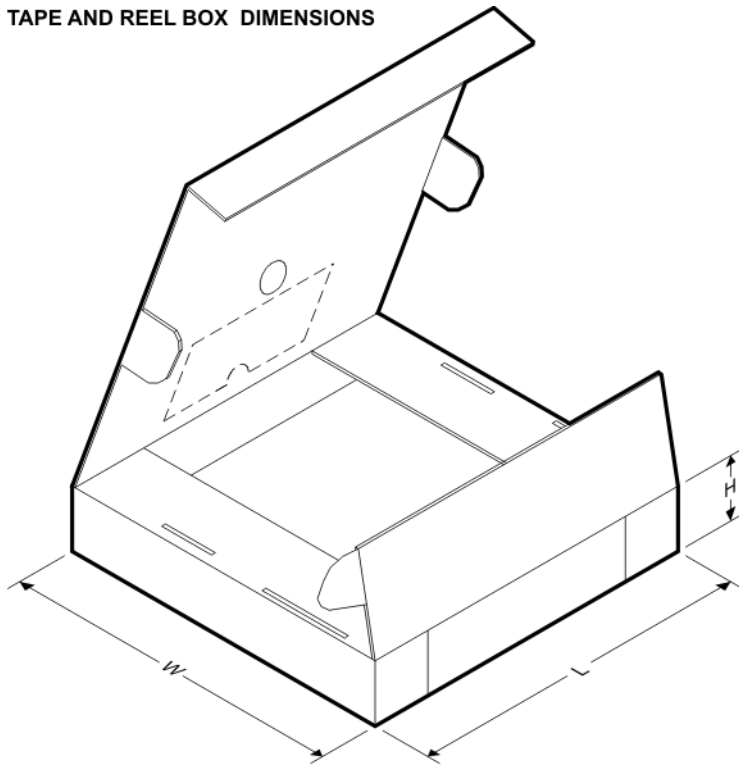
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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	179.0	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	195.0	200.0	45.0
REF3012AIDBZT	SOT-23	DBZ	3	250	195.0	200.0	45.0
REF3020AIDBZR	SOT-23	DBZ	3	3000	195.0	200.0	45.0
REF3020AIDBZT	SOT-23	DBZ	3	250	195.0	200.0	45.0
REF3025AIDBZR	SOT-23	DBZ	3	3000	195.0	200.0	45.0
REF3025AIDBZT	SOT-23	DBZ	3	250	195.0	200.0	45.0
REF3030AIDBZR	SOT-23	DBZ	3	3000	195.0	200.0	45.0
REF3030AIDBZT	SOT-23	DBZ	3	250	195.0	200.0	45.0
REF3033AIDBZR	SOT-23	DBZ	3	3000	195.0	200.0	45.0
REF3033AIDBZT	SOT-23	DBZ	3	250	195.0	200.0	45.0
REF3040AIDBZR	SOT-23	DBZ	3	3000	195.0	200.0	45.0
REF3040AIDBZT	SOT-23	DBZ	3	250	195.0	200.0	45.0

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products

Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
RF/IF and ZigBee® Solutions	www.ti.com/lprf

Applications

Audio	www.ti.com/audio
Automotive	www.ti.com/automotive
Broadband	www.ti.com/broadband
Digital Control	www.ti.com/digitalcontrol
Medical	www.ti.com/medical
Military	www.ti.com/military
Optical Networking	www.ti.com/opticalnetwork
Security	www.ti.com/security
Telephony	www.ti.com/telephony
Video & Imaging	www.ti.com/video
Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
 Copyright © 2009, Texas Instruments Incorporated