SBOS283 – SEPTEMBER 2003

10ppm/°C, 1μA, 1.25V Shunt Voltage Reference

FEATURES

- MICRO-PACKAGE: SOT23-3
- WIDE CURRENT RANGE: 1μA to 5mA
- HIGH INITIAL ACCURACY: 0.2%
- EXCELLENT SPECIFIED DRIFT PERFORMANCE:
  30ppm/°C (max) from 0°C to +70°C
  50ppm/°C (max) from –40°C to +85°C

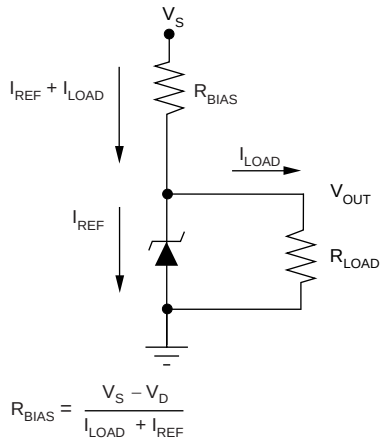
APPLICATIONS

- BATTERY-POWERED INSTRUMENTS
- PORTABLE DEVICES
- MEDICAL EQUIPMENT
- CURRENT SOURCES
- CALIBRATORS
- MICROPOWER CURRENT AND VOLTAGE REFERENCE

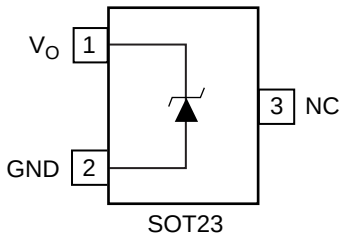
DESCRIPTION

The REF1112 is a two-terminal shunt reference designed for power and space-sensitive applications. The REF1112 features an operating current of 1μA in a SOT23-3 package and is an improved, lower power pin-compatible drop-in replacement for designs currently using the REF1004 and LT1004. The REF1112 is specified from –40°C to +85°C with operation extending from –40°C to +125°C.

The REF1112 complements other 1μA components from Texas Instruments including the OPA349 and the TLV240x low power operational amplifiers, and the TLV349x micropower voltage comparator.



$$R_{BIAS} = \frac{V_S - V_D}{I_{LOAD} + I_{REF}}$$



NC indicates pin should be left unconnected.

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ABSOLUTE MAXIMUM RATINGS[1]

Reverse Breakdown Current	10mA
Forward Current	10mA
Operating Temperature	–55°C to +125°C
Storage Temperature	–65°C to +150°C
Junction Temperature	+150°C
Lead Temperature (soldering, 10s)	+300°C

(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.

ELECTROSTATIC DISCHARGE SENSITIVITY

Electrostatic discharge can cause damage ranging from performance degradation to complete device failure. Texas Instruments recommends that all integrated circuits be handled and stored using appropriate ESD protection methods.

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 published specifications.

PACKAGE/ORDERING INFORMATION

PRODUCT	PACKAGE-LEAD	PACKAGE DESIGNATOR[1]	SPECIFIED TEMPERATURE RANGE	PACKAGE MARKING	ORDERING NUMBER	TRANSPORT MEDIA, QUANTITY
REF1112	SOT23-3	DBZ	–40°C to +125°C	R11A	REF1112AIDBZT	Tape and Reel, 250
"	"	"	"	"	REF1112AIDBZR	Tape and Reel, 3000

NOTE: (1) For the most current specifications and package information, refer to our web site at www.ti.com.

PRELIMINARY ELECTRICAL CHARACTERISTICS

Boldface limits apply over the specified temperature range, **T_A = –40°C to +125°C**.
At T_A = +25°C, I_{REF} = 1.2μA, and C_{LOAD} = 10nF, unless otherwise noted.

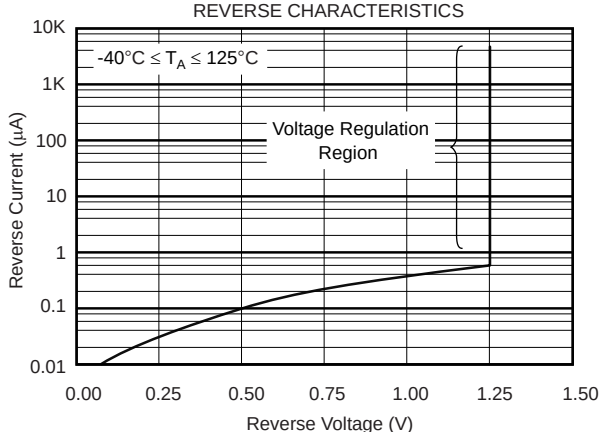
PARAMETER	CONDITIONS	REF1112 - 1.25V MIN	REF1112 - 1.25V TYP	REF1112 - 1.25V MAX	UNITS
REVERSE BREAKDOWN VOLTAGE	I_{REF} = 1.2μA	1.2475 -0.2	1.25	1.2525 + 0.2	V %
TEMPERATURE COEFFICIENT	1.2μA ≤ I_{REF} ≤ 5mA **0°C to +70°C** **–40°C to +85°C** **–40°C to +125°C**		 **10** **15** **15**	 **30** **50**	 ppm/°C ppm/°C ppm/°C
MINIMUM OPERATING CURRENT			1	1.2	μA
REVERSE BREAKDOWN VOLTAGE CHANGE WITH CURRENT	1.2μA ≤ I_{REF} ≤ 5mA		30	100	ppm/mA
REVERSE DYNAMIC IMPEDANCE	1.2μA ≤ I_{REF} ≤ 5mA		0.037	0.125	Ω
LOW-FREQUENCY NOISE[1] 0.1Hz ≤ I_{REF} ≤ 10Hz			 25		 μV_{PP}
THERMAL HYSTERESIS[2]			100		ppm
LONG-TERM STABILITY +25°C ± 0.1°C			 60		 ppm/kHr
TEMPERATURE CHARACTERISTICS Specified Range Operating Range Storage Range Thermal Resistance θ_{JA} SOT23-3 Surface-Mount		 –40 –55 –65	 135	 +125 +125 +150	 °C °C °C °C/W

(1) Peak-to-peak noise is measured with a 2-pole high-pass filter at 0.1Hz and a 4-pole low-pass chebyshev filter at 10Hz.
(2) Thermal hysteresis 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.

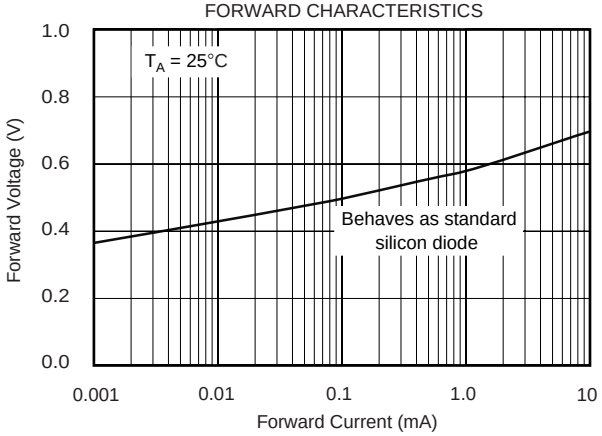
TYPICAL CHARACTERISTICS

At T_A = +25°C, I_{REF} = 10μA and C_L = 10nF, unless otherwise specified.

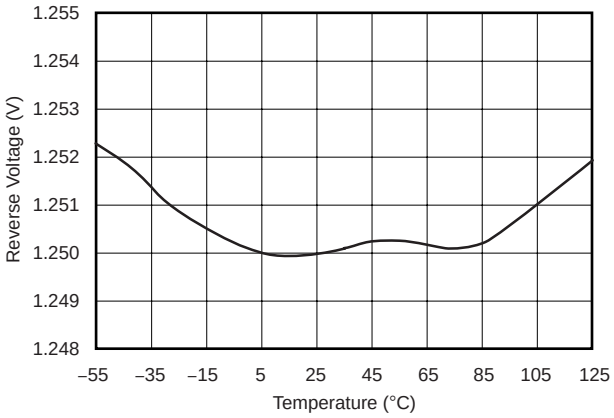
REVERSE CHARACTERISTICS



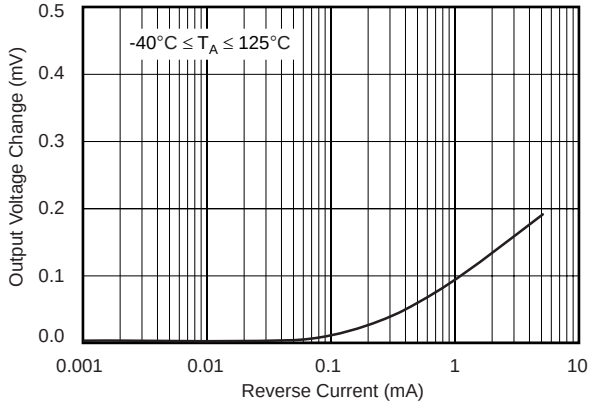
FORWARD CHARACTERISTICS



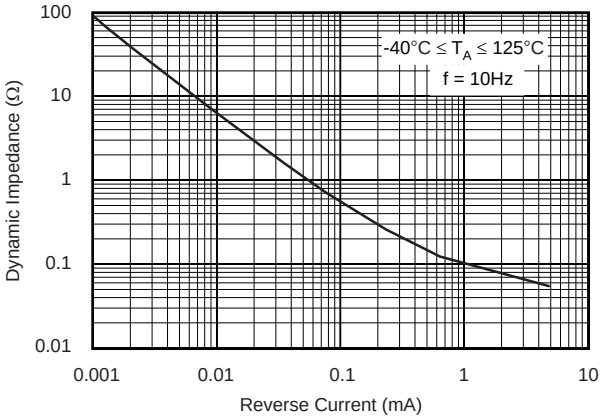
TEMPERATURE DRIFT



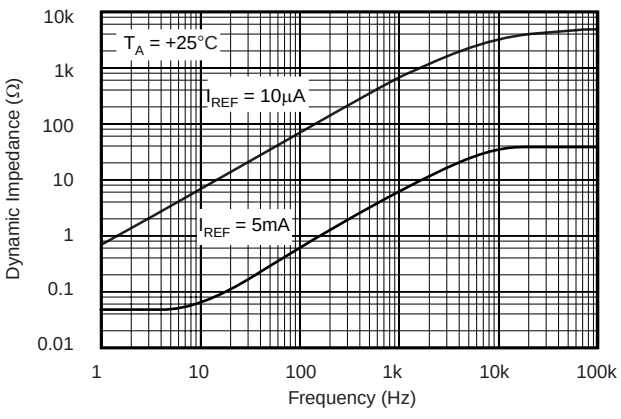
REVERSE VOLTAGE CHANGE vs CURRENT



REVERSE DYNAMIC IMPEDANCE



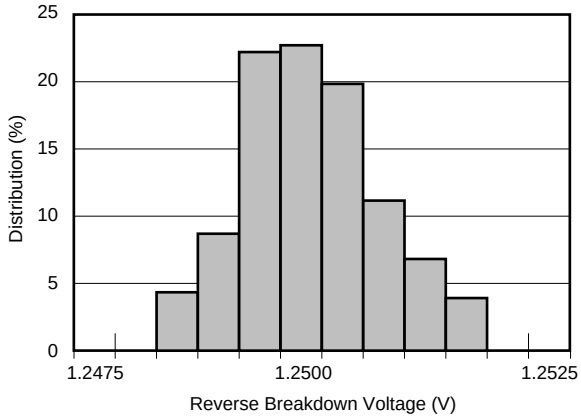
REVERSE DYNAMIC IMPEDANCE



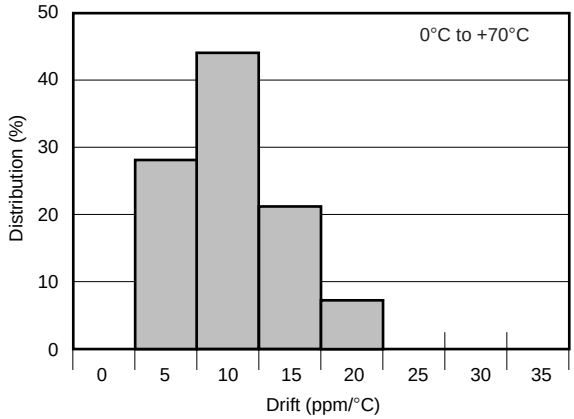
TYPICAL CHARACTERISTICS (Cont.)

At T_A = +25°C, I_{REF} = 10µA and C_L = 10nF, unless otherwise specified.

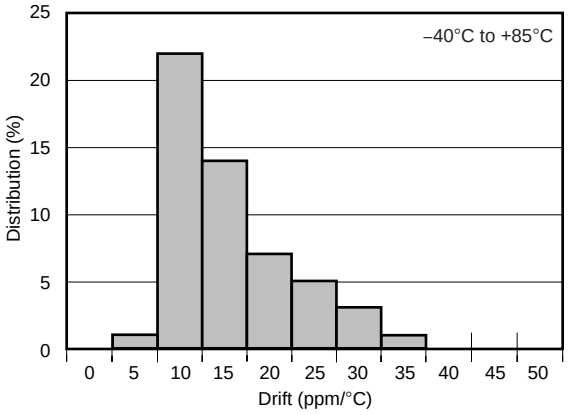
REVERSE BREAKDOWN VOLTAGE DISTRIBUTION



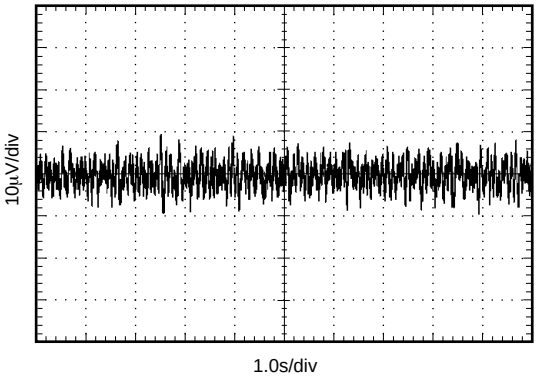
TEMPERATURE DRIFT DISTRIBUTION



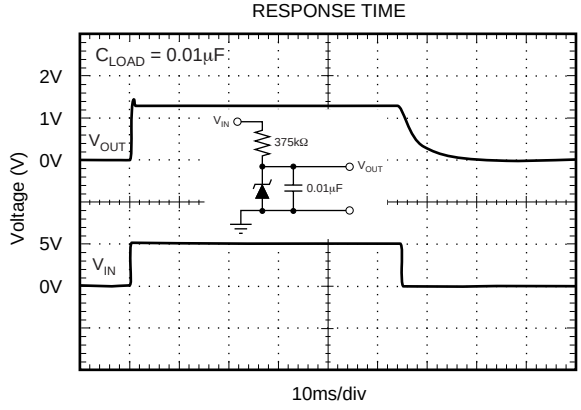
TEMPERATURE DRIFT DISTRIBUTION



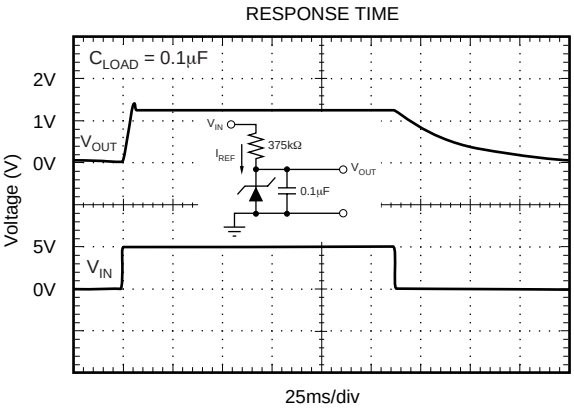
LOW-FREQUENCY NOISE, 0.1 to 10Hz



RESPONSE TIME



RESPONSE TIME



APPLICATIONS INFORMATION

The REF1112 is a two-terminal bandgap reference diode designed for high accuracy with outstanding temperature characteristics at low operating currents. Precision thin-film resistors result in 0.2% initial voltage accuracy and 50ppm/°C maximum temperature drift. The REF1112 is specified from –40°C to +85°C, with operation from –40°C to +125°C, and is offered in a SOT23-3 package.

Typical connections for the REF1112 are shown in Figure 1. A minimum 1μA bias current is required to maintain a stable output voltage and can be provided with a resistor connected to the supply voltage. I_{BIAS} depends on the values selected for R_{BIAS} and V_S, and will vary as a sum of the minimum operating current and the load current. To maintain stable operation, the value of R_{BIAS} must be low enough to maintain the minimum operating current at the minimum and maximum load and supply voltage levels.

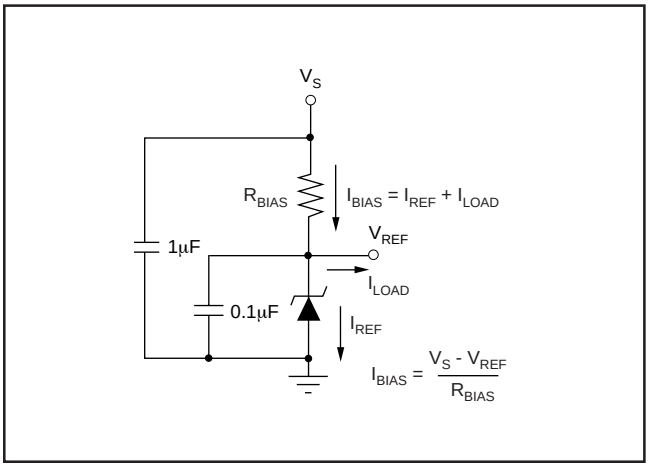


FIGURE 1. Typical Connections.

A 0.1μF load capacitor is recommended to maintain stability under varying load conditions. A minimum 0.01μF load capacitor is required for stable operation. Start-up time for the REF1112 will be affected, depending on the value of load capacitance and the bias currents being used. A 1μF power supply bypass capacitor is recommended to minimize supply noise within the circuit.

The REF1112 shunt voltage reference provides a versatile function for low power and space-conservative applications. The REF1112 can be configured with an additional diode and NPN transistor to provide a temperature compensated current reference as shown in Figure 2. The REF112 can be scaled to provide extremely low power reference voltages. Figure 3 shows the REF1112 used as a 1V out, 3μA voltage reference, and in Figure 4 a 2.5V reference on 1μA.

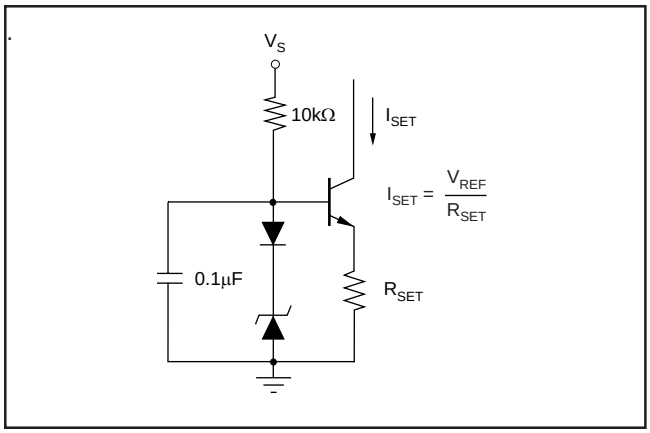


FIGURE 2. REF1112 Provides a Stable Current Source.

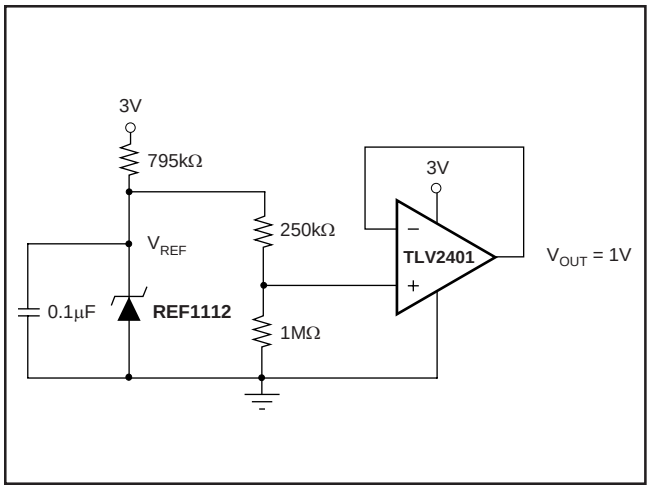


FIGURE 3. MicroPOWER 3μA 1V Voltage Reference.

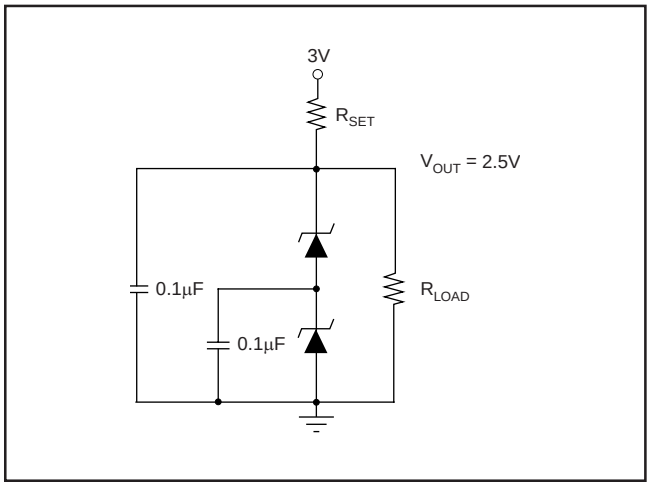


FIGURE 4. 2.5V Reference on 1μA.

For applications requiring a stable voltage reference capable of sinking higher than 5mA of current, a REF1112 combined with an OPA347 can sink up to 10mA of current. This configuration is shown in Figure 5, and through appropriate selection of R1 and R2, can be used to provide a wide range of stable reference voltages. The REF1112 is also useful for level shifting, and as shown in Figure 6, can be used to achieve the full input range of an ADC.

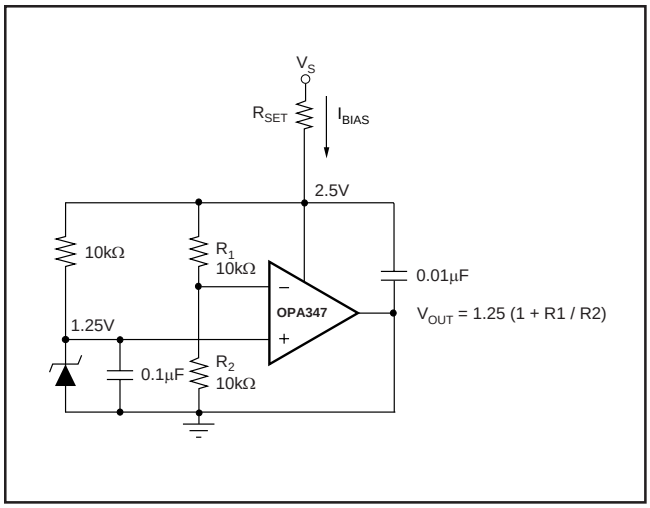


FIGURE 5. Adjustable Voltage Shunt Reference

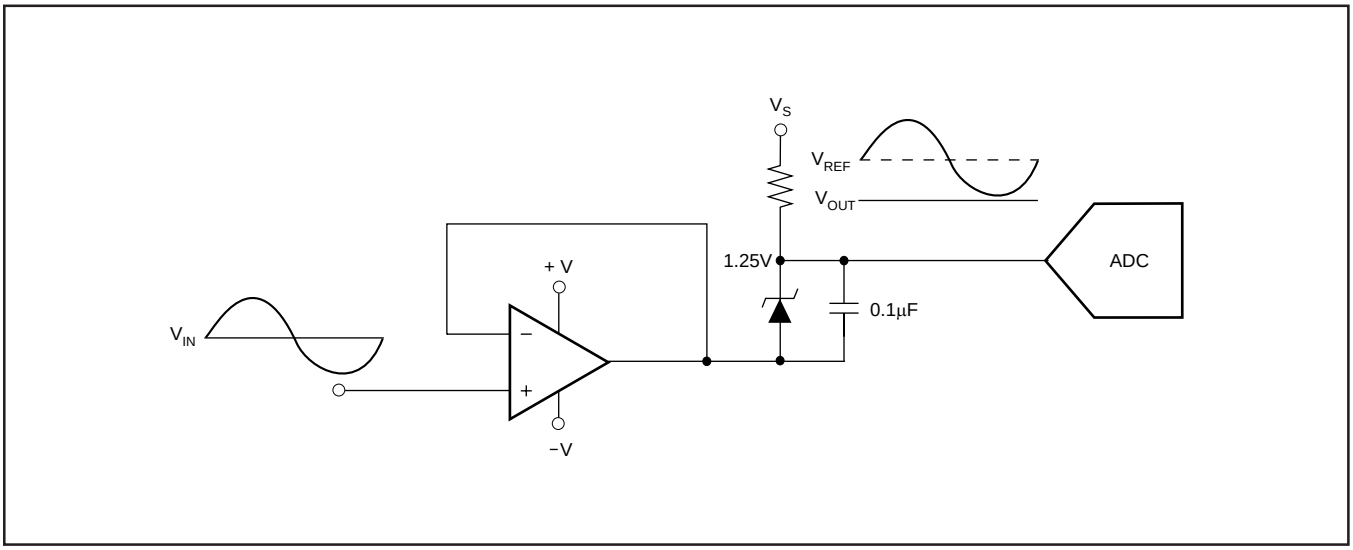
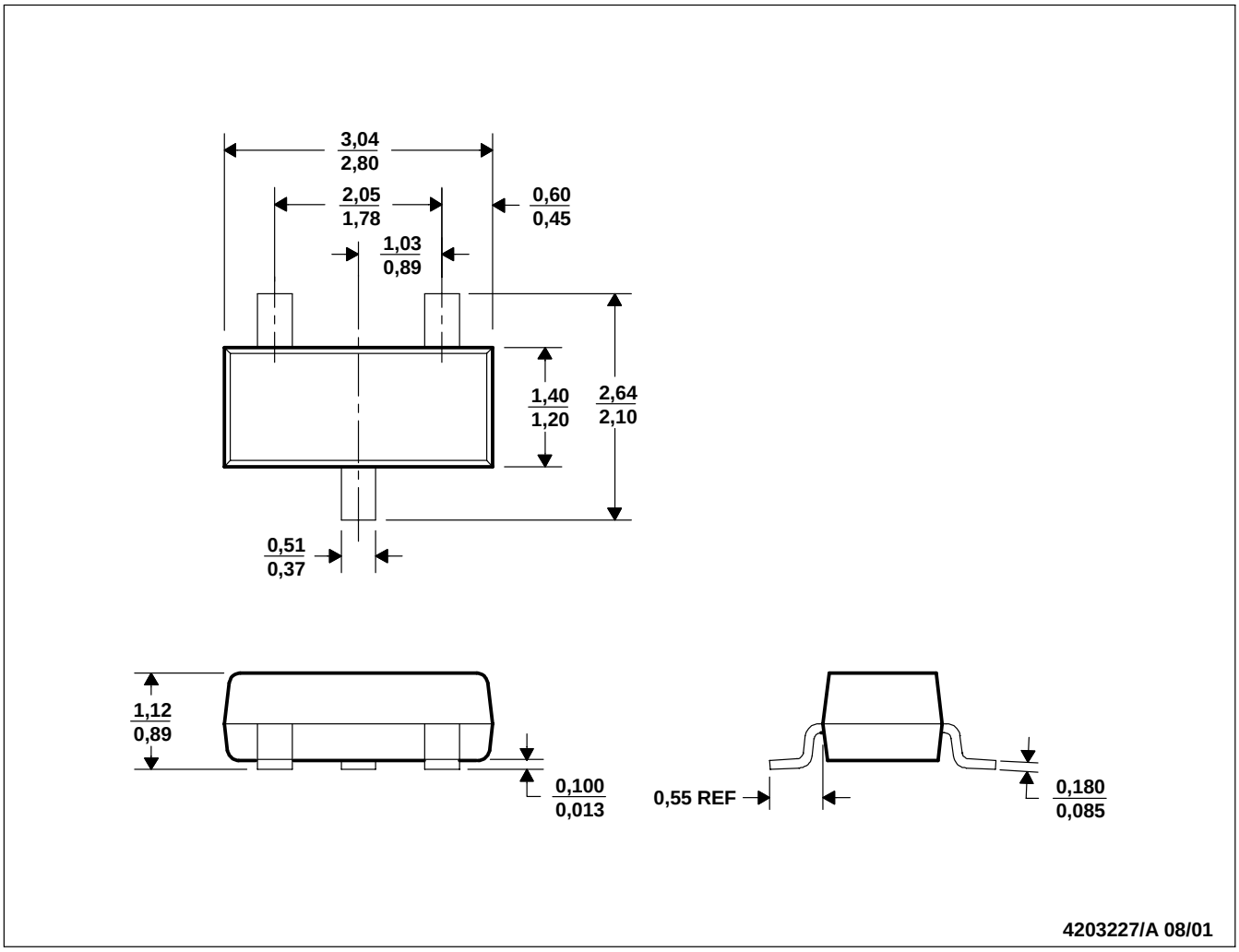


FIGURE 6. REF1112 Provides a Level Shift to Achieve Full ADC Input Range.

MPDS108 – AUGUST 2001

DBZ (R-PDSO-G3) **PLASTIC SMALL-OUTLINE**



NOTES: A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Dimensions are inclusive of plating.
D. Dimensions are exclusive of mold flash and metal burr.

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